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Foreword

This European Telecommunication Standard (ETS) has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1   Scope

This European Telecommunication Standard (ETS) specifies the characteristics of an access digital section for the Integrated Services Digital Network (ISDN) basic access between the user-network interface (at T reference point, as defined in ETS 300 012 [6] and the local exchange (at V_1 reference point defined in CCITT Recommendation Q.512 [4]) supporting the basic access interface channel structure (defined in CCITT Recommendation I.412 [1] and ETS 300 012 [6]) and the additional functions required for operation and maintenance of the access digital section. This ETS is based on CCITT Recommendation G.960 [7].

The requirements of this ETS and subsequently for the transmission systems based on this ETS, satisfy network performance requirements of CCITT Recommendation G.821 on error performance as well as CCITT Recommendations G.801 and I.350 with regard to availability. Annex A to this ETS is normative and specifies requirements for working with the Exchange Termination (ET) and the definition of the ET layer 1 state machine which are outside the scope of this ETS, but nevertheless are important for the understanding of the behaviour of the access digital section.

Annex B specifies an optional procedure for partial activation and deactivation of the access digital section.

Annex C provides a bibliography of informative references used in this ETS.

A further annex is under development which will specify conformance testing for this ETS. This will be added to this ETS using the ETSI standards maintenance procedures.

2   Normative references

This ETS incorporates, by dated or undated reference, provision 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 applies.

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

[2]   ETS 300 125 (1990): "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".

[3]   ETR 001 (1990): "Integrated Services Digital Network (ISDN); Customer access maintenance".

[4]   CCITT Recommendation Q.512 (1988): "Exchange interfaces for subscriber access".

[5]   CCITT Recommendation G.114 (1988): "Mean one-way propagation time".

[6]   ETS 300 012 (1991): "Integrated Services Digital Network (ISDN); Basic user-network interface Layer 1 specification and test principles".

[7]   CCITT Recommendation G.960 (1988): "Digital section for ISDN basic rate access".

[8]   ETR 080 (1992): "Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access Digital transmission system on metallic local lines".

[9]   CCITT Recommendation I.430 (1988): "Basic user-network interface - Layer 1 specification".

3 Definitions and abbreviations

3.1 Definitions

Access: The ISDN customer access as defined in CCITT Recommendation G.960 [7], annex B. The Access consists of the ET, the access digital section and the terminal equipment.

full activation: Activation of the access in order to establish a layer 2 service between the user and the network.

partial activation: Partial activation of the access digital section under control from the ET. No signal shall be sent from the NT1 to the interface at the T reference point, but signals can be received for the activation from the user side.

TE: In this ETS, unless otherwise indicated, the term TE is used to indicate terminating layer 1 aspects of TE1, TA and NT2 functional groups. When the term TE indicates terminating layer 1 aspects of TE1, then, according to CCITT Recommendation I.411, figure 2, the S and T reference points coincide. However, for the purposes of this ETS, the terminology used is in accordance with annex B of CCITT Recommendation G.960 [7].

3.2 Abbreviations

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

AI	Action Indicator
DS	access Digital Section
ET	Exchange Termination
FE	Function Element used between the ET and LT
HDLC	High level Data Link Control
INFO	Information element defined at the user-network interface
ISDN	Integrated Services Digital Network
LFA	Loss of Frame Alignment
LOS	Loss Of Signal
LT	Line Termination
MPH	Communication between Management and Physical layer
NT	Network Termination
PH	Communication between data link layer and Physical layer
REG	Regenerator
SIG	Signal between LT and NT1
TE	Terminal Equipment (see also subclause 3.1)

4 Configuration and application

4.1 Configuration

Figure 1 shows the boundaries of the access digital section in relation to the digital system definition.

> NOTE 1: From a functional point of view the information transferred via the reference points T and V_1 are different and, therefore, the access digital section is not symmetrical.

> NOTE 2: The T and V_1 reference points are defined in CCITT Recommendations I.411 and Q.512 [4].
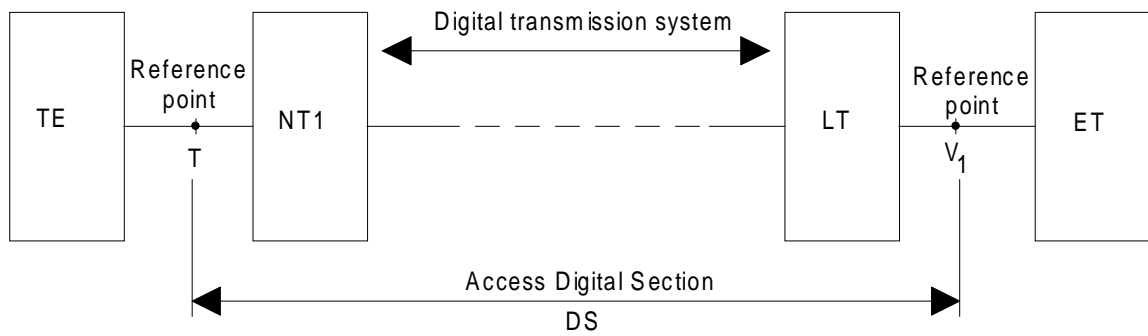
NOTE 1:   Digital transmission system refers to a line system using metallic pairs, optical fibres or radio systems.

NOTE 2:   The line transceivers in the Network Termination (NT) and the Line Termination (LT) are part of the digital transmission system.

Figure 1: Access digital section and transmission system boundaries

The concept of the access digital section is used in order to allow a functional and procedural description and a definition of the network requirements.

The concept of a digital transmission system is used in order to describe the characteristics of an implementation, using a specific medium, in support of the access digital section.

4.2   Application

The basic access digital section may be applied as given in figure 2 for:

-     direct access to the local exchange (V_1 reference point);

-     access via a basic access multiplex equipment (V_5 interface) to the local exchange;

-     access via a basic access concentrator (V_5 interface) to the local exchange.

NOTE: Other applications may also be possible and may be defined in the relevant standard, e.g. flexible access network. However, it is assumed that the functionality of the basic access section will be maintained.
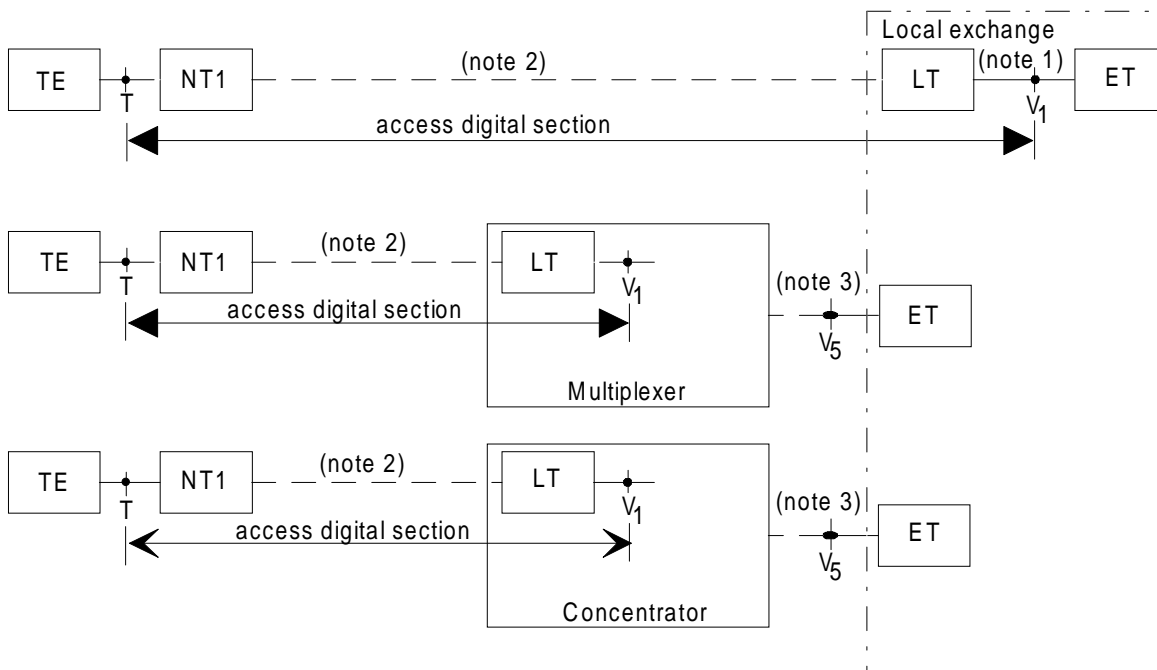
NOTE 1:   The LT may be integrated together with the ET or separate (as integral part or outside of the local exchange).

NOTE 2:   An access digital section using a digital transmission system for metallic pairs the application of one regenerator may be foreseen.

NOTE 3:   Local and remote applications are envisaged. For the remote case, a transparent link between the remote multiplexer or concentrator and the local exchange shall be used.

NOTE 4:   Depending of the functionality implemented in the multiplexer or concentrator there may be a part of the ET function implemented in this equipment.

Figure 2: Examples of equipment configuration in the ISDN basic access

This model includes primitive procedures between ET layer 1, ET layer 2 and system management:

a)   ETS 300 012 [6] and ETS 300 125 [2] interactions between ET layer 1 and ET layer 2 and system management based on PH and MPH primitives, respectively, as defined in ETS 300 012 [6]. These interactions are for the support of functions specified in ETS 300 125 [2];

b)   interactions between ET layer 1 and system management for the support of functions associated with the access digital section, based on MPH primitives.

The primitive procedures within TE comply with the specification according to ETS 300 012 [6].

This model does not constrain layer 1 arrangements between LT and NT1, (it is also applicable to remote access as shown in figure 2), or the digital transmission system technology.

4.3   Modelling and relationship between the access digital section and the ET
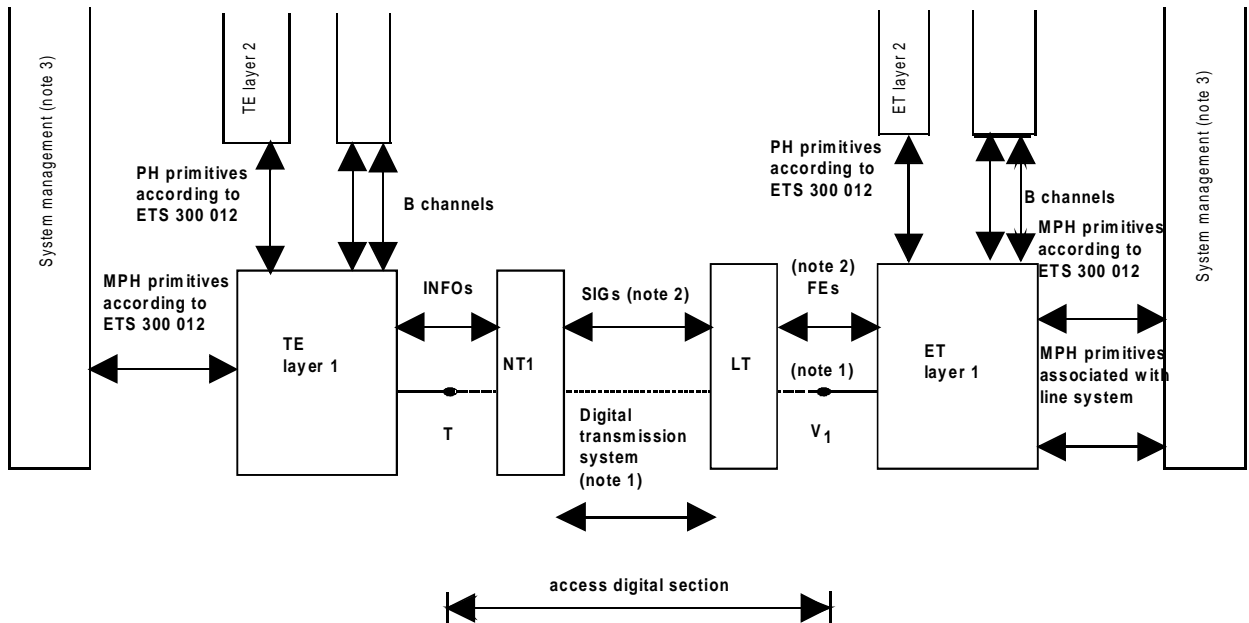
NOTE 1:   The digital transmission system refers to a digital line transmission system using either a metallic pair of wires, optical fibre or radio system.

NOTE 2:   SIG, Function Element (FE) and primitives refer to an exchange of information. They do not imply any specific coding nor implementation. Some of these functions may be terminated in the LT and do not pass through the digital transmission system.

NOTE 3:   The term system management corresponds to both system management and layer management as defined in CCITT Recommendation Q.940 (see also clause A.1 of this ETS).

Figure 3: General model of ISDN customer access layer 1 and adjacent entities

The general model shown in figure 3 depicts the whole ISDN customer access layer 1 and adjacent entities, and provides the basis to describe the functions performed by the access digital section and those performed by TE, ET and system management and how various functions are grouped. In particular, according to this model, the activation/deactivation procedures and maintenance functions specified in this ETS are not confined to functions performed by the access digital section but include functions associated with ET layer 1.

5 Functions

Figure 4 shows the functions which need to be supported by the basic access digital section.

T reference point   Access Digital Section V_1 reference point

| B-Channels |
| D-Channel |
| Bit timing |
| Octet timing |
| Activation (note) |
| Deactivation (note) |
| Power feeding |
| Operation and Maintenance |
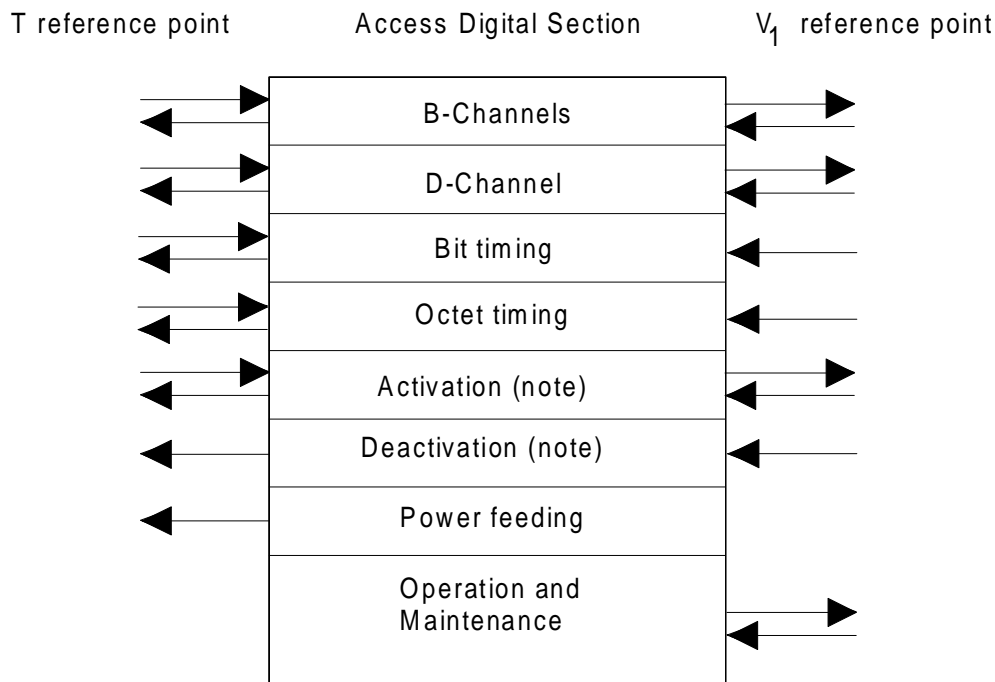
NOTE: The activation and deactivation functions are concerned with the operation of the access digital section and the user-network interface. However, for consistency with ETS 300 012 [6], they are described as separate functions.

Figure 4: Functions supported in the access digital section

5.1 B-channel

This function provides, for each direction of transmission, two independent 64 kbit/s channels for use as B-channels (as defined in CCITT Recommendation I.412 [1]).

5.2 D-channel

This function provides, for each direction of transmission, one D-channel at a bit rate of 16 kbit/s (as defined in CCITT Recommendation I.412 [1]).

5.3 Bit timing

This function provides bit (signal element) timing to enable the receiving equipment to recover information from the aggregate bit stream. For the V_1 reference point, the bit timing function is used for both transmit and receive data.

5.4 Octet timing

This function provides 8 kHz octet timing for the B-channels.

5.5 Activation

5.5.1 Activation from ET

This function places all the functions of the access digital section into a normal operating mode and supports the activation of the interface at the T reference point according to ETS 300 012 [6]. This takes into account:

- power down mode;

- initial power up;

- a failure condition.

The procedures and exchange of information are described in clause 8 of this ETS.

An activation should be possible to a state which allows maintenance actions to be performed in the access digital section even when there is no customer equipment connected to the T reference point.

5.5.2 Request for activation from TE

This function supports activation of the access digital section and of the interface at the T reference point according to ETS 300 012 [6].

5.6 Deactivation

This function is specified in order to permit the interface at the T reference point and the access digital section or the T reference point only to be placed in a low power consumption mode. The procedures and exchange of information are described in clause 8 of this ETS.

Deactivation should be initiated only by the ET.

5.7 Power feeding

This function provides for remote power feeding of NT1. This function is dependent on the transmission medium used. The power feeding through the interface at the T reference point is defined in ETS 300 012 [6].

5.8 Operation and maintenance

This function supports required actions and information for operating and maintaining the access digital section controlled by the ET as defined in ETR 001 [3].

Four categories of functions have been identified:

- commands regarding LT, regenerator, or NT1;

- information from LT, regenerator, or NT1;

- indications of fault conditions;

- control of access digital section power feeding.

6 Signal transfer delay

The mean one-way delay between the T and V_1 reference points shall not exceed 1 250 µs when no regenerator is implemented. In accordance with CCITT Recommendation G.114 [5], this value is the mean of the propagation times in the two directions of transmission.

7 Jitter

7.1 Output/input jitter at the T reference point

The requirements are specified in ETS 300 012 [6], subclause A.8.3.

7.2 Jitter at V_1 reference point

Jitter on timing signals provided at V_1 reference point to the LT shall be limited to values which do not require jitter reduction in the LT.

Jitter limits at the V_1 reference point from LT are not required, because the timing at the V_1 reference point is defined as contra-directional.

Jitter requirements additional to those given in CCITT Recommendation G.960 [7], § 4.4.2 are system dependent and outside the scope of this ETS and may be as defined in ETR 080 [8].

8 Activation/deactivation

8.1 Functional capabilities

The access digital section provides the layer 1 signalling capability and the necessary procedures to enable the installations described in subclauses 8.1.1 and 8.1.2.

8.1.1 Customer installation at the user side of the T reference point

To activate the layer 1 of the user-network interface at the T reference point and, if not already activated, at the access digital section.

8.1.2 Installation at the network side of V_1 reference point

Installation at the network side of V_1 reference point to:

a)   activate:

  1)   the layer 1 of the user-network interface at the T reference point and, if not already activated, at the access digital section (this activation is related to call control); or

  2)   the access digital section partially (this activation is related to controlling the configuration of the access: it is a network option);

b)   deactivate:

  1)   the layer 1 of the user-network interface at the T reference point and at the access digital section; or

  2)   the layer 1 of the user-network interface at the T reference point only.
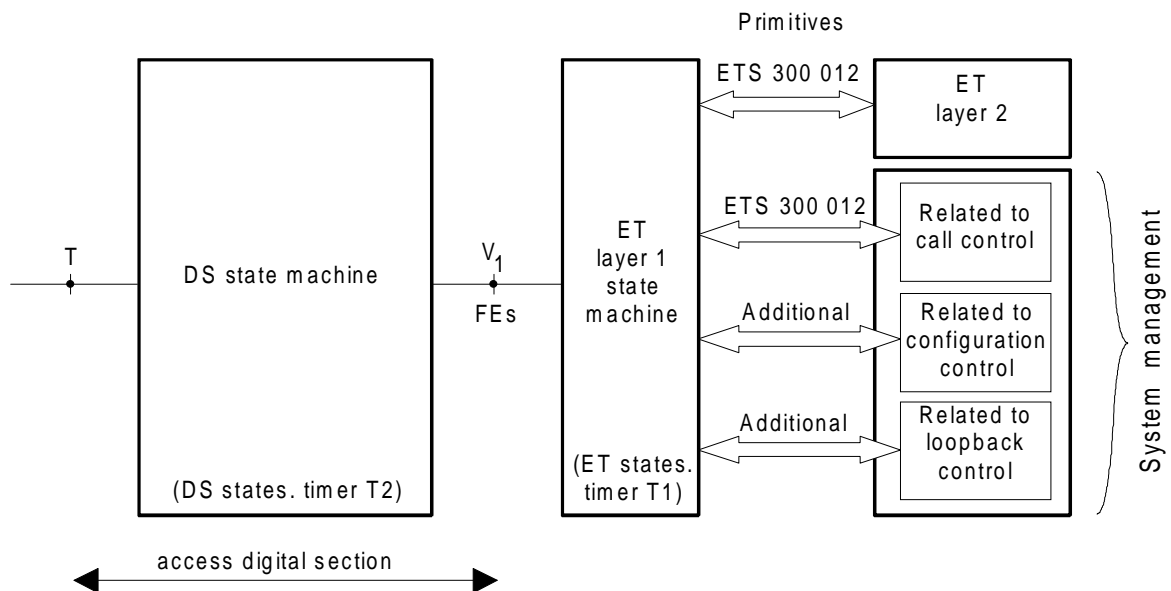
Figure 5: State machines

The functional capabilities defined in subclause 8.1.2 a2) allow maintenance actions in the access digital section which do not affect the deactivated user-network interface at the T reference point to be performed. If required in some applications, they also permit the access digital section to be placed in a mode where the full information transfer capability is available while the user-network interface at the T reference point remains deactivated.

The procedures for the activation or deactivation of the layer 1 of the user-network interface at the T reference point comply with the ETS 300 012 [6], annex A, table A.1, subclause A.6.2. These procedures are based on a set of INFO signals as defined in ETS 300 012 [6] (annex A, table A.1, subclause A.6.2).

The procedures at the V_1 reference point are based on a set of Function Elements (FEs). These FEs have specific relationships to primitives between the ET layer 1 and ET layer 2, and ET layer 1 and system management for the activation or deactivation of the layer 1 of the user-network interface in accordance with ETS 300 012 [6], annex A, table A.1, subclause A.6.2 and ETS 300 125 [2]. The means for defining these interactions are the primitive procedures (see annex A, table A.1, subclause A.6.2.1.6 of ETS 300 012 [6]) based on a set of PH and MPH primitives.

8.2 Modelling

8.2.1 General

The model for activation/deactivation procedures is given in subclause 4.3.

It is recognised that activation/deactivation is a process between subscriber installation and local exchange, requiring appropriate functionality at both ends. The model contained in subclause 4.3 includes the functional blocks relevant to activation/deactivation and depicts the primitives related to the activation/deactivation procedures.

8.2.2 Partitioning of functions

ETS 300 012 [6] defines the network side of the user-network interface at the T reference point as one functional block which supports the layer 1 activation/deactivation procedures across the T reference point and the primitive procedures at the ET layer 1/ET layer 2 boundary and ET layer 1/system management boundary. This block includes the functional groupings NT1, LT and ET layer 1.

This concept is described in terms of a state machine, called the G state machine in ETS 300 012 [6].
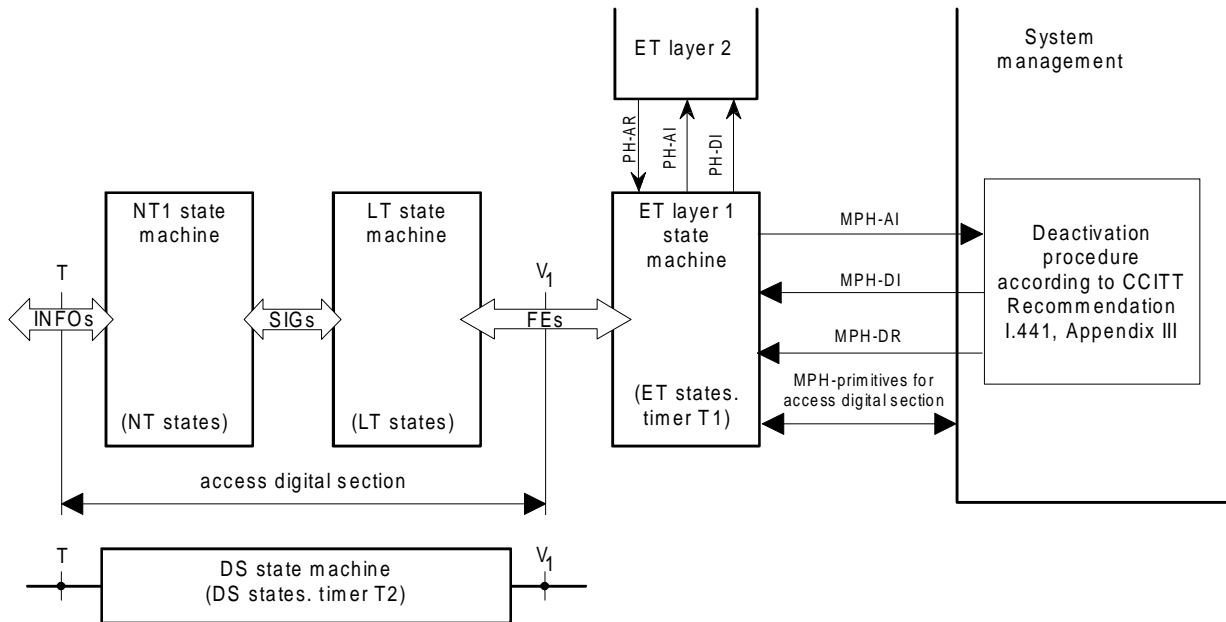
Figure 6: Partitioning of the access Digital Section (DS) state machine

In order to describe the relationship between signals across the user-network interface at the T reference point and function elements across reference point V_1, and the relationship between function elements across reference point V_1 and primitives, two state machines are defined. One in the access digital section (DS state machine), and one at the network side of the V_1 reference point (ET layer 1 state machine). Figure 5 illustrates this approach.

In addition to primitives defined in ETS 300 012 [6] and in ETS 300 125 [2] related to call control, figure 5 also introduces a new set of primitives related to configuration control and the control of loopbacks. Partitioning of activation/deactivation procedures between two state machines is used for the convenience of easy and accurate description. The ET layer 1 state machine is to be viewed as conceptual and does not imply any particular implementation.

However, in order to implement a customer access the DS state machine shall be partitioned further. Figure 6 shows the partition of the DS state machine into NT1 state machine (NT-states) and LT state machine (LT-states).

The NT1 state machine supports user-network interface procedure in accordance with ETS 300 012 [6], based on the INFOs, and interacts with the LT state machine by means of a set of signals (SIGs) which shall be supported by the line transmission system. The LT state machine interacts with the ET layer 1 state machine by means of a set of FEs. The ET layer 1 state machine contains those states which represent the local exchange view of the status of the interface at the T reference point and the access digital section. It supports the already specified primitive procedures to provide services to ET layer 2 and system management in accordance with ETS 300 012 [6], and additional primitive procedures for the support of functions associated with the access digital section.

8.2.3 Location of timer T2

The exact location of timer T2 within the access digital section has no impact on the description of the DS state machine.

8.3 Activation/deactivation procedures

The procedures allow the activation/deactivation of the user-network interface at the T reference point. The activation may be invoked by either side while deactivation can only be invoked by the network. The overall activation/deactivation procedures can be divided into two classes:

a)   basic procedures for call control used to activate the access digital section;

b)   procedures to control loopbacks.

8.3.1 Basic characteristics of the procedures

8.3.1.1 Priority

Priority refers to contention resolution between activation/deactivation requests which have been invoked concurrently.

If contention between conflicting activation/deactivation requests from ET side and user side occurs it is resolved in the DS state machine. Table 1 shows the DS state machine priority order.

8.3.1.2 System management

Some assumptions related to the system management are described in annex A.

8.3.1.3 Loopbacks

In case a transparent loopback 2 is applied, the NT1 shall send INFO 4 frames toward the user with the D-echo-channel set to binary ZERO.

With a transparent loopback 1, the NT1 (when able to activate the user-network interface at the T reference point) shall send INFO 4 frames towards the user with the D-echo-channel set to binary ZERO or operating normally.

Table 1: Priority order of request in the DS state machine

Type of request	Priority order
Call control activation request from ET side	2 (highest)
Call control activation request from user side	1
access digital section partial activation/deactivation request from the ET side	0 (lowest)

8.3.1.4 Protection of layer 2 frames

According to ETS 300 012 [6] annex A, table A.1, subclause A.6.2.6.1, a TE is allowed to take up to 100 ms to synchronise on INFO 2, no lower time limit is defined. The different time each TE may take to synchronise on INFO 2 affects the offering of an incoming call in layer 1 multiple terminal arrangements. The fastest TE notifies the network that the access is activated and the message offering the incoming call (SET-UP) may be transmitted (TE ready to receive the message) while other TEs are not yet ready to receive the message.

This could result in the slow TEs losing all, or part of, the incoming messages (layer 2 frames).

Concerning the full activation procedure, reference is made to CCITT Recommendation G.960 [7], table 2, note 5 and to CCITT Recommendation I.430 [9], table 6, note 4, where some information concerning layer 1 methods to protect layer 2 frames can be found. With regard to partial activation, the notification of the receipt of INFO3 by the NT to the ET could be delayed either by the definition of the procedure or a definite timer value to reduce the risk of a loss of layer 2 message.

8.3.1.5 Structure of the tables

The DS state transition table is structured such that the two classes of the activation/deactivation procedures described at the beginning of subclause 8.3 are clearly separated.

8.4 Description of the state transition table

8.4.1 Access digital section states (DS-states)

Defined below are the states that the access digital section may enter as a result of INFOs received from the user across the T reference point, FEs received from the ET across the V_1 reference point, or internal events. They are classified according to the functionality they support as follows:

a)   DS 1.X states for the support of functionality according to ETS 300 012 [6];

b)   DS 2.X states for the support of functionality related to loopbacks;

c)   DS 3.X states for the optional support of functionality related to partial activation of the access digital section (as defined in annex B).

8.4.1.1 State DS 1.0 (access deactivated)

The access digital section is in its non-operational mode. INFO 0 is sent to the user and FE 6 is sent to the ET. Viewed from the user side of the T reference point, the network is in state G1 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.1.

8.4.1.2 State DS 1.1 (access activation initiated)

Activation of the access digital section has been requested either by the receipt of FE 1 from the ET or by the receipt of INFO 1 from the user. The first stage of activation, namely, the activation of the digital transmission system, has been initiated. INFO 0 is sent to the user and FE 2 is sent to the ET. Viewed from the user side of the T reference point, the network is in state G1 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.1.

8.4.1.3 State DS 1.2 (access activation: DS synchronised LT --> NT)

In this second state of the access digital section activation, the NT has been synchronised with the LT. INFO 2 is sent to the user and FE 2 is sent to the ET while the DS is synchronising NT$\rightarrow$LT. Viewed from the user side of the T reference point, the network is in state G2 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.2.

8.4.1.4 State DS 1.3 (access activation: DS activated)

In this third stage of the access digital section activation, the DS has been synchronised in both directions. INFO 2 continues to be sent to the user, but FE 3 is sent to the ET while the receipt of INFO 3 from the user is awaited. Viewed from the user side of the T reference point, the network is in state G2 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.2.

8.4.1.5 State DS 1.4 (access activated)

The access digital section is in its stable active state, INFO 3 having been received from the user. FE 4 is sent to the ET and INFO 4 is sent to the user (see note 4 to table 2). Viewed from the user side of the T reference point, the network is in state G3 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.3.

8.4.1.6 State DS 1.5 (LOS/LFA at T)

The signal or frame alignment has been lost on the user side of the T reference point while the access digital section is in its stable active state. This may have been caused, for example, by the temporary removal of the terminal (the terminal portability facility). INFO 2 is sent to the user to assist rapid resynchronization of the terminal, and FE 12 is sent to the ET while awaiting either the receipt of INFO 3 from the user, or FE 5 from the ET (instruction to deactivate). Viewed from the user side of the T reference point, the network is in state G2 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.2. Upon receipt of INFO 3 from the user, the access digital section returns to state DS 1.4.

8.4.1.7 State DS 1.6 (access deactivation initiated)

The access digital section has been instructed by the ET to deactivate by the receipt of FE 5. The FE sent to the network is identical to the FE sent prior to the issue of FE 5 from the network and INFO 0 is sent to the user. Viewed from the user side of the T reference point, the network is in state G4 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.4. Upon the receipt of INFO 0 from the user, the deactivation of the DS or the expiry of timer T2, the access digital section changes to state DS 1.0.

8.4.1.8 State DS 1.7 (defect condition)

Loss of Signal/Loss of Frame Alignment (LOS/LFA) has occurred on the transmission system, or power has been lost at the NT. The defect condition is reported to the ET by sending FE 7. The INFO sent to the user shall depend on the NT state prior to the defect condition. Viewed from the user side of the T reference point, the network is in the same G state prior to the defect condition according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2. Upon the receipt of FE 5 from the ET, the access digital section changes to state DS 1.0.

8.4.1.9 State DS 2.0 (loopback 1 or 1a initiated)

Activation of loopback 1 or 1a has been requested by the receipt of FE 9 or FE 10 respectively from the network. Activation has been initiated and FE 2 is sent to the ET.

8.4.1.10 State DS 2.1 (loopback 1 or 1a activated)

The appropriate loopback is in its stable state. FE 4 is sent to the ET. The control of the NT is not part of the loopback procedure, so the INFO sent to the user cannot be defined.

8.4.1.11 State DS 2.2 (loopback 2 initiated)

Activation of loopback 2 has been requested by the receipt of FE 8 from the network. Activation has been initiated and FE 2 is sent to the ET.

8.4.1.12 State DS 2.3 (DS synchronised LT --> NT)

NT has recognised the request of loopback 2. INFO2 is sent in the user direction.

8.4.1.13 State DS 2.4 (DS activated)

NT has recognised looped back INFO 2, acting in this case as INFO 3 for normal activation. FE 3 is sent to the ET.

8.4.1.14 State DS 2.5 (loopback 2 activated)

NT sends INFO 4 frames as described in subclause 8.3.1.3. FE 4 is sent to the ET.

8.4.2 Set of signals sent across the T reference point

The INFO signals used in the activation/deactivation of the access digital section are defined in ETS 300 012 [6], annex A, table A.1, subclause A.6.2.2. Signals referring to loopbacks are given in subclause 8.3.1.3.

8.4.3 Set of function elements sent across the V_1 reference point

The function elements used in the activation/deactivation of the access digital section are defined as follows:

- FE 1 (LT ← ET) activate access;
- FE 2 (LT → ET) access activation initiated;
- FE 3 (LT → ET) access digital section activated;
- FE 4 (LT → ET) access or loopback activated;
- FE 5 (LT ← ET) deactivate access;
- FE 6 (LT → ET) access deactivated;
- FE 7 (LT → ET) LOS/LFA in DS or loss of power at NT1;
- FE 8 (LT ← ET) activate loopback 2;
- FE 9 (LT ← ET) activate loopback 1;
- FE 10 (LT ← ET) activate loopback 1a;
- FE 11 (LT ← ET) partially activate the DS (optional, see annex B);
- FE 12 (LT → ET) LOS/LFA at T reference point;
- FE 13 (LT ← ET) deactivate the interface at T reference point whilst keeping the DS activated (optional, see annex B).

8.4.4 Assumptions made in specifying the procedures in table 2

a) The response to events that should not normally occur in a current state shall be: no action, no state change.

b) The response to a request for an operation which is currently in progress shall be: no action, no state change.

c) The response to a request for an operation which has already been completed shall be to confirm the present status with no state change.

Table 2: State transition table of access digital section (DS state machine) full activation

State number	DS 1.0	DS 1.1	DS 1.2	DS 1.3	DS 1.4	DS 1.5	DS 1.6	DS 1.7
State name	Access de-activated	Access activation			Access activated	Access activated	Access deactivation initiated	Network defect
		initiated	DS synch LT→NT	DS activated		LOS/LFA at T		
FE sent	FE 6	FE 2	FE 2	FE 3	FE 4	FE 12 (note 1)	note 8	FE 7
INFO sent	INFO 0	INFO 0	INFO 2	INFO 2	INFO 4	INFO 2	INFO 0	note 2
Event: Internal state	G1	G1	G2	G2	G3	G2	G4	note 2
FE 1	DS 1.1	-	-	-	-	-	DS 1.1	-
FE 5	-	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	-	DS 1.0
Receiving INFO 0	-	-	-	-	DS 1.5	-	DS 1.0	-
Receiving INFO 1	DS 1.1	-	-	-	/	-	-	-
Receiving INFO 3	-	-	-	(note 4) DS 1.4	-	(note 4) DS 1.4	-	-
LOS/LFA at T	/	-	-	-	DS 1.5	-	-	-
Expiry of timer T2 (note 3)	-	-	-	-	-	-	DS 1.0	-
DS synchronised LT→NT	/	DS 1.2	-	-	-	-	-	-
DS activated	/	/	DS 1.3	-	-	-	-	-
DS deactivated	-	-	-	/	/	/	DS 1.0	-
FE 8	DS 2.2	I	I	I	I	I	I	I
FE 9	DS 2.0	I	I	I	I	I	I	I
FE 10	DS 2.0	I	I	I	I	I	I	I
LOS/LFA at either NT or LT line side; or loss of NT power	-	DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7	-

(continued)

Table 2 (concluded): State transition table of access digital section (DS state machine) full activation

State number	DS 2.0	DS 2.1	DS 2.2	DS 2.3	DS 2.4	DS 2.5
State name	Loopback 1 or 1a		Loopback 2			
	initiated	activated	initiated	DS synch LT→NT	DS activated	activated
FE sent	FE 2	FE 4	FE 2	FE 2	FE 3	FE 4
INFO sent	INFO 0	note 5	INFO 0	INFO 2	INFO 2	note 6
Event: Internal state	G1	note 5	G1	G2	G2	note 5
FE 1	-	-	-	-	-	-
FE 5	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6
Receiving INFO 0	-	-	-	-	-	-
Receiving INFO 1	-	-	-	-	-	-
Receiving INFO 3	-	-	-	-	(note 9) DS 2.5	-
LOS/LFA at T	-	-	-	-	-	-
Expiry of timer T2 (note 3)	-	-	-	-	-	-
DS synchronised LT→NT	-	-	DS 2.3	-	-	-
DS activated	(note 7) DS 2.1	-	/	DS 2.4	-	-
DS deactivated	-	/	-	-	/	/
FE 8	I	I	-	-	-	-
FE 9	-	-	I	I	I	I
FE 10	-	-	I	I	I	I
LOS/LFA at either NT or LT line side; or loss of NT power	-	-	DS 1.7	DS 1.7	DS 1.7	DS 1.7

NOTE 1:   FE 12 may not be provided in some networks. Those networks that do not employ FE 12 shall continue to provide FE 4 to the ET.
NOTE 2:   The INFO sent to the user and the corresponding G state depends on the NT state.
NOTE 3:   A description of timer T2 can be found in note 2 to table 6 of ETS 300 012 [6].
NOTE 4:   As an implementation option, to avoid premature transmission of information (i.e. INFO 4), the DS state machine may introduce a delay before it changes state, i.e. see note 4 to table 6 of ETS 300 012 [6].
NOTE 5:   Not to be defined.
NOTE 6:   See subclause 8.3.1.3 for the description of the INFO sent to the user across the T reference point.
NOTE 7:   The event "DS activated" can also indicate that a loopback 1 or 1a is activated:
For loopback 1, this event indicates that loopback 1 is active in the LT.
For loopback 1a, this event indicates that loopback 1a is active in the regenerator.
NOTE 8:   The FE sent to the network is identical to the FE sent prior to the issue of FE 5 from the network.
NOTE 9:   The event "Receiving INFO 3" can also indicate that loopback 2 is activated in the NT (as near as possible to the T reference point).
Key:
-          = No state change, no action when event occurs.
/   = Impossible event due to internal reasons or peer-to-peer procedures.
I   = Impossible event due to the definition of the layer 1 service.
FE...   = Issue function element FE.. across V_1 reference point.
DS a.b   = Enter state a.b.

8.5 Activation time

For activation from the user side, the activation time is measured at the T reference point between the initiation of the sending of INFO 1 to the interface at the T reference point and the receipt of INFO 4 from the access digital section.

For activation from the network side the activation time is defined between FE 1 and FE 4 at the V_1 reference point.

The values do not take into account the response time of TE for sending INFO 3 on receipt of INFO 2.

> NOTE: Most of the activation of a TE takes place in parallel with the activation of the access digital section and, in general, does not extend the total activation time. For conformance testing, an activation request with loopback 2 is appropriate.

8.5.1 Warm start time

Maximum activation times (see note in subclause 8.5.2) for activation, occurring after a deactivation without any intervening loopback or powering action and without any change in cable characteristic for a metallic pair cable transmission system are as follows:

a)   without regenerator: 300 ms;

b)   with regenerator: 600 ms.

8.5.2 Cold start time

Maximum activation times (see note) for activation occurring after the first powering on of an access digital section are:

a)   without regenerator: 15 s;

b)   with regenerator: 20 s.

> NOTE: The specified value for activation time is understood as a 95%-value when testing with line models specified for the digital transmission system. In any case, all warm start activation attempts should be finally successful within the time defined for the cold start. However, due to spurious effects this may not be possible. The conformance test specification should cope with this problem. With regard to the cold start activation, the requirement should be that if a cold start attempt fails in total no more than 5%, then the next cold start applied with the same test conditions shall be successful.

9 Operation and maintenance

This clause specifies the operation and maintenance functions for the access digital section of the ISDN basic access.

Operation functions related to activation/deactivation procedure are specified in clause 8.

The maintenance functions recommended in ETR 001 [3] provide the capability to maintain the access digital section to the required level of network performance. It shall be possible to test and maintain the access digital section in accordance with ETR 001 [3], irrespective of the customer equipment.

9.1 Control facilities

9.1.1 Loopbacks

9.1.1.1 Loopback implementation

The location and characteristics of loopbacks are defined in ETR 001 [3].

9.1.1.2 **Loopback procedure**

The loopbacks are controlled by ET system management.

A normal call activation request cannot override a request for loopback 1, 1a or 2.

The procedure for loopback operation always starts from, and ends in, the deactivated state of the access digital section. The sequence is defined in the states tables.

9.1.2 **Information request**

This function allows the ET to request regenerator and NT1 specific status reports from the LT.

9.1.3 **Power switch on/off to the line**

This function allows the power to the line to be switched on/off.

9.1.4 **Continuity test**

The continuity test is described in ETR 001 [3]. The continuity test is controlled by the ET and is initiated by MPH-AR. System management decides when the test is passed (i.e. on reception of MPH-DSAI or MPH-AI). When the system management receives MPH-EI (expiry T1) the test is considered to be failed. See also annex A of this ETS.

9.2 **Monitoring**

9.2.1 **Functions**

The following operational conditions are monitored throughout the access digital section:

a)   the defect conditions;

b)   the power feed arrangements;

c)   the transmission error detection.

9.2.2 **Defect conditions and consequent actions**

9.2.2.1 **Detection of defect conditions**

a)   LOS/LFA at LT line side (mandatory).

b)   LOS/LFA at NT1 line side (mandatory).

c)   LOS/LFA at NT1 T side (mandatory).

d)   Loss of power for NT1 functionality (mandatory).

e)   Power overload condition at the DS (optional).

f)   Power feed failure at the DS (optional).

g)   Power feed failure at the S/T (optional).

9.2.2.2 Consequent actions

Consequent actions for defect conditions which detection is identified as mandatory are defined in table 3. The conditions and consequent actions are relevant during activation or an activated state. LOS/LFA at the line side of a REG leads to the same FE 7 as produced by a LOS/LFA at the NT or LT line side.

Table 3: Defect conditions and consequent actions

Equipment	Defect condition	Consequent	actions
		signal at V1	signal at T
LT Line side	LOS/LFA at LT line side	FE 7	(note 1)
NT Line side	LOS/LFA at NT1 line side	FE 7	INFO 0
NT at T	LOS/LFA at NT1 T side	FE 12 (note 2)	INFO 2 state G2
NT	Loss of power for NT1 functionality	FE 7	INFO 0
NOTE 1: The INFO sent depends on the NT state.			
NOTE 2: FE 12 may not be provided in some networks. Those networks that do not employ FE 12 shall continue to provide FE 4 to the ET.			

9.2.3 Error detection and reporting

The access digital section shall deliver the error information to the ET to allow it to evaluate its error performance.

9.2.4 Status report functions

Status report functions cover information which relate to the overall operation and performance of the access digital section. The information may be transmitted either automatically or under request of ET.

Listed below are descriptions of the status report functions:

a) transmission errors (mandatory).
This information, derived in the access digital section, allows the ET to evaluate the transmission error performance;

b) loopback 1 status (mandatory) (note).
This information, sent from the LT, gives the status of loopback 1;

c) loopback 1a status (mandatory) (note).
This information, sent from the regenerator, gives the status of loopback 1a;

d) loopback 2 status (mandatory) (note).
This information, sent from the NT1, gives the status of loopback 2;

e) user-network interface power feed status (optional).
This information indicates the status of the user-network interface at the T reference point power feed, e.g. normal or fault condition of power feed.

NOTE: The information may be implicit (e.g. activation indication).

9.2.5 System dependent status report functions

System status reports are dependent upon the type of digital transmission system used and are, therefore, defined in the transmission system specification.

Annex A (normative):   System management requirements

A.1   Introduction

This annex specifies requirements for interaction of the access digital section and the ET layer 1. In order to ensure correct operation, it is necessary to take into account the assumptions made about the management functions involved in the ET.

In this ETS, distinction is made between ET layer 1 and system management only. Where the term system management is used it corresponds to both system management and layer management as defined in CCITT Recommendation Q.940 ("ISDN user-network interface protocol for management - General aspects").

A.2   System management requirements

A.2.1   General

System management shall not initiate more than one action at a time towards the ET layer 1. An action is delimited by the primitive which is issued by system management and the corresponding primitive which confirms completion of the task.

A.2.2   Error indications

The management entity shall take account of the sequence of primitives before and after the reception of MPH-EI. From the sequence of the primitives, the system management may determine the cause of the MPH-EI primitive (e.g. unsuccessful activation of the interface, unsuccessful activation of the access, loss of synchronisation or signal at the interface at the T reference point).

Upon the occurrence of an error, the ET layer 1 shall notify this event to the system management by means of the primitive MPH-EI. The system management shall decide which appropriate actions should be taken (e.g. hold or abandon call, initiate MPH-DR or MPH-DSDR).

A.2.3   Loopback operations

The system management shall take into account that when the ET layer 1 is in loopback operation it does not send any primitives to ET layer 2.

If a primitive is sent by ET layer 2 to ET layer 1 during loopback operation, it shall be ignored by ET layer 1.

The setting of the loopbacks 1, 2 and 1a is confirmed to the system management by means of the MPH-AI primitive. The system management shall be able to interpret this MPH-AI as a loopback confirmation and not as a normal activation indication by taking into account the sequence of the primitives.

A.2.4   Continuity test

The continuity test is initiated by the system management using the primitive MPH-AR. The system management shall decide when the test is passed (i.e. on reception of MPH-DSAI or MPH-AI). If the system management receives MPH-EI (expiry T1) the test is considered to be failed.

If the test is passed, the system management should check whether a call establishment has been progressed or if there is a call available before sending MPH-DR.

A.2.5   Information to be sent in the D-channel during loopback operation

The information sent in the D-channel shall not imitate any High level Data Link Control (HDLC) pattern.

A.2.6 Configuration control

The system management shall ensure that any action related to configuration control shall be issued only when the T reference point is deactivated.

If contention between conflicting activation/deactivation requests from the ET side and the user side occurs it is resolved in the DS state machine.

A.3 Description of the ET layer 1 state transition table

If contention between conflicting activation/deactivation request from layer 2 and system management occurs it is resolved in the ET layer 1 state machine, which shall then pass to the V_1 reference point a co-ordinated set of FEs. Table A.1 shows the ET layer 1 state machine priority order.

Table A.1: Priority order of request in the ET layer 1 state machine

Type of request	Priority order
Deactivation request	3 (highest)
Loopback	2
Call control activation request	1
Access digital section partial activation/deactivation request from ET side	0 (lowest)

A.3.1 ET layer 1 states (ET-states)

Defined below are the states that the ET layer 1 may enter as a result of FEs received from the DS across the V_1 reference point, service primitives received (PH, MPH- primitives), or internal events. They are classified according to the functionality they support as follows:

a)   ET 1.x states for the support of functionality according to ETS 300 012 [6];

b)   ET 2.x states for the support of functionality related to loopbacks;

c)   ET 3.x states for the optional support of functionality related to partial activation of the access digital section, as defined in annex B.

A.3.1.1 State ET 1.0 (access deactivated)

The access digital section is deactivated (indicated by the receipt of FE 6). Timer T1 is not running.

A.3.1.2 State ET 1.1 (access activation initiated)

Activation of the access digital section has been initiated (indicated by the receipt of FE 2 followed by FE 3) to establish a call. Timer T1 is running.

A.3.1.3 State ET 1.2 (access activated):

The access digital section is activated (indicated by the receipt of FE 4). Timer T1 has been stopped.

A.3.1.4 State ET 2.0 (access in loopback state)

A loopback has been established in the access digital section. Timer T1 is not running.

A.3.1.5 State ET 2.1 (loopback requested)

A loopback within the access digital section has been requested. Timer T1 is running.

A.3.2   Set of primitives within the ET for the support of functions associated with the access digital section

a)   MPH-access digital section partial activation indication (MPH-DSAI). The MPH-DSAI primitive indicates that the access digital section is fully synchronised.

b)   MPH-Awake Indication (MPH-AWI). The MPH-AWI primitive is issued when FE 2 is received from the access digital section to notify the system management that activation of the access digital section has been initiated.

c)   MPH-Error Indication (MPH-EI). The MPH-EI primitive is issued when an activation or loopback operation attempt has failed, or when FE 7 (defect condition) or FE 12 (LOS/LFA at T) is received from the access digital section. As the issue of FE 7 is accompanied by deactivation of the access digital section, the issue of MPH-EI is accompanied by the primitive MPH-DI for this condition.

d)   MPH-AR. Request to activate the access digital section for continuity testing.

e)   PH-AR. Request to activate the access for layer 2 calls.

f)   MPH-AI. Access activation indication.

g)   PH-AI. Access activation indication for layer 2 calls.

h)   PH-DI/MPH-DI. Access deactivated indication. In the partial activation of DS this means that the interface at the T reference point has been deactivated keeping the DS activated.

The primitives below are associated with maintenance functions based on loopbacks. The activate request primitives include the activation of the access digital section and possibly the user-network interface at the T reference point. The establishment of the requested loopback is notified to the requester by means of the MPH-AI primitive. The deactivation of the loopback is invoked by means of the MPH-DR primitive.

j)   MPH-L2AR: activation request for loopback 2.

k)   MPH-L1AR: activation request for loopback 1.

l)   MPH-L1aAR: activation request for loopback 1a.

A.3.3   Assumptions made in specifying the procedures in table A.1 (ET 1.x states)

a)   The response to the receipt of an indication (FE) from the access digital section which should not normally occur in the current ET state shall be to issue the corresponding primitive to the management for interpretation with no state change of the ET.

b)   The response to a request for an operation which is currently in progress shall be: no state change, no action (-).

c)   Upon receipt of FE 7 from the access digital section, the ET shall issue FE 5 (deactivate access) to confirm the response of the access digital section to the defect condition.

NOTE: Some digital transmission systems deactivate autonomously when a transmission failure has been identified.

d)   Upon receipt of FE 12 (LOS/LFA at T) from the access digital section while in the access activated state (ET 1.2), the ET shall issue MPH-EI to the management with no state change of the ET.

Table A.2: State transition table of ET layer 1 (ET layer 1 state machine) full activation

State number	ET 1.0	ET 1.1	ET 1.2	ET 2.0	ET 2.1
State name	Access deactivated	Access activation initiated	Access activated	Loopback activated	Loopback requested
Event:	T1 stopped	T1 running	T1 stopped	T1 stopped	T1 running
PH-AR/MPH-AR	Start T1 FE 1 ET 1.1	-	MPH-AI PH-AI -	PH-DI -	PH-DI -
MPH-DR	-	Stop T1 FE 5 PH-DI ET 1.0	PH-DI FE 5 ET 1.0	FE 5 ET 1.0	Stop T1 FE 5 ET 1.0
FE 2	Start T1 MPH-AWI FE 1 ET 1.1	MPH-AWI -	-	/	-
Expiry of timer T1	/	MPH-EI PH-DI FE 5 ET 1.0	/	/	MPH-EI FE 5 ET 1.0
FE 3	(note 2) MPH-DSAI -	MPH-DSAI -	MPH-DSAI -	MPH-DSAI -	MPH-DSAI -
FE 4	(note 2) MPH-AI -	Stop T1 PH-AI MPH-AI ET 1.2	-	-	Stop T1 MPH-AI ET 2.0
FE 6	MPH-DI -	MPH-DI -	MPH-DI -	MPH-DI -	MPH-DI -
FE 12 (note 3)	/	-	MPH-EI -	/	/
FE 7	MPH-DI -	PH-DI MPH-EI STOP T1 FE 5 ET 1.0	PH-DI MPH-EI FE 5 ET 1.0	MPH-EI FE 5 ET 1.0	MPH-EI Stop T1 FE 5 ET 1.0
MPH-L2AR	Start T1 FE 8 ET 2.1	I	I	-	-
MPH-L1AR	Start T1 FE 9 ET2.1	I	I	-	-
MPH-L1aAR	Start T1 FE 10 ET 2.1	I	I	-	-

NOTE 1:	A description of timer T1 can be found in note 1 to table 6 of ETS 300 012 [6].
NOTE 2:	These events occur if timer T1 expires concurrently with the completion of a task which the access digital section indicates to ET layer 1 by means of the appropriate function element (FE 3 and FE 4). It is a situation caused by excessive delay within the access digital section. In some cases it is advantageous to issue the appropriate primitive to notify to management the status of the customer access subsequent to the error indication which would have been conveyed in an MPH-EI primitive. This provides the management with the information to initiate the optimum recovery procedure.
NOTE 3:	FE 12 is not available on all networks. FE 12 indicates to the ET state machine LOS/LFA at the user side of the T reference point.

Key:

-	= No state change, no action when event occurs.
I	= Impossible event by definition of the layer 1 service.
/	= Impossible event due to internal reasons or peer-to-peer procedures.
FE...	= Issue function element FE... across V_1 reference point.
ET a.b	= Enter state ET a.b.

Annex B (informative): Partial activation of the access digital section

B.1 Introduction

This annex is informative but the use of the functionalities provided are, however, a network provider option. The necessary elements for the provision of these functionalities are reserved for this use (e.g. primitives, bit coding, bits) and cannot be reallocated to any other functions.

In this annex, the state transition tables (DS and ET) relating to partial activation of the access digital section are provided.

B.2 Description of DS 3.x states for the partial DS activation of the access digital section mode of operation

B.2.1 State DS 3.0 (partial activation initiated)

The access digital section has entered this state from DS 1.0 following the receipt from the ET of FE 11. FE 2 is returned to the ET and INFO 0 is sent to the user. Viewed from the user side of the T reference point, the network is in state G1 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.1. The access digital section remains in this state until the DS is synchronised in both directions.

B.2.2 State DS 3.1 (DS activated, T interface deactivated)

The DS is synchronised in both directions and this has been notified to the ET by FE 3. This is the stable deactivated state for the partial DS activation mode of operation, so INFO 0 is sent to the user. Viewed from the user side of the T reference point, the network is in state G1 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.1.

B.2.3 State DS 3.2 (DS activated, T interface activating)

Activation of the interface at the T reference point has been initiated either by the receipt of FE 1 from the ET or by the receipt of INFO 1 from the user, while the access digital section was in state DS 3.1. FE 2 is sent to the ET, but as the DS is already fully synchronised, INFO 2 is sent to the user while the receipt of INFO 3 from the user is awaited. Viewed from the user side of the T reference point, the network is in state G2 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.2. Upon receipt of INFO 3 from the user the access digital section changes to state DS 3.3.

B.2.4 State DS 3.3 (access activated)

The access digital section is in its stable active state, equivalent to DS 1.4 in the normal mode of operation. INFO 3 has been received from the user and INFO 4 returned (see note 4 to table B.2). FE 4 is sent to the ET. Viewed from the user side of the T reference point, the network is in state G3 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.3.

B.2.5 State DS 3.4 (LOS/LFA at T)

This state is equivalent to DS 1.5 in the normal mode of operation. The signal or frame alignment has been lost on the user side of the T reference point while the access digital section is in its stable active state. This may have been caused, for example, by the temporary removal of the terminal (the terminal portability facility). INFO 2 is sent to the user to assist rapid re-synchronisation of the terminal, and FE 12 is sent to the ET while awaiting either the receipt of INFO 3 from the user, or FE 13 from the ET (instruction to deactivate interface at the T reference point). Viewed from the user side of the T reference point, the network is in state G2 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.2. Upon receipt of INFO 3 from the user, the access digital section returns to state DS 3.3.

B.2.6   State DS 3.5 (T interface deactivating)

Deactivation of the interface at the T reference point has been initiated in response to the receipt of FE 11 from the ET. FE 3 is returned to the ET and INFO 0 is sent to the user. Viewed from the user side of the T reference point, the network is in state G4 according to ETS 300 012 [6], annex A, table A.1, subclause A.6.2.1.2.4. Upon the receipt of INFO 0 from the user or the expiry of timer T2, the access digital section changes to state DS 3.1.

Table B.1: State transition table of access digital section (DS state machine) full and partial activation

State number	DS 1.0	DS 1.1	DS 1.2	DS 1.3	DS 1.4	DS 1.5	DS 1.6	DS 1.7
State name	Access de-activated	Access activation: initiated	DS synch. LT→NT	DS activated	Access activated	Access activated LOS/LFA at T	Access de-activation: initiated	Network defect
FE sent	FE 6	FE 2	FE 2	FE 3	FE 4	FE 12 (note 1)	note 8	FE 7
INFO sent	INFO 0	INFO 0	INFO 2	INFO 2	INFO 4	INFO 2	INFO 0	note 2
Event: Internal state	G1	G1	G2	G2	G3	G2	G4	note 2
FE 1	DS 1.1	-	-	-	-	-	DS 1.1	-
FE 5	-	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6		DS 1.0
Receiving INFO 0	-	-	-	-	DS 1.5	-	DS 1.0	-
Receiving INFO 1	DS 1.1	-	-	-	/	-	-	-
Receiving INFO 3	-	-	-	(note 4) DS 1.4	-	(note 4) DS 1.4	-	-
LOS/LFA at T	/	-	-	-	DS 1.5	-	-	-
Expiry of Timer T2 (note 3)	-	-	-	-	-	-	DS 1.0	-
DS synchronised LT→NT	/	DS 1.2	-	-	-	-	-	-
DS activated	/	/	DS 1.3	-	-	-	-	-
DS deactivated	-	-	-	/	/	/	DS 1.0	-
FE 8	DS 2.2	I	I	I	I	I	I	I
FE 9	DS 2.0	I	I	I	I	I	I	I
FE 10	DS 2.0	I	I	I	I	I	I	I
LOS/LFA at either NT or LT line side; or Loss of NT power	-	DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7	-
FE 11	DS 3.0	-	-	-	-	-	-	-
FE 13	-	-	-	-	-	-	-	-

(continued)

Table B.1 (continued): State transition table of access digital section (DS state machine) full and partial activation

State number	DS 2.0	DS 2.1	DS 2.2	DS 2.3	DS 2.4	DS 2.5
State name	Loopback 1 or 1a		Loopback 2			
	Initiated	Activated	Initiated	DS synch LT → NT	DS activated	Activated
FE sent	FE 2	FE 4	FE 2	FE 2	FE 3	FE 4
INFO sent	INFO 0	note 5	INFO 0	INFO 2	INFO 2	note 6
Event: Internal state	G1	note 5	G1	G2	G2	note 5
FE 1	-	-	-	-	-	-
FE 5	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6
Receiving INFO 0	-	-	-	-	-	-
Receiving INFO 1	-	-	-	-	-	-
Receiving INFO 3	-	-	-	-	(note 9) DS 2.5	-
LOS/LFA at T	-	-	-	-	-	-
Expiry of Timer T2 (note 3)	-	-	-	-	-	-
DS synchronised LT→NT	I	-	DS 2.3	-	-	-
DS activated	(note 7) DS 2.1	-	/	DS 2.4	-	-
DS deactivated	-	/	-	-	/	/
FE 8	I	I	-	-	-	-
FE 9	-	-	I	I	I	I
FE 10	-	-	I	I	I	I
LOS/LFA at either NT or LT line side; or Loss of NT power	-	-	DS 1.7	DS 1.7	DS 1.7	DS 1.7
FE 11	I	I	I	I	I	I
FE 13	I	I	I	I	I	I

(continued)

Table B.1 (concluded): State transition table of access digital section (DS state machine) full and partial activation

State number		DS 3.0	DS 3.1	DS 3.2	DS 3.3	DS 3.4	DS 3.5
State name		Partial	DS activated		Access	Access activated	
		activation	T interface	T interface	activated	LOS/LFA	T interface
		initiated	deactivated	activating		at T	deactivating
	FE sent	FE 2	FE 3	FE 2	FE 4	FE 12 (note 1)	FE 3
	INFO sent	INFO 0	INFO 0	INFO 2	INFO 4	INFO 2	INFO 0
Event:	Internal state	G1	G1	G2	G3	G2	G4
FE 1		-	DS 3.2	-	-	-	DS 3.2
FE 5		Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	Start T2 DS 1.6	DS 1.6
Receiving INFO 0		-	-	-	DS 3.4	-	DS 3.1
Receiving INFO 1		-	DS 3.2	-	/	-	-
Receiving INFO 3		-	-	(note 4) DS 3.3	-	(note 4) DS 3.3	-
LOS/LFA at T		/	/	/	DS 3.4	-	-
Expiry of Timer T2 (note 3)		-	-	-	-	-	DS 3.1
DS synchronised LT→NT		-	-	-	-	-	-
DS activated		DS 3.1	-	-	-	-	-
DS deactivated		-	/	/	/	/	/
FE 8		I	I	I	I	I	I
FE 9		I	I	I	I	I	I
FE 10		I	I	I	I	I	I
LOS/LFA at either NT or LT line side; or Loss of NT power		DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7	DS 1.7
FE 11		-	-	-	-	-	-
FE 13		-	-	Start T2 DS 3.1	Start T2 DS 3.5	Start T2 DS 3.1	-

NOTE 1:   FE 12 may not be provided in some networks. Those networks that do not employ FE 12 shall continue to provide FE 4 to the ET.

NOTE 2:   The INFO sent to the user and the corresponding G state depends on the NT state.

NOTE 3:   A description of timer T2 can be found in note 2 to table 6 of ETS 300 012 [6].

NOTE 4:   As an implementation option, to avoid premature transmission of information (i.e. INFO 4), the DS state machine may introduce a delay before it changes state, i.e. see note 4 to table 6 of ETS 300 012 [6].

NOTE 5:   Not to be defined.

NOTE 6:   See subclause 8.3.1.3 for the description of the INFO sent to the user across the T reference point.

NOTE 7:   The event "S activated" can also indicate that a loopback i1 or 1a is activated \\.
For loopback 1, this event indicates that loopback 1 is active in the LT.
For loopback 1a, this event indicates that loopback 1a is active in the regenerator.

NOTE 8:   The FE sent to the network is identical to the FE sent prior to the issue of FE 5 from the network.

NOTE 9:   The event "Receiving INFO 3" can also indicate that loopback 2 is activated in the NT (as near as possible to the T reference point).

Key:

-          = No state change, no action when event occurs.

/   = Impossible event due to internal reasons or peer-to-peer procedures.

I   = Impossible event due to the definition of the layer 1 service.

FE...   = Issue function element FE.. across V1 reference point.

DS a.b   = Enter state DS a.b.

Table B.2: State transition table of ET layer 1 (ET layer 1 state machine) full and partial activation

State number	ET 1.0	ET 1.1	ET 1.2	ET 2.0	ET 2.1
State name Event:	Access deactivated T1 stopped	Access activation initiated T1 running	Access activated T1 stopped	Loopback activated T1 stopped	Loopback requested T1 running
PH-AR/MPH-AR	Start T1 FE 1 ET 1.1	-	MPH-AI PH-AI -	PH-DI -	PH-DI -
MPH-DR	-	Stop T1 PH-DI FE 5 ET 1.0	PH-DI FE 5 ET 1.0	FE 5 ET 1.0	Stop T1 FE 5 ET 1.0
FE 2	Start T1 MPH-AWI FE 1 ET 1.1	MPH-AWI -	-	/	-
Expiry of timer T1	/	MPH-EI PH-DI FE 5 ET 1.0	/	/	MPH-EI FE 5 ET 1.0
FE 3	(note 3) MPH-DSAI -	MPH-DSAI -	MPH-DSAI -	MPH-DSAI -	MPH-DSAI -
FE 4	(note 3) MPH-AI -	Stop T1 PH-AI MPH-AI ET 1.2	-	-	Stop T1 MPH-AI ET 2.0
FE 6	MPH-DI -	MPH-DI -	MPH-DI -	MPH-DI -	MPH-DI -
FE 12 (note 5)	/	-	MPH-EI -	/	/
FE 7	MPH-DI -	Stop T1 PH-DI MPH-EI FE 5 ET 1.0	MPH-EI PH-DI FE 5 ET 1.0	MPH-EI FE 5 ET 1.0	Stop T1 MPH-EI FE 5 ET 1.0
MPH-L2AR	Start T1 FE 8 ET 2.1	I	I	-	-
MPH-L1AR	Start T1 FE 9 ET2.1	I	I	-	-
MPH-L1aAR	Start T1 FE 10 ET 2.1	I	I	-	-
MPH-DSAR (note 2)	Start T1 FE 11 ET 3.0	-	I	I	I
MPH-DSDR	-	-	I	I	I

(continued)

Table B.2 (concluded): State transition table of ET layer 1 (ET layer 1 state machine) full and partial activation

State number	ET 3.0	ET 3.1	ET 3.2	ET 3.3
State name Event:	Partial activation initiated T1 running	DS activated T deactivated T1 stopped	DS activated T activation initiated T1 running	DS activated T activated T1 stopped
PH-AR/MPH-AR	-	Start T1 FE 1 ET 3.2	-	MPH-AI PH-AI -
MPH-DR	Stop T1 FE 5 ET 1.0	MPH-DSDI FE 5 ET 1.0	Stop T1 PH-DI FE 5 ET 1.0	PH-DI FE 5 ET 1.0
FE 2	-	Start T1 MPH-AWI FE 1 ET 3.2	MPH-AWI -	-
Expiry of timer T1	MPH-EI FE 5 ET 1.0	/	MPH-EI PH-DI FE 13 ET 3.1	/
FE 3	Stop T1 MPH-DSAI ET 3.1	(note 2) MPH-DSAI -	-	MPH-DSAI -
FE 4	MPH-AI -	(note 2) MPH-AI -	Stop T1 PH-AI MPH-AI ET 3.3	-
FE 6	-	MPH-DI -	MPH-DI -	MPH-DI -
FE 12 (note 5)	MPH-EI STOP T1 FE 5 ET 1.0	MPH-EI FE 5 ET 1.0	PH-DI MPH-EI STOP T1 FE 5 ET 1.0	PH-DI MPH-EI FE 5 ET 1.0
FE 7	-	-	-	MPH-EI -
MPH-L2AR	I	I	I	I
MPH-L1AR	I	I	I	I
MPH-L1aAR	I	I	I	I
MPH-DSAR (note 2)	-	I	I	I
MPH-DSDR	-	-	Stop T1 PH-DI FE 13 DS 3.1	MPH/PH-DI FE 13 DS 3.1

NOTE 1: A description of timer T1 can be found in note 1 to table 6 of ETS 300 012 [6].
NOTE 2: The primitives MPH-DSAR is allowed only if the interface at the T reference point is deactivated. The management has to meet this requirement.
NOTE 3: These events occur if timer T1 expires concurrently with the completion of a task which the access digital section indicates to ET layer 1 by means of the appropriate function element (FE 3 and FE 4). It is a situation caused by excessive delay within the access digital section. In some cases it is advantageous to issue the appropriate primitive to notify to management the status of the customer access subsequent to the error indication which would have been conveyed in an MPH-EI primitive. This provides the management with the information to initiate the optimum recovery procedure.
NOTE 4: This event occurs if timer T1 expired and management invokes a deactivation as a consequence of the receipt of the MPH-EI primitive. In particular, this recovery seems to be useful in case of excessive delays (see note 3).
NOTE 5: FE 12 is not available on all networks. FE 12 indicates to the ET state machine LOS/LFA at the user side of the T reference point.

Key:
- = No state change, no action when event occurs.
I = Impossible event by definition of the layer 1 service.
/ = Impossible event due to internal reasons or peer-to-peer procedures.
FE... = Issue function element FE... across V_1 reference point.
ET a.b = Enter state ET a.b

B.3 Description of ET 3.x states for the partial activation of the access digital section mode of operation

B.3.1 State ET 3.0 (partial activation initiated)

This state is entered from ET 1.0 in response to the receipt of MPH-DSAR. FE 2 is received from the DS. Timer T1 is running.

B.3.2 State ET 3.1 (DS partially activated, interface at T deactivated)

This stable state is entered either from state ET 3.0 following the receipt of FE 3 from the DS or from states ET 3.2 or ET 3.3 in response to the receipt of MPH-DSDR or from ET 3.2 in response of expiring of timer T1. Timer T1 has been stopped.

B.3.3 State ET 3.2 (DS partially activated, interface at T activation initiated)

This state is entered from ET 3.1 in response to the receipt of PH-AR or MPH-AR, or FE 2 from the DS. Timer T1 is running.

B.3.4 State ET 3.3 (DS partially activated, interface at T activated)

This state is equivalent to ET 1.2 (access activated). FE 4 has been received from the DS. Timer T1 has been stopped.

> NOTE: The usual way to enter or to leave the optional partial activation of the DS mode of operation (the DS 3.X states) is by means of the primitives MPH-DSAR and MPH-DR respectively. Both, while the DS is in this mode of operation, the primitives PH/MPH-AR and MPH-DSDR serve only to activate and deactivate the interface at the T reference point, the DS remaining partially activated.

B.4 Set of primitives within the ET for the support of functions associated with the partial activation of the access digital section

a) **MPH-access digital section partially activate request (MPH-DSAR).**
The MPH-DSAR primitive is used to activate the DS without activating the interface at T reference point. This may be required for maintenance purposes. The configuration control shall ensure that this primitive is issued only when the access digital section is deactivated (state DS 1.0).

b) **MPH- access digital section partially deactivate request(MPH-DSDR).**
The MPH-DSDR primitive is used to restore the configuration of the DS to the partial active state from a full active state (e.g. for maintenance purposes).

c) **MPH-access digital section deactivate indication (MPH-DSDI).**
This primitive is issued when the DS is in the partially activated state.

Annex C (informative):   Bibliography

The following documents are referenced informatively within this ETS.

CCITT Recommendation G.801 (1988): "Digital transmission models".

CCITT Recommendation G.821 (1988): "Error performance of an international digital connection forming part of an integrated services digital network".

CCITT Recommendation I.411 (1988): "ISDN user-network interfaces - Reference configurations".

CCITT Recommendation I.350 (1988): "General aspects of quality of service and network performance in digital networks, including ISDN".

CCITT Recommendation Q.940 (1988): "ISDN user-network interface protocol for management - General aspects".

CCITT Recommendation I.441, Appendix III: "ISDN user-network interface - data link layer specification".

History

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