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TELEMATIC SERVICES

TERMINAL EQUIPMENTS AND PROTOCOLS FOR TELEMATIC SERVICES

NETWORK-INDEPENDENT BASIC TRANSPORT SERVICE FOR THE TELEMATIC SERVICES

ITU-T Recommendation T.70

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation T.70 was revised by the ITU-T Study Group VIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation T.70

NETWORK-INDEPENDENT BASIC TRANSPORT SERVICE FOR THE TELEMATIC SERVICES

(Geneva, 1980, amended at Malaga-Torremolinos, 1984; Melbourne, 1988 and Helsinki, 1993)

The CCITT,

considering

(a) that the Teletex service will be introduced in different types of network, i.e. circuit-switched public data networks (CSPDN), packet-switched public data networks (PSPDN) and the public switched telephone network (PSTN);

(b) that there is a need for international interworking between terminals belonging to the same or different types of Telematic services;

unanimously declares the following view

1 Scope

1.1 This Recommendation defines the *network-independent basic transport service* applicable to Teletex and Group 4 facsimile terminals connected to the types of network mentioned in (a) above in terms of:

a) the transport services provided to the higher layer [the transport services are provided by the transport layer (layer 4) in association with the underlying services provided by the supporting layers 1 to 3];

b) the transport layer procedure (see clause 5 below).

1.2 Clause 2 describes the transport service. Clause 3 describes the transport service implementation for different types of networks. Clause 4 outlines the guidelines for interworking between networks. Clause 5 specifies the transport layer procedure, and Annexes A and B provide associated state transition diagrams and tables, respectively.

2 Transport service

2.1 Transport service objectives

2.1.1 The purpose of the transport service is to provide two communicating session entities within two terminals with transport services, i.e. the means for transparent and reliable end-to-end transfer of data between them irrespective of the particular type of network used.

2.1.2 The main requirements of the transport service to be provided by a transport entity to the local transport user, i.e. the session entity, are:

a) *Network independence* – The transport service shall be homogeneous, while allowing a suitable wide variety of underlying communications media, protocols and mechanisms.

b) *End-to-end significance* – The transport service shall have end-to-end significance, connecting the end users irrespective of the number of individual communication links used.

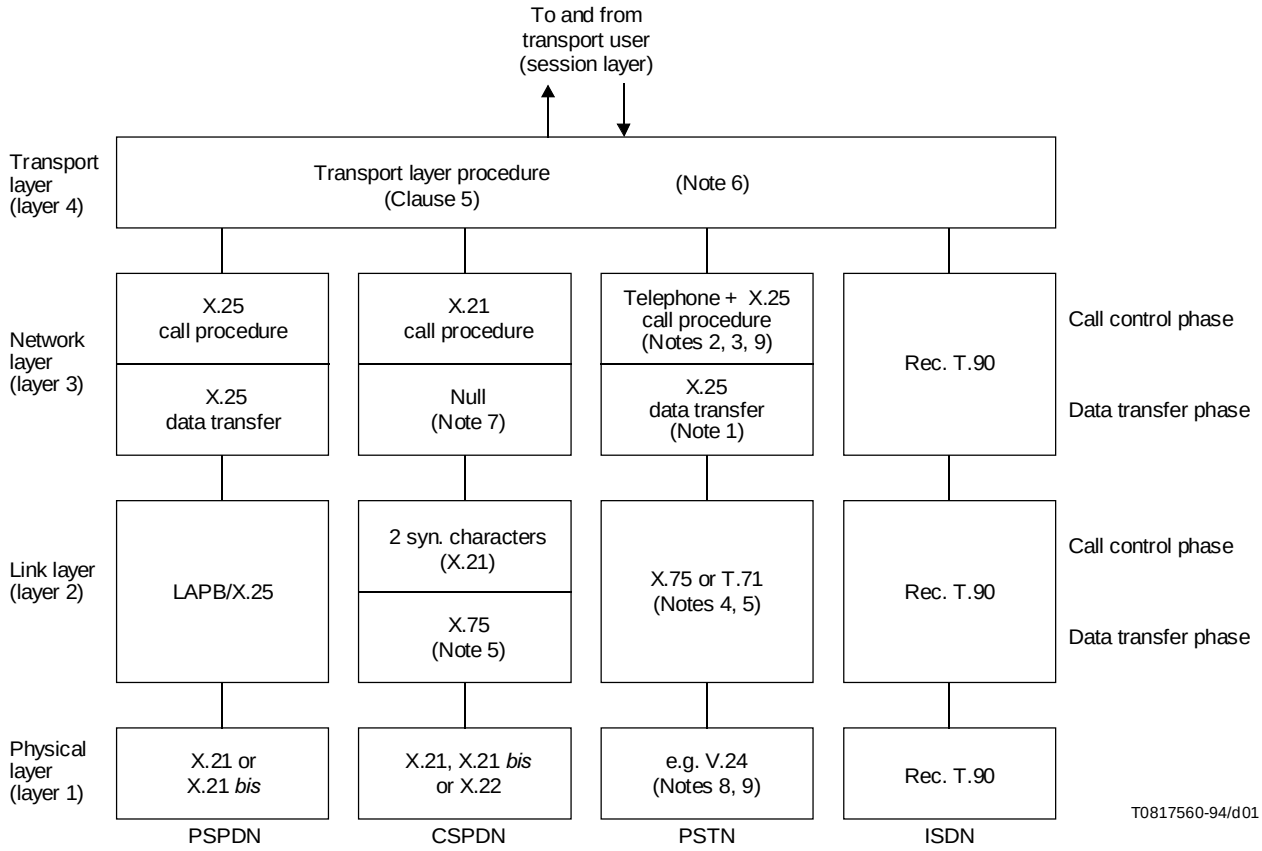
c) *Transparency* – The transport service shall be octet transparent, i.e. not restrict the content, format or coding of the information (data or control) received from or delivered to the transport user.

d) *Error-free delivery* – The transport service shall assure error-free delivery. Non-recoverable errors are to be visible to the transport service user.

e) *Cost efficiency* – The transport service shall optimize the use of the available communication resources to provide the performance required by each communicating transport user at maximum efficiency.

2.2 General structure of the transport service

2.2.1 The general structure of the transport service is shown in Figure 1.



NOTES

1 The X.25 network layer procedure is introduced to ease interworking with PSPDNs.

2 The establishing of the network connection is performed by two-stage selection: the first using normal telephone procedures and the second using X.25 call control procedures.

3 For terminals connected to PSTN accessing PSPDN, the procedures in Note 2 apply. See also Recommendation X.32.

4 Recommendation T.71 defines a half-duplex link access procedure, based on Recommendation X.75 for single link operation (see 3.2.2).

5 The link layer procedures are in accordance with Recommendation X.75 for single link operation. Additional application rules can be found in 3.2.2. and 3.3.2.

6 In all cases of interworking including interworking between terminals connected to the same type of network or to different types of networks (i.e. CSPDN, PSPDN, PSTN), this transport layer procedure is executed peer-to-peer between the communicating terminals.

7 For terminals connected to CSPDNs, no function is needed in the network layer in the data transfer phase as indicated in this figure. However, in order to facilitate interworking with PSPDNs a minimum network layer is introduced (see 3.3.3).

8 The modem may also be integrated within the terminal and in such cases Recommendation V.24 need not apply (see 3.2.1).

9 For automatic calling and/or answering, Recommendation V.25 may be applicable.

FIGURE 1/T.70

Transport service general structure

3 Transport service implementation for different types of networks

NOTE – The transport layer procedure on all types of networks is defined in clause 5. The network dependent control procedures of the underlying layers are described in the following.

3.1 Terminals connected to a PSPDN

3.1.1 Physical layer DTE/DCE interface characteristics

The physical layer of Recommendation X.25 applies.

3.1.2 Link layer procedure

The link layer procedure shall, unless otherwise specified, be the symmetrical procedures as specified in Recommendation X.25, LAPB (Link Access Procedure B).

3.1.3 Network layer procedure

Recommendation X.25 Virtual Call procedures apply. However, the following points should be noted when using this transport protocol:

a) The qualifier bit in data packets should always be set to 0.

b) The delivery confirmation bits in all packets should be set to 0.

c) The terminal should not send an *interrupt request* packet.

d) Normal X.25 reset procedures will apply.

e) Each control block or data block of the transport layer shall be carried in a complete data packet sequence.

f) The terminal should not send a *DTE REJ packet*.

g) Terminals shall use a specific protocol identifier within call request/incoming call packets for the Teletex service and Group 4 facsimile apparatus. This identifier is represented by the first octet of the call user data field (remaining octets, if any, should be ignored) as shown below:

bit 87654321

octet 1 00000010

In the case of CSPDN/PSPDN interworking the functional mapping of this protocol identifier requires further study.

h) Terminals shall not use the fast select facility.

3.2 Terminals connected to the PSTN

3.2.1 Physical layer DTE/DCE interface characteristics

The DTE/DCE physical layer element shall be in accordance with existing Series V Recommendations. The physical layer may provide for half-duplex or full-duplex transmission depending on the modem standard.

NOTE – The PSTN modem standards are discussed in Study Group XVII. Furthermore, in the case of a modem integrated in the terminal, the interface may only be functionally equivalent to a Series V Recommendation. This is also for further consideration in Study Group XVII.

3.2.2 Link layer procedure

3.2.2.1 Depending on the service provided by the physical layer, the link layer procedures over a single physical circuit between two terminals have to cater for a half-duplex or full-duplex transmission facility to provide a full-duplex service to the network layer. For full-duplex physical layer service, the link layer procedure shall conform to the Link Access Procedure described in Recommendation X.75, for single link operation. For addressing assignments and the system parameters see 3.2.2.2 and 3.2.2.3, respectively. For half-duplex physical layer service the link layer procedure is as defined in Recommendation T.71. This is a half-duplex Link Access Procedure, based on Recommendation X.75 for single link operation.

3.2.2.2 The following describes the application of the link addressing procedure of Recommendation X.75. Link addresses (A and B) shall be assigned dynamically or on a per-call basis according to the following rules:

a) the calling terminal shall take Address A;

b) the called terminal shall take Address B;

c) commands and responses shall be transferred as shown in Figure 2;

d) A and B addresses are coded as follows:

Address	12345678
A	11000000
B	10000000

NOTE – The terminal will discard all frames received with an address other than A and B.

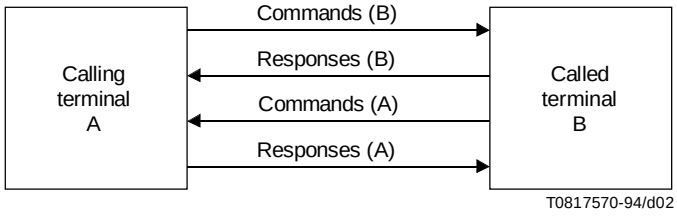


FIGURE 2/T.70

3.2.2.3 System parameters are:

a) timer, T1;

b) maximum number of retransmissions, N2;

c) maximum number of bits in an I frame, N1;

d) maximum number of outstanding I frames, *k*.

The above system parameters are to be specified by the Administration. However, the possible range of values that may be attributed to each parameter is to be standardized. Such values are for further study.

3.2.3 Network layer procedure

3.2.3.1 See 3.1.3. In addition, for all calls (PSTN only, PSTN-PSPDN, PSTN-PSPDN-PSTN) second stage addressing will apply using X.25 virtual call procedures. The calling terminal should include the called address and the calling address (see Note 2) in call request packets. The format of the called address shall conform to:

a) the telephone network addressing scheme for PSTN only calls;

b) the telephone network addressing scheme with an X.121 DNIC for PSTN-PSPDN calls (see Note 3);

c) the X.121 addressing scheme for PSTN-PSPDN calls (see Note 1).

NOTES

1 For other cases of internetworking the above rule shall apply.

2 In the case of PSTN-PSPDN calls the verification of the calling address by the network requires further study. The format of the calling address is for further study.

3 The feasibility of such connections is for further study.

3.3 Terminals connected to a CSPDN

3.3.1 Physical layer DTE/DCE interface characteristics

The DTE/DCE physical interface characteristics shall be in accordance with Recommendation X.21, or as an option, Recommendation X.22 for multi-call operation.

3.3.2 Link layer procedure

3.3.2.1 General

The link layer procedure shall be used during the data phase of Recommendation X.21 (or X.22) for data interchange over a single physical circuit between two terminals operating in User Classes of Services 3 to 7 and 30 as defined in Recommendation X.1. The link layer procedure shall consist of a fully symmetrical HDLC procedure as defined in Recommendation X.75 for single link operation.

3.3.2.2 Link layer address procedure

The following describes the application of the link addressing procedures of Recommendation X.75. Link addresses (A and B) shall be assigned dynamically on a per-call basis according to the following rules:

a) the calling terminal shall take address A;

b) the called terminal shall take address B;

c) commands and responses shall be transferred as shown in Figure 3;

d) A and B addresses are coded as follows:

Address	12345678
A	11000000
B	10000000

NOTE – The terminal will discard all frames received with an address other than A and B.

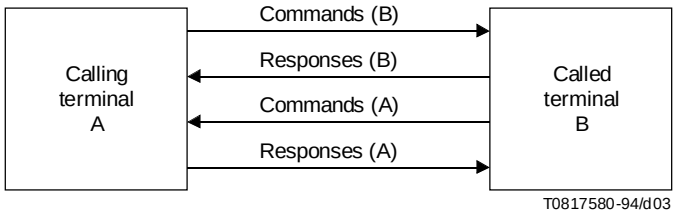


FIGURE 3/T.70

3.3.2.3 Link layer implementation rules

In order to achieve full compatibility between different implementations, the rules below for the implementation of Recommendation X.75 shall be followed.

3.3.2.3.1 General rules

a) The 1984 version (*Red Book*) of clause 2/X.75, shall be used as the reference specification.

b) The term “STE” shall be read as “DTE”.

c) At present the non-extended mode of operation (i.e. modulo 8) and the extended mode of operation (i.e. modulo 128) are defined. The support of modulo 8 is mandatory and modulo 128 is optional. However, the long term objective is to use modulo 128 as the common base modulo. Therefore, it is strongly recommended that the extended mode of operation (i.e. modulo 128) be supported, and the terminal supporting the extended mode shall also support the non-extended mode.

d) Only the single link procedure (SLP) shall be used.

3.3.2.3.2 Specific rules

The following rules refer to the indicated subclauses and tables of Recommendation X.75.

a) *Table 1/X.75* (see Note 1)

I-frame must not be sent with an empty I-field.

$N \geq 0$

$N \leq N1 - 32$

A received empty I-frame shall be treated as a valid I-frame.

b) *Subclause 2.3.4.9*

Items 5), 6) and 7) are not valid (shall not result in the sending of a FRMR). Instead the following actions shall be implemented:

– Not expected supervisory frames with the F bit set to 1 shall be ignored.

– Not expected UA or DM response shall be ignored.

– Frames with an invalid N(S) shall be responded to by sending REJECT.

Frames with an FRMR control field shall not be responded by sending a FRMR.

c) *Table 7/X.75*

Bits W, X, Y and Z set to 0 indicate that no reason for frame rejection is given.

d) *Subclause 2.3.5.3*

The DTE and the CSPDN are not octet aligned and the last paragraph is therefore not valid.

e) *Subclause 2.3.5.5*

Higher layers should be notified when timer T3 expires (excessive idle state).

f) *Subclause 2.4.3*

Related to the first paragraph, read instead of “next response” “corresponding response”.

g) *Subclause 2.4.4.1*

In the active channel state, the DTE shall transmit contiguous flags independent of the other DTE.

The calling DTE shall initialize the link by sending a SABM command with the P bit set to 1.

h) *Subclause 2.4.4.4.1*

A condition for entering the disconnected phase is also that no unacknowledged DISC command exists, because of collision cases (see 2.4.4.5/X.75).

In the disconnected phase, it is the calling DTE which may initiate link set up.

i) *Subclause 2.4.5.9, fourth paragraph*

If an RNR is received, the DTE shall remain in the timer recovery condition (because the other DTE is still in the busy condition).

j) *Subclause 2.4.5.9, fifth paragraph*

If an RNR is received, the DTE shall not resume I-frame transmission or retransmission.

k) *Subclause 2.4.5.9, last paragraph*

If the transmission attempt variable is equal to N2, the DTE shall enter the disconnected phase.

l) *Subclause 2.4.7.3*

In the frame rejection condition, the DTE shall only check the commands and react with an FRMR according to the P bit.

The frame rejection condition is cleared when the DTE receives an SABM, or, receives or transmits a DISC command.

m) *Subclause 2.4.7.3, second paragraph* (see Note 2)

Only the DTE which caused the FRMR condition may try to reset the link.

n) *Subclause 2.4.7.3, third paragraph* (see Note 3)

After N2 attempts to get the other DTE to reset the link, the DTE shall enter the disconnected phase.

o) *Subclause 2.4.8.1* (see Note 4)

The timer T1 shall be started at the end of frame transmission. The value of T1 depends on the data signalling rate, the frame length, the value of N2, and a fixed time representing both T2 and the transmission delay [see item r)]. A value is recommended between 2.5 and 7 seconds.

p) *Subclause 2.4.8.2* (see Note 4)

$T1 > T2$

$T2 < 1$ s

Depending on the acknowledgement strategy used, the DTE designer may regard T2 as a decision parameter only, in which case the DTE is not obliged to implement a corresponding timer.

q) *Subclause 2.4.8.3, second paragraph*

$30 \text{ s} \leq T3 \leq 60 \text{ s}$

r) *Subclause 2.4.8.4*

$N2 \times T1 \geq 60$ s

s) *Subclause 2.4.8.5* (see Note 5)

For the non-extended mode,

$N1 - 1080 + (n \times 1024)$ bits; $n = 0$ or 1 or 3 or 7 or 15.

For the extended mode,

$N1 - 1096 + (n \times 1024)$ bits; $n = 0$ or 1 or 3 or 7 or 15.

t) *Subclause 2.4.8.6* (see Note 5)

For the non-extended mode, $k \leq 7$.

For the extended mode, $k \leq 127$.

NOTES

1 Terminals complying with the *Red Book* version of this Recommendation may react by DL-RESET indication (FRMR).

2 Terminals complying with the *Red Book* version of this Recommendation may react differently.

3 It is not meaningful to reset the link if the other DTE is not responding for $N2 \times T1$.

4 The acknowledge strategy used by the receiving DTE should be independent of any knowledge about the value of k used by the sending DTE. This can be achieved by acknowledging every correctly received I-frame as soon as possible.

5 The selection of N1 and k values should be performed so that adequate throughput performance can be achieved for a link with longer transmission delay. The recommended combination of N1 and k values for a link having a higher data rate (e.g. 48 kbit/s or 64 kbit/s) are as follows:

For the non-extended mode, $N1 = 16\,440$ ($n = 15$) and $k = 7$;

For the extended mode, $N1 = 16\,456$ ($n = 15$) and $k = 80$.

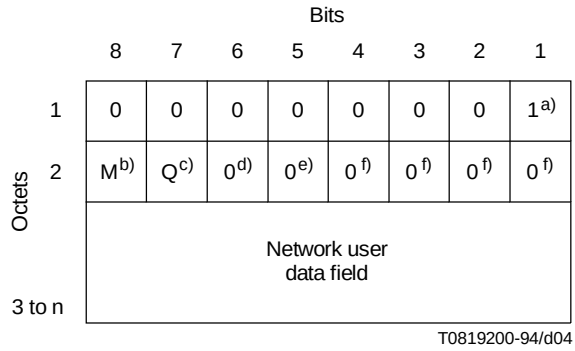
3.3.3 Network layer procedure

3.3.3.1 Call control phase

The call control procedure conforms to Recommendation X.21, or as an option, Recommendation X.22 for multi-call operation.

3.3.3.2 Data transfer phase

A minimal network layer is present during the data transfer phase and accommodated through the use of a two-octet network block header. The header comprises a one-octet length indicator followed by a network block type code specified below. The only network block currently defined is a network protocol data block as shown in Figure 4.



a) The length indicator expresses in octets the length of the network data block header. This length does not include octet 1.

b) The more data mark (M) is used to preserve the integrity of transport layer control and transport data blocks. When M is set to 1 it indicates that more data is to follow. A terminal has to accept as much bytes as the terminal can support by block size negotiation. Receiving more bytes the terminal may react by N-DISC indication.

c) The qualifier bit (Q) is introduced to provide a functional mapping with the X.25 qualifier bit for CSPDN/PSPDN interworking. If the Q bit is not used it shall be set to zero.

d) and e) are spare bits for possible new single bit functions.

f) The bits 1 to 4 with the code four zeros (0000) are used to identify the network data block. Other network layer protocol unit types (i.e. control blocks used in the data transfer phase) may be defined in the future.
The network user data field is delimited by the HDLC Closing Flag at the link layer. It must contain at least one octet.

FIGURE 4/T.70

Network data block

3.3.3.3 Data transfer procedure

3.3.3.3.1 Handling of the M-bit

The calling DTE shall negotiate the TPDU size with the called DTE at the transport layer, based on either the maximum TPDU size supported or the optimum TPDU size for the specific call, unless the default value of 128 octets is used. The agreed value will allow the sending DTE to transfer TPDUs without the need for segmenting at the Network layer and consequently the M-bit is set to zero.

However, receiving DTEs must always be capable of reassembling segmented TPDUs by using the M-bit, since segmenting may take place in the network in some interworking situations, e.g., when the composite network connection comprises a PSDN.

3.3.3.3.2 Error procedures

A Data PDU with a length indicator different from hexadecimal “01” and/or with less than three octets shall be discarded and the physical network connection shall be cleared.

3.4 Terminals connected to an ISDN

See Recommendation T.90.

4 Interworking between networks

4.1 It is the responsibility of Administrations to decide in which network(s) the telematic services are to be provided.

4.2 Four possibilities are considered below:

a) Terminals connected to a circuit switched public data network (CSPDN);

b) Terminals connected to a packet switched public data network (PSPDN);

c) Terminals connected to a public switched telephone network (PSTN);

d) Terminals connected to an integrated services digital network (ISDN).

4.3 Interworking between telematic terminals connected to any network must be possible.

4.4 International interworking between telematic terminals shall preferably take place between networks of the same type when these networks are provided by both countries involved.

4.5 In the case of international interworking between telematic terminals connected to dissimilar networks, Recommendation X.300 shall apply.

The interworking between CSPDNs and PSPDNs is described in Recommendation X.82 (detailed arrangements for interworking between CSPDNs and PSPDNs based on this Recommendation).

5 Transport layer procedure

5.1 Transport functions

5.1.1 General

5.1.1.1 The transport layer will perform all those functions that are necessary to bridge the gap between the services provided by the network layer and the services needed by the session layer. Therefore, the functions performed are dependent on two criteria: the services provided by the underlying network layer and the services required by the session layer.

5.1.1.2 It is the responsibility of the transport service user to select a given quality of service, which may imply the use of certain transport layer functions such as:

a) establishment of a transport connection
   - transport connection identification
   - transport connection multiplexing;

b) data transfer
   - sequence control
   - error detection
   - error recovery
   - segmenting and reassembling
   - flow control
   - purge;

c) termination of a transport connection.

NOTE – Not all of the above functions will be available in the basic transport service (see 5.1.3).

5.1.2 Transport protocol classes

5.1.2.1 Transport layer functions are grouped (for ease of negotiation) into a hierarchical system of transport protocol classes whereby classes occupying superior positions in the hierarchy implement functions of the lower classes together with the optional functions identified for their own class.

5.1.2.2 During transport connection establishment the use of a given transport protocol and optional functions should be negotiated according to the following rules:

- the calling terminal indicates the transport protocol class and (if applicable) the optional functions required;
- the called terminal indicates the transport protocol class and (if applicable) the optional functions that it is willing to support;
- all parameters to be used in the transport connection must be explicity indicated, otherwise default values will apply.

5.1.2.3 The basic transport service described here is fulfilled by a protocol denoted in Recommendation X.224 as transport protocol class 0. That protocol class is compatible with this Recommendation. In the event of a discrepancy between transport protocol class 0 as described in Recommendation X.224 and in this Recommendation, the latter takes precedence.

5.1.3 The basic transport service (TS)

5.1.3.1 A limited set of transport layer functions is defined for a basic transport service. The basic transport service is provided by transport layer functions which are performed by *transport layer protocol elements*.

5.1.3.2 Transport protocol data units (TPDUs) carrying transport service (TS) user information or control information are called *blocks*.

5.1.3.3 Transport layer block types are as follows:

a) transport connection request (TCR) block;

b) transport connection accept (TCA) block;

c) transport connection clear (TCC) block;

d) transport data (TDT) block;

e) transport block reject (TBR) block.

5.1.3.4 The TCR and TCA blocks are used to indicate the protocol class, and optional functions, applying to a transport connection. The TCC block is used to indicate the reason for refusing a connection establishment. The TDT block carries information of the transport service user. The TBR block is used to report procedure errors to the remote terminal.

5.1.4 Transport layer functions

5.1.4.1 Basic class functions and associated transport layer protocol elements, i.e. blocks, include:

a) transport connection establishment, transport connection identification, optional extended addressing and optional transport data block size negotiation (TCR, TCA and TCC blocks);

b) data delimitation, segmentation/reassembling of arbitrarily long transport service data units (TSDU). These are contained within TDT blocks. The end of a TSDU is indicated by a TSDU end mark in the last data block;

c) detection and indication of procedural errors (TBR block).

5.1.4.2 Other characteristics of the basic transport service are:

a) Maintenance of TSDU integrity.

b) *Overflow* – If the user cannot absorb new data and if the appropriate buffers are not available, flow control is performed at the network/link layer as appropriate.

c) *Error* – No mechanism is provided within the transport layer to facilitate recovery from detected errors. Where such errors are detected the user of the transport service should be informed so that appropriate recovery action may be taken.

5.2 Description of connection establishment and termination procedures

5.2.1 General

5.2.1.1 The transport layer connection establishment and termination procedures shall also be used for negotiating transport protocol class and, if applicable, optional transport connection functions.

5.2.1.2 For the basic transport service, means are provided to establish a transport connection using a TCR block and a TCA block. This exchange provides:

a) a way to negotiate options;

b) a transport connection identification. The transport connection is identified by use of cross-references. Each end of the connection is responsible for selecting a suitable transport connection identifier.

5.2.1.3 This mechanism also provides an identification of the transport connection independent of any network connection identification and therefore provides independence from the life of the network connection. The binary value 0 should not be used as an identifier. The use of such references for reconnection requires further definition.

5.2.2 Transport connection request (TCR) block

5.2.2.1 The calling terminal shall indicate a transport connection request by transferring a TCR block to the remote terminal. The TCR block includes the transport functions (e.g. source reference, class, and optional functions) for negotiation of the characteristics of the transport connection being established.

5.2.3 Transport connection accept (TCA) block

5.2.3.1 The called terminal shall indicate its acceptance of the transport connection by transferring a TCA block to the remote terminal. The TCA block includes the transport parameters applying to the connection and to be used by the calling terminal.

5.2.3.2 If a terminal receives the request for an optional TDT block size it may either:

- indicate its support by reproducing the requested value in the TCA block;
- request in the TCA block the use of a shorter allowable TDT block. The calling side either accepts this size by sending the first TDT block or disconnects the network connection;
- not accept the requested TDT block size parameter value by sending a TCA block without a TDT block size parameter. Therefore, the standardized TDT block size will apply.

A TCR requesting an optional TDT block size not supported by the called side should not be answered with TBR.

5.2.4 Transport connection clear (TCC) block

5.2.4.1 If a transport connection cannot be established, the called terminal shall respond to the TCR block with a TCC block. The clearing cause shall indicate why the connection was not accepted.

It is up to the calling side whether the receipt of a TCC will cause complete disconnection or whether a new TCR with a parameter different from the first one will be sent (e.g. another extended transport layer address). In order to allow for subsequent TCRs, the sender of TCC may provide in the optional parameter field an appropriate parameter and associated value to indicate that another TCR is invited. The new optional parameter and its associated value(s) are for further study.

NOTE – There is no explicit transport connection termination procedure in this Recommendation. Therefore, the lifetime of the transport connection is directly correlated to the lifetime of the supporting network connection.

5.2.5 Transport connection collision

5.2.5.1 If the calling terminal receives a TCR block, it shall transfer a TBR block to notify the called terminal of the procedure error (see Annex B).

5.2.6 Extended addressing

5.2.6.1 The extended addressing capability may be used to address terminals in a multiterminal configuration.

The extension addresses for called and calling terminals are optional parameters to TCR and TCA. The use of the calling extension address is for further study.

5.2.6.2 The receiving terminal shall respond with a TCA according to Table 1.

5.2.6.3 The calling terminal may, when receiving a called terminal address in the TCA, act as specified in Table 2.

TABLE 1/T.70

Received TCR	Receiver reaction	
	Multi-terminal with extended addressing [a)]	Stand-alone terminal
Without extended addressing	Send TCA with extended addressing	Send TCA without extended addressing
With extended addressing	Send TCA with extended addressing [b)]	Send TCA without extended addressing

a) Multi-terminal configuration, with capability for extended addressing.

b) If the called terminal is occupied or out of order, the call should be routed to a default terminal or mailbox. The sender will then be informed of the routing by the extension address of the connected terminal. The receiver of TCR may also in this case react by sending TCC.

TABLE 2/T.70

Sent TCR	Calling terminal reaction		
	TCA received with:		
	No extended addressing	Correct extended addressing	Incorrect extended addressing
Without extended addressing	OK	Neglect extension (Note)	
With extended addressing	a)	OK	a)

a) Reaction left to the discretion of the calling terminal.

NOTE – Terminal complying with the 1980-1984 version of this Recommendation may react by releasing the network connection.

5.3 Description of data transfer procedures

5.3.1 General

5.3.1.1 The data transfer procedure described in the following subclauses applies only when the transport layer is in the data transfer phase, i.e. after completion of transport connection establishment and prior to clearing.

NOTE – When a connection is cleared, transport data blocks may be discarded. Hence it is left to the transport service user to define protocols able to cope with the various possible situations that may occur.

5.3.2 Transport data block (TDT) length

5.3.2.1 The standard maximum TDT block length to be supported by all terminals is 128 octets including the data block header octets. However, the TDT block length may be restricted to a lower value when the TDT block is concatenated with other TDT blocks (see 5.5.3).

5.3.2.2 Other maximum data field lengths may be supported in conjunction with an optional TDT block size negotiation connection function (see 5.5.4.3 and 5.5.5.3). Optional maximum data field lengths shall be chosen from the following: 256, 512, 1024 and 2048 octets. If the requested optional TDT block size cannot be supported, a shorter allowable TDT block size must be selected (see 5.2.3.2).

The agreed maximum TDT block size should be aimed at for TDT blocks having the TSDU end mark set to 0 and a number of octets less than the agreed maximum shall not cause the receiving transport entity to reject this TDT block.

5.3.2.3 The selection of the maximum TDT length should be performed so that adequate throughput performance can be achieved for a link with a longer transmission delay.

5.3.3 Transport service data unit (TSDU) end

5.3.3.1 The TSDU end mark is used to preserve the integrity of the TSDU. The TSDU end mark is set to binary 1 in the last TDT data block carrying information related to a certain TSDU. Exceptionally, this TDT block may be sent without carrying user information in order to allow for an immediate termination of a TSDU in certain error conditions.

In case of a TSDU that comprises a single TDT block the TSDU end mark is also set to 1. In all other cases the TSDU end mark is set to zero.

5.4 Treatment of procedure errors

5.4.1 A terminal shall send a TBR block to the remote terminal to report the receipt of an invalid or not implemented block (if not explicitly specified otherwise in this Recommendation). During the establishment of a transport connection, terminals shall not send a TBR block upon the receipt of a TCR block whose parameters or parameter values are invalid or not implemented. In this case, terminals shall act as if no errors have occurred and send the appropriate response (if any).

A terminal receiving a TBR block shall take appropriate recovery action.

NOTES

1 A TBR whether invalid or valid shall not be answered by sending a TBR block.

2 Terminals complying with the 1981-1984 study period version of this Recommendation may react to all of the above indicated conditions by sending TBR.

3 The definition of invalid block/parameter, etc. is provided by the state transition tables (see Annex B).

4 A TCR of which the PV of the TPDU size parameter is less than 07 (which is the basic length of the transport block size) shall be considered as an invalid TPDU.

5 In the states 1.1 for the calling side and 2.1 for the calling and called side the terminal may react either by sending TBR or by releasing the network connection.

6 The state tables and state transition diagrams have to be read according to Notes 4 and 5 above.

5.5 Formats

5.5.1 General

5.5.1.1 Transport protocol data units (TPDUs) carrying transport service (TS) user information or control information are called *blocks* (see 5.1.3). All blocks contain an integral number of octets.

5.5.1.2 Bits of an octet are numbered 8 to 1 where bit 1 is the low order bit and is transmitted first. Octets of a block are consecutively numbered starting from 1 and are transmitted in this order.

When consecutive octets are used to represent a binary number, the lower octet has the most significant value.

5.5.1.3 *TDT block(s)* are used to transfer a transport service data unit (TSDU) transparently whilst maintaining the structure of the latter by means of the TSDU end mark.

5.5.1.4 *Control blocks* (TCR, TCA, TCC, TBR) are used to control the transport protocol functions, including optional functions.

5.5.1.5 A parameter field is present in all control blocks within the basic transport service to indicate optional functions. The parameter field contains one or more parameter elements. The first octet of each parameter element contains a parameter code to indicate the function(s) requested.

The general coding structure is shown in Figure 5.

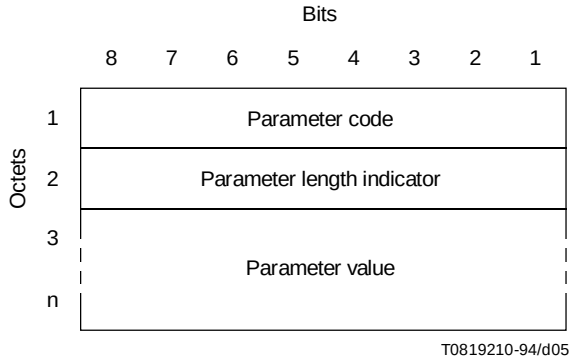


FIGURE 5/T.70

Parameter element coding structure

5.5.1.6 The parameter code field is binary coded and, without extension, provides for a maximum of 255 parameters. Parameter code 11111111 is reserved for extension of the parameter code. The extension mechanism is for further study.

Octet 2 indicates the length, in octets, of the parameter value field. The parameter field length is binary coded and bit 1 is the low order bit of this indicator.

Octet 3 and subsequent octets contain the value of the parameter identified in the parameter code field. The coding of the parameter value field is dependent on the function being requested.

5.5.2 Structure of transport control and transport data blocks

5.5.2.1 Figure 6 illustrates the general structure of transport layer blocks. A summary of transport layer blocks is given in Figure 7.

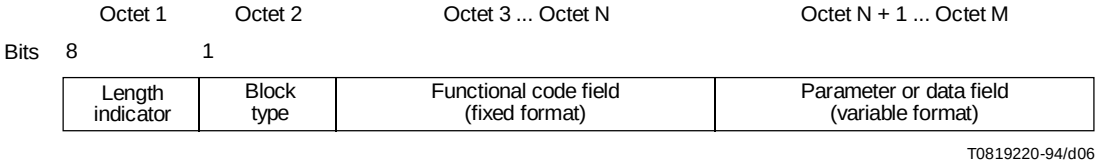


FIGURE 6/T.70

General block structure

5.5.2.2 Length indicator (LI) field

5.5.2.2.1 Octet 1 contains the length indicator (LI). The value of this indicator is a binary number that represents the length in octets of the control block (including parameters) and the header length in octets of data blocks (excluding any subsequent user information). In both cases this length does not include octet 1.

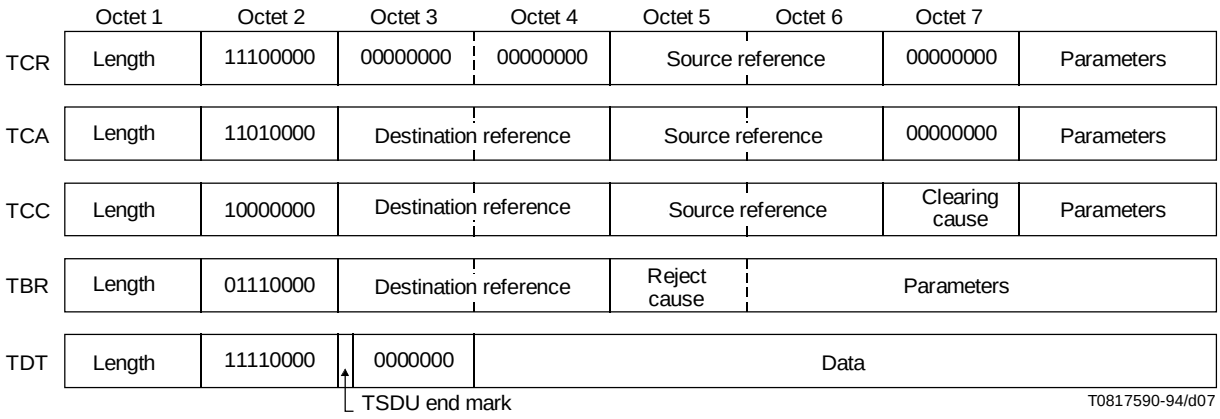
5.5.2.2.2 The basic LI value shall be restricted to 127 (i.e. a binary value of 01111111). The use of higher LI values and the use of the binary value 11111111 for extension purposes is for further study.

5.5.2.3 Block type field

5.5.2.3.1 Octet 2 contains the block type code. Bits 1 to 4 of octet 2 are set to 0 for all transport layer blocks currently defined. It is for further study to determine whether or not bits 1 to 4 are required for future extension to the range of transport layer blocks currently defined or are used for other functions.

5.5.2.4 Functional code field

5.5.2.4.1 Octet 3 and subsequent octets contain functional codes in a fixed format as per the block type (see Figure 7).



NOTE – The terms "source" and "destination" refer to the initiator and the recipient of the transport protocol data unit (TPDU), respectively. The value of the "source reference" is a local system parameter. The source reference of a received transport block is to be used as destination reference in the response to that transport block.

FIGURE 7/T.70

Transport layer block types

5.5.2.5 Parameter or TSDU field

5.5.2.5.1 A parameter field or a data field containing transport service (TS) user data may optionally follow the functional code field.

5.5.3 Concatenation

5.5.3.1 Concatenation of transport control and/or transport data blocks is currently not applicable to this Recommendation. However, where concatenation is used in the future, the arrangement shown in Figure 8 would apply.

5.5.4 Transport connection request (TCR) block format

5.5.4.1 Figure 9 illustrates the format of the TCR block.

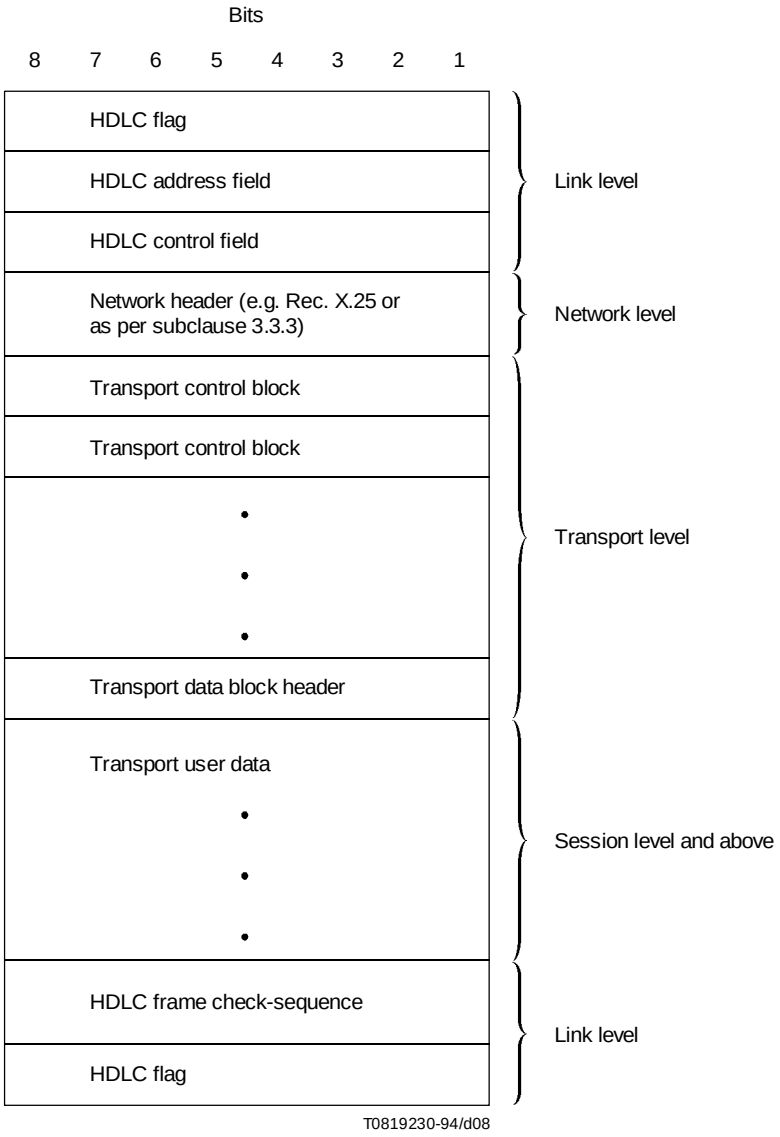
5.5.4.2 Parameters for extended addressing

Separate parameters are provided for the indication of called and calling extension addresses. The coding of these parameters is shown in Figure 10. The setting of bit 8 for extended addressing should be ignored by the transport layer.

The use of more than one called extension address is for further study.

5.5.4.3 Parameter for transport data block size negotiation

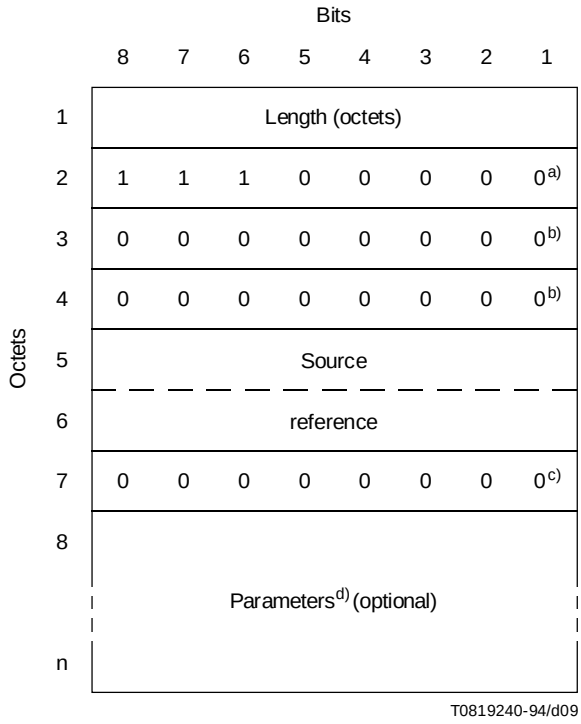
This parameter defines the proposed maximum transport data block size (in octets including the transport data block header) to be used over the requested transport connection. The coding of this parameter is shown in Figure 11.



NOTE – This figure does not imply that a transport data or control block will fit within a single network data block.

FIGURE 8/T.70

Information field structure of HDLC I-frame (example)



a) Block type: TCR.

b) Octets 3 and 4 are not used and shall be set to zero.

c) Transport service extension field: Octet 7 is reserved for any future extension such as providing for a range of transport service classes. In the basic transport service this octet shall be set to zero.

d) The parameter field is present only when the terminal is requesting an optional transport connection function.

FIGURE 9/T.70

Transport connection request block

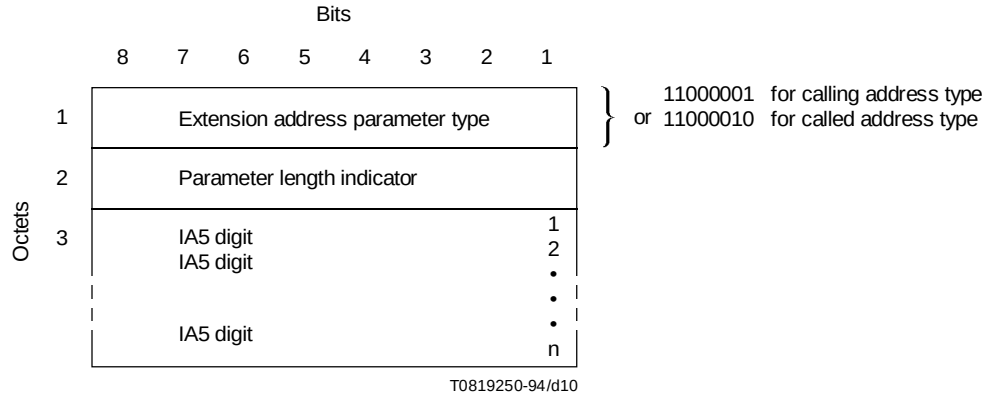


FIGURE 10/T.70

Extended addressing

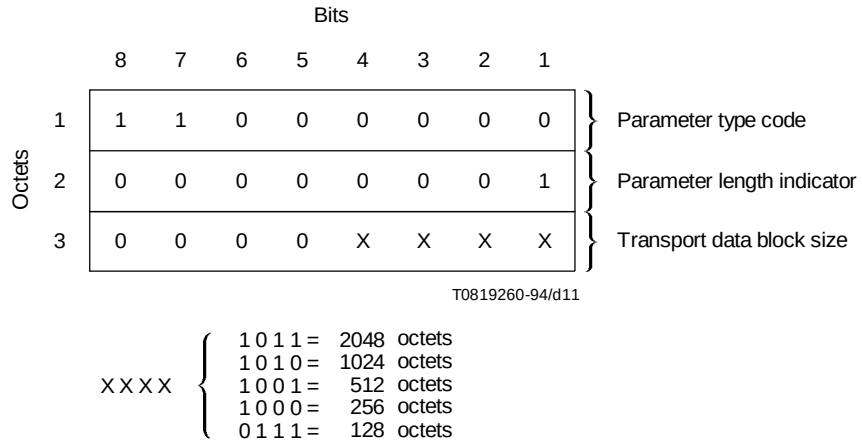
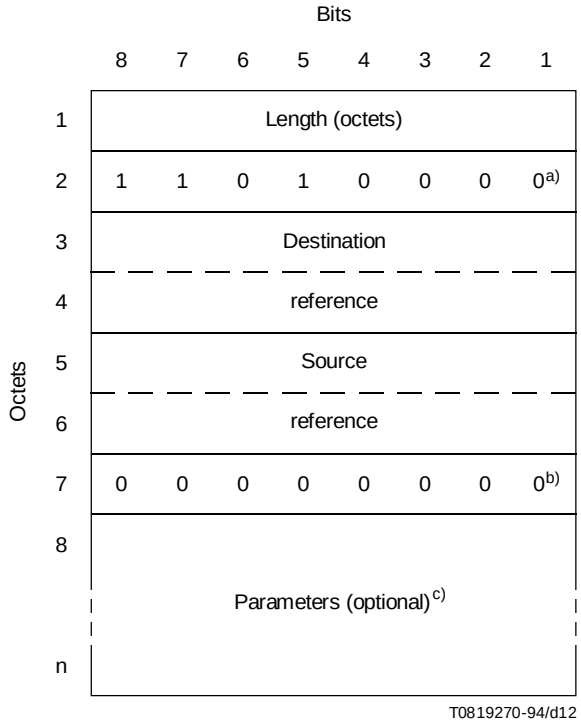


FIGURE 11/T.70

Transport data block size parameter

5.5.5 Transport connection accept (TCA) block format

5.5.5.1 Figure 12 illustrates the format of the TCA block.



a) Block type: TCA.

b) Transport service extension field; Octet 7 is reserved for any future extension such as providing for a range of transport service classes. In the basic transport service this octet shall be set to zero irrespective of the setting in the TCR block.

c) The parameter field is present only when the terminal is requesting or confirming an optional transport connection function.

FIGURE 12/T.70

Transport connection accept block

5.5.5.2 Parameters for extended addressing

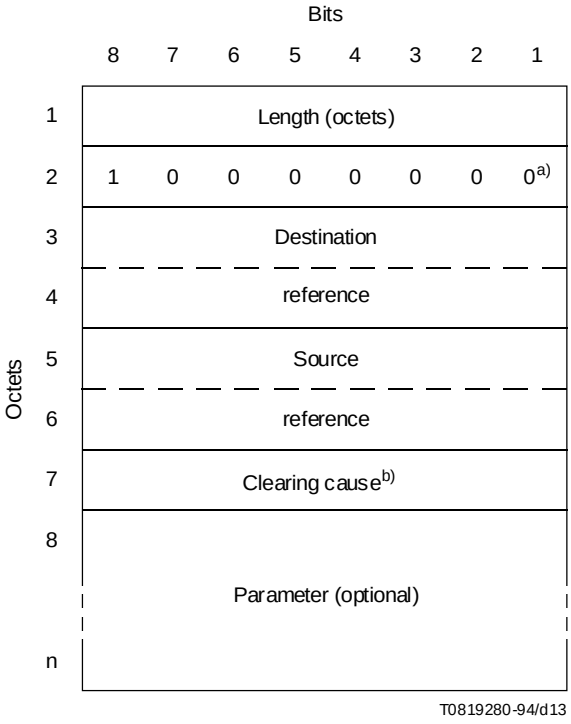
See 5.5.4.2.

5.5.5.3 Parameter for transport data block size negotiation

See 5.5.4.3. The parameter value shall be equal to or less than the value specified in the TCR block.

5.5.6 Transport connection clear (TCC) block format

5.5.6.1 Figure 13 illustrates the format of the TCC block.



a) Block type: TCC.

b) Clearing cause:

		Bits
		8 7 6 5 4 3 2 1
0 – Reason not specified	=	0 0 0 0 0 0 0 0
1 – Terminal occupied	=	0 0 0 0 0 0 0 1
2 – Terminal out of order	=	0 0 0 0 0 0 1 0
3 – Address unknown	=	0 0 0 0 0 0 1 1

FIGURE 13/T.70

Transport connection clear block

5.5.6.2 Parameter for additional clearing information

This parameter is provided to allow additional information relating to the clearing of the connection. The coding of this parameter is given in Figure 14.

5.5.7 Transport block reject (TBR) block format

5.5.7.1 Figure 15 illustrates the format of the TBR block.

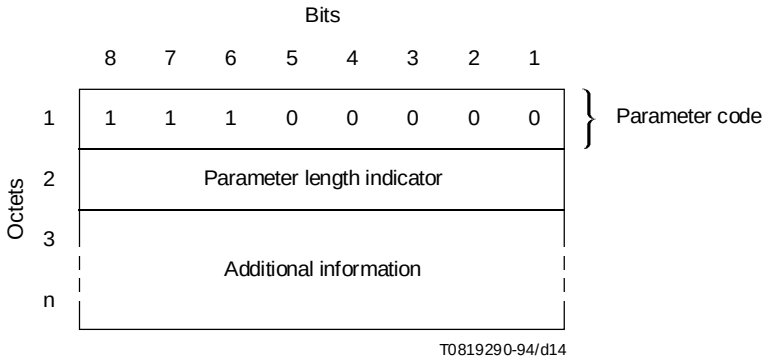
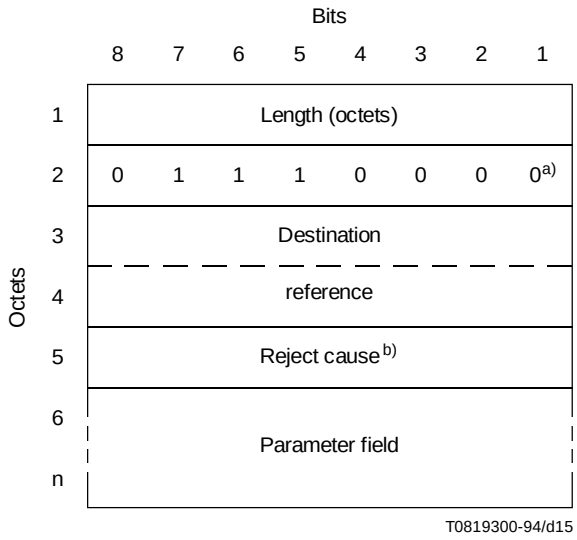


FIGURE 14/T.70

Additional clearing information parameter



a) Block type: TBR.

b) Reject cause:

		Bits 8 7 6 5 4 3 2 1
0 – Reason not specified	=	0 0 0 0 0 0 0 0
1 – Function not implemented	=	0 0 0 0 0 0 0 1
2 – Invalid block	=	0 0 0 0 0 0 1 0
3 – Invalid parameter	=	0 0 0 0 0 0 1 1

FIGURE 15/T.70

Transport block reject block

5.5.7.2 **Rejected block parameter** (mandatory)

This parameter is used to indicate the bit pattern of the rejected block up to and including the octet that caused the rejection. Only the first detected procedural error or parameter, which cannot be acted upon, shall be indicated by this method. The coding of this parameter is given in Figure 16.

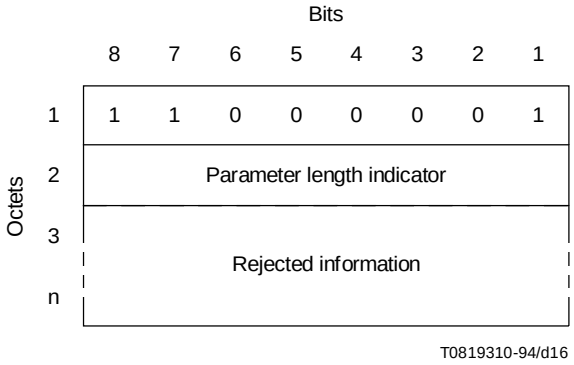
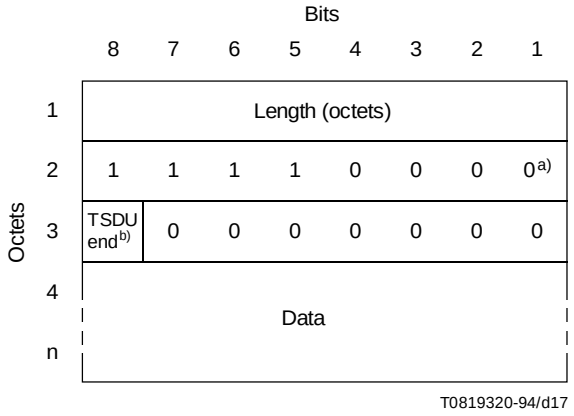


FIGURE 16/T.70

5.5.8 **Transport data block (TDT) format**

5.5.8.1 Figure 17 illustrates the format of the TDT block.



a) Block type: TDT.

b) TSDU end: indicates the end of TSDU when set to 1.

FIGURE 17/T.70

Transport data block

Annex A

(This annex forms an integral part of this Recommendation)

A.1 Transport and network service

The transport service (TS) is provided by the transport protocol (TP) making use of the services available from the network layer. This annex also defines the TS characteristics which the TS users may exploit.

Interactions between TS users and the TS provider take place at the two TS access points (TSAP) (see Figures A.1 to A.6). Information is passed between a TS user and a TS provider by means of primitives, which may convey parameters.

Primitives are abstract representations of interactions. They are solely descriptive and do not represent a specification or implementation.

The occurrence of a primitive is a logically instantaneous and indivisible event. The event occurs at a logically separate instant, which cannot be interrupted by another event. Only primitives of global significance are mentioned (having an impact on the remote user).

The following types of primitives are defined:

a) request primitive;

b) indication primitive;

c) response primitive;

d) confirm primitive.

The primitives a) and c) are directed from the service user to the service provider, b) and d) are going in the opposite direction.

“Transport” is designated by T, “Network” is designated by N. The terms CONNECT, DATA, DISCONNECT as part of a primitive name indicate that the primitive is used for establishment, data transfer, release of a transport connection (TC) or network connection (NC).

Examples:

T-CONNECT request	Request to establish a TC.
T-DATA request	Request to transmit TS user data.
N-DISCONNECT indication	Indication that the NC has been released.

The relationship between valid sequences of TS primitives and the appropriate protocol elements is shown in Figures A.1 to A.6. The sequences of valid network service (NS) primitives are illustrated in Figures A.7 to A.12.

A.1.1 Transport service

The interactions shown in Figures A.1 to A.6 are not exhaustive.

A.1.1.1 Transport connection establishment

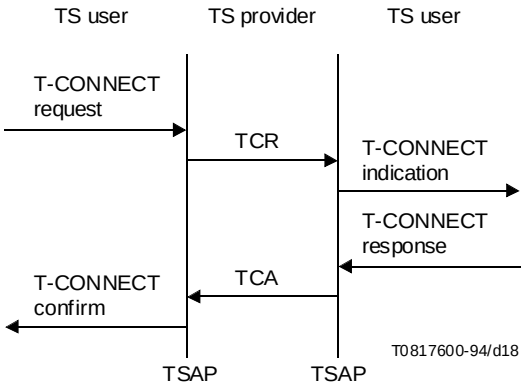


FIGURE A.1/T.70

Successful TC establishment

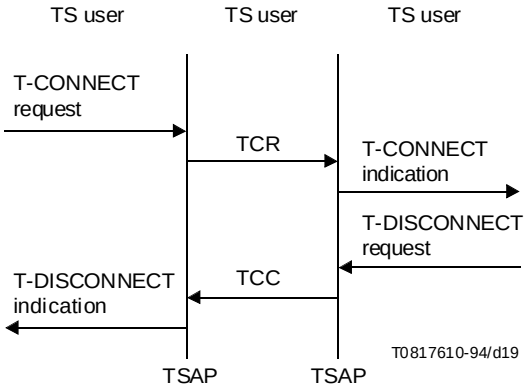
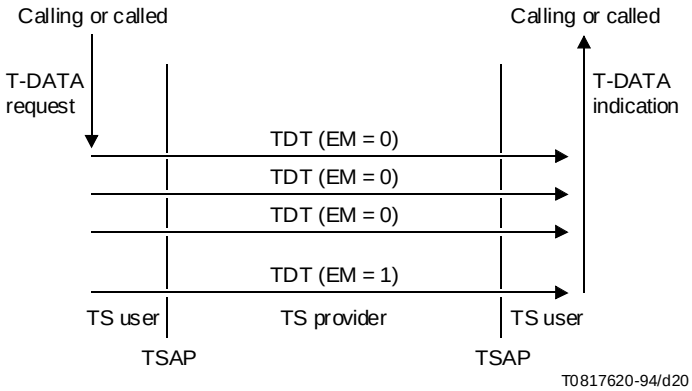


FIGURE A.2/T.70

Rejection of TC establishment by TS user

A.1.1.2 Transfer phase

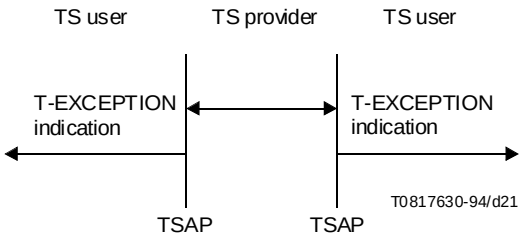


NOTE – This is one method of realizing segmenting/reassembling.

FIGURE A.3/T.70

T-DATA transfer

A.1.1.3 Transport service error reporting



NOTE – The use of this primitive is optional.

FIGURE A.4/T.70

Transport service error reporting

A.1.1.4 TC release

At present only the implicit release of TC is defined (see 5.2.4.1).

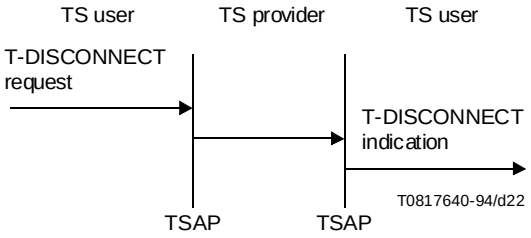


FIGURE A.5/T.70

TC release initiated by TS user

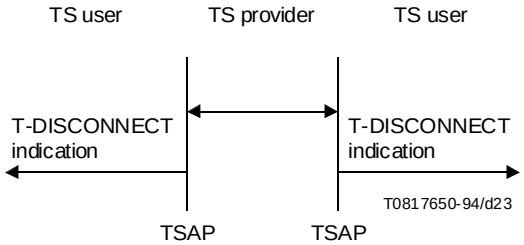


FIGURE A.6/T.70

TC release initiated by the TS provider

A.1.2 Network service

Figures A.7 to A.12 show the relationships of network service (NS) primitives at both sides of an NC.

A.1.2.1 Network connection establishment

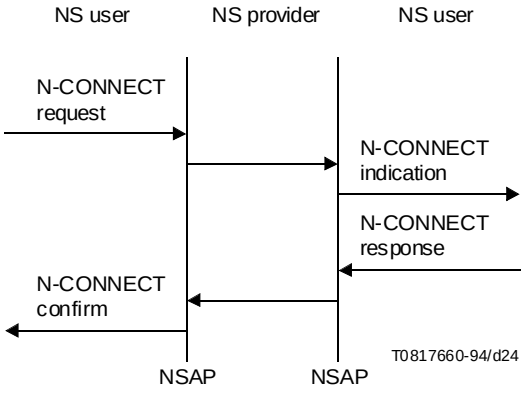


FIGURE A.7/T.70

Successful NC establishment

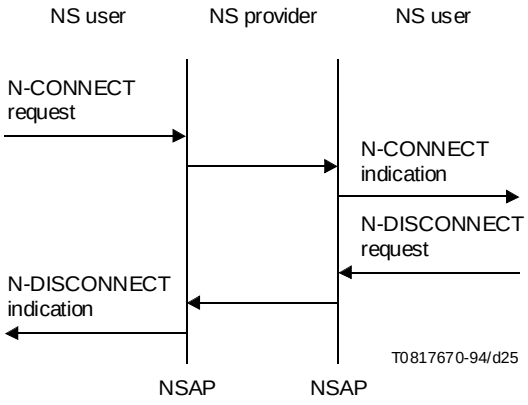


FIGURE A.8/T.70

Rejection of NC establishment by NS user

A.1.2.2 Network data transfer

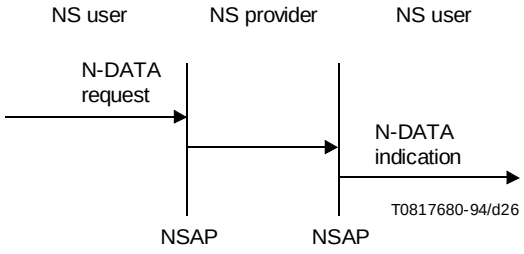


FIGURE A.9/T.70

N-DATA transfer

A.1.2.3 Network service error reporting

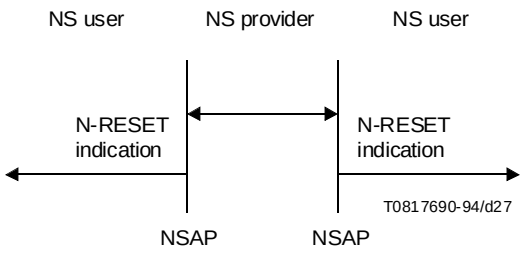


FIGURE A.10/T.70

Network service error reporting

A.1.2.4 Network connection release

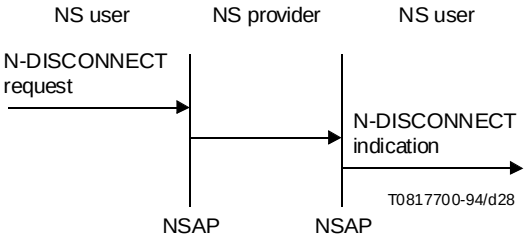


FIGURE A.11/T.70

NC release initiated by NS user

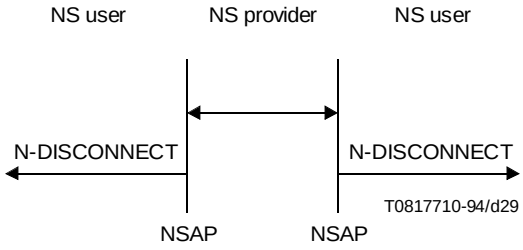


FIGURE A.12/T.70

NC release initiated by the NS provider

A.2 State transition diagrams for the basic transport layer procedures

This part represents detailed state transition diagrams for the basic transport procedures.

Two description levels are used:

a) *Protocol level*

This level addresses only the peer to peer protocol activities between two transport entities. It identifies the protocol state, events [receipt of transport protocol data units (TPDUs)] and actions (sending of TPDUs).

b) *Detailed level*

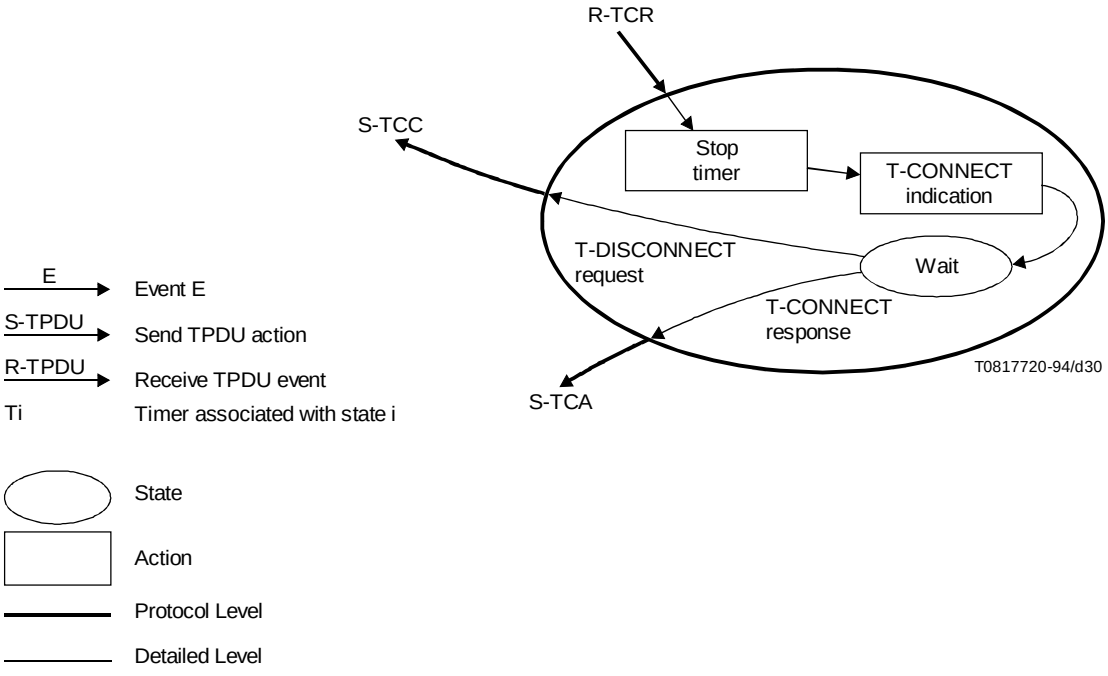
This level addresses the inter-layer and local activities. It identifies the events, actions, conditions and states within each of the protocol level states. The inter-layer activities are described using the transport service primitives defined in the first part of this annex.

Example (see Figure A.13).

For pure illustrative reasons, the example shows a simplified description of state 1 (response pending, called side) of the state transition diagram of this Recommendation. The event R-TCR may be answered either by sending the action S-TCA or S-TCC.

The events and actions are not interruptable. They will complete their transfer irrespective of the occurrence of other events.

The detailed state transition diagrams are given in Figures A.14 and A.15.

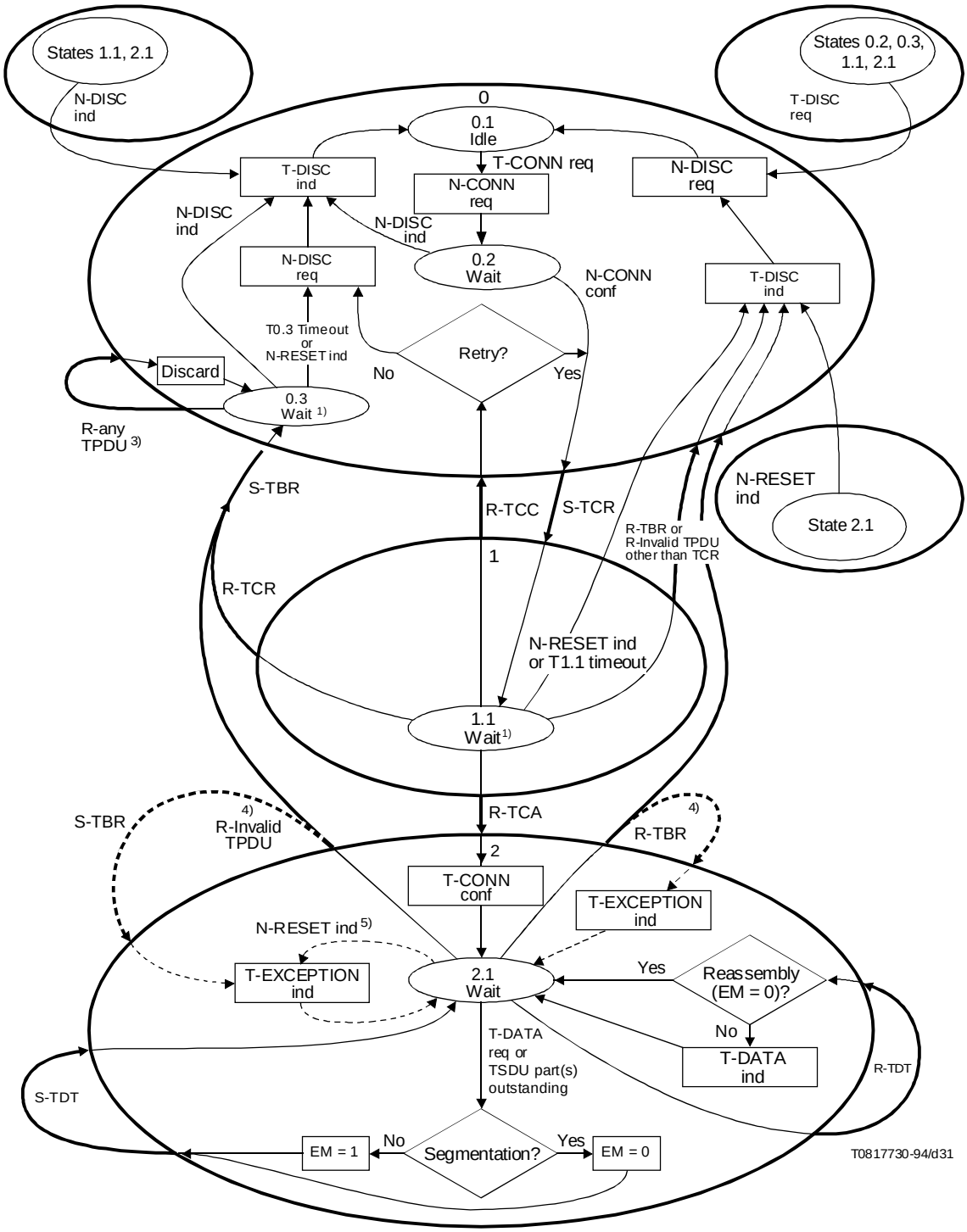


NOTES

1 Each TPDU is transferred by N-DATA request. The NSDU will contain the TPDU.

2 Each TPDU is received by N-DATA indication. The NSDU will contain the TPDU.

FIGURE A.13/T.70



1) States 0.3 and 1.1 have timers, T0.3 and T1.1 respectively. When entering any of these states the associated timer is started. The timer is stopped upon exit from the state [see 3)].

2) There are other valid methods for describing segmentation.

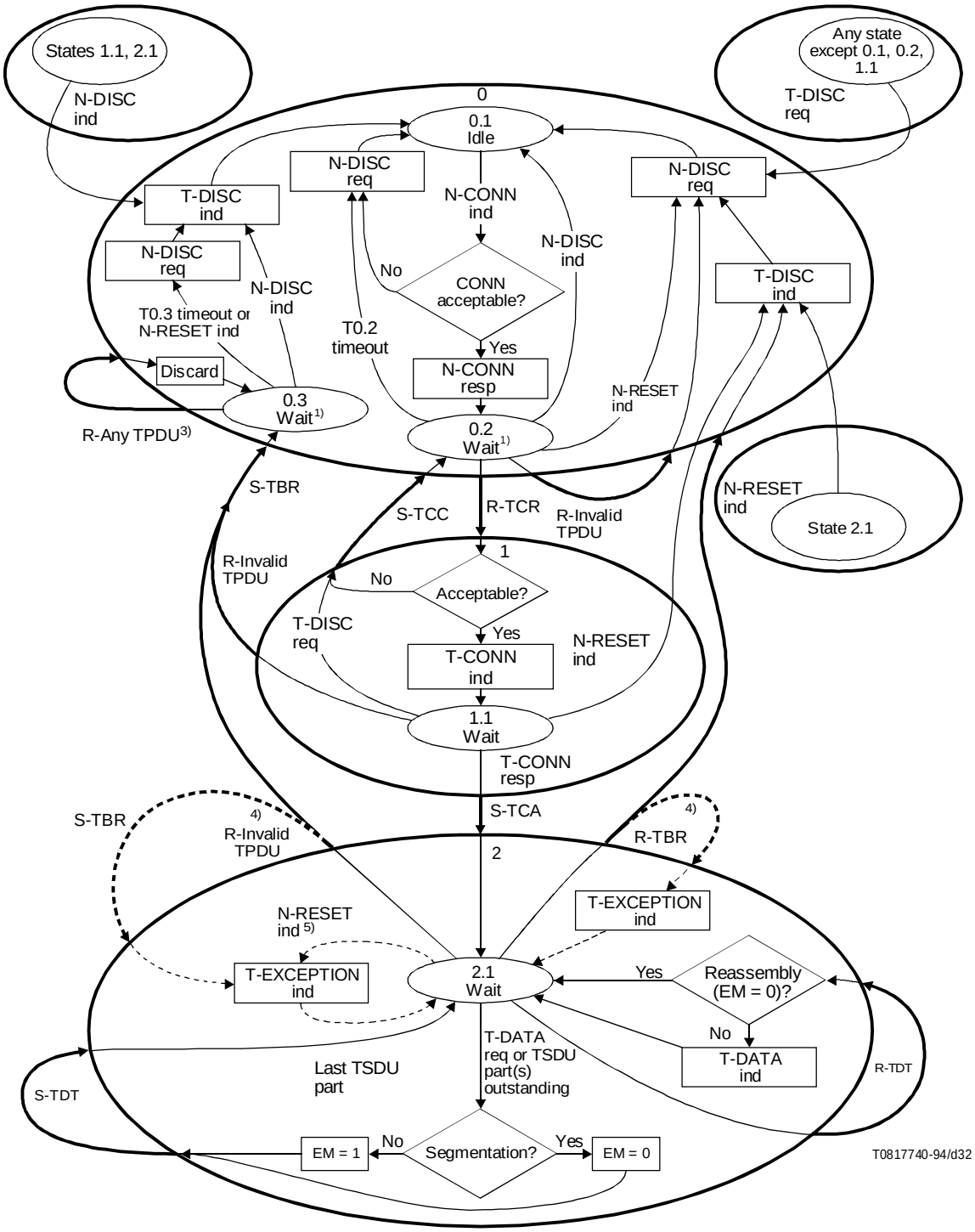
3) This state transition does not start/stop T0.3 timer.

4) Optional transition (shown in broken lines) if "T-EXCEPTION ind" is provided.

5) Optional transition (shown in broken lines) if "T-EXCEPTION ind" is provided. The use of this option is independent of the use of option 4) above.

FIGURE A.14/T.70

Teletex transport state transition diagram (calling side)



1) States 0.2 and 0.3 have timers, T0.2 and T0.3 respectively. When entering any of these states the asssociated timer is started. The timer is stopped upon exit from the state [see 3)].

2) There are other valid methods for describing segmentation.

3) This state transition does not start/stop T0.3 timer.

4) Optional transition (shown in broken lines) if "T-EXCEPTION ind" is provided.

5) Optional transition (shown in broken lines) if "T-EXCEPTION ind" is provided. The use of this option is independent of the use of option 4) above.

FIGURE A.15/T.70

Teletex transport transition diagram (called side)

Annex B

(This annex forms an integral part of this Recommendation)

B.1 State tables

The state tables:

B.1: Transport connection establishment, calling side

B.2: Transport connection establishment, called side

B.3: Data phase (symmetrical protocol)

present the transitions of the transport protocol in a table form in contrast to the diagram form to be seen in Annex A. While the diagrams are useful to overview the protocol mechanism the appropriate tables give clear information of which event is possible in which state and which actions are to be performed. Moreover each of the events and conditions is combined with a shortening in brackets (e.g.: E 5) which is a pointer to the 2nd part of this annex, so that the reader of these tables can easily come to know which meaning a certain event, action or condition has.

An impossible event related to a certain state can be recognized by an empty field in the crossing-point of the state and the event.

B.2 Lists of events, actions and conditions

The lists of events (Table B.4), actions (Table B.5) and conditions (Table B.6) intend to care for detailed explanations and clarification related to the protocol components (events, actions and conditions) found in the diagrams and tables.

All the components in the tables are accompanied by a list number (e.g. E 1, A 10, C 3, etc.) which can be interpreted as a pointer to the corresponding additional information in the lists. The letters E, A, C of the list numbers stand for Event, Action, Condition.

The following abbreviations are used:

EM	End Mark
LI	Length Indicator of the transport block (octet 1)
loc.	local
NC	Network Connection
NS	Network Service
NSDU	Network Service Data Unit
PLI	Parameter Length Indicator
TC	Transport Connection
TP	Transport Protocol
TPDU	Transport Protocol Data Unit
TS	Transport Service
TSDU	Transport Service Data Unit

AND, OR and NOT (used mainly in E 5) shall be considered as the known Boolean operators.

TABLE B.1/T.70

State table for calling side

	State			Idle												Waiting			
	Event			0.1				0.2				0.3				1.1			
No.	Local	Protocol event	Service primitive	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state
1.1		R-TCR (E 1)											Discard any R-TPDU (A 14)		0.3	STOP T1.1 (A 1) START T0.3 (A 2)	S-TBR (A 3)		0.3
1.2		R-TCC (E 2) Retry (C 1)													0.3	RESTART T1.1 (A 6)	S-TCR (A 7)		1.1
1.3		R-TCC (E 2) No retry (C 2)													0.3	STOP T1.1 (A 1)		N-DISC req (A 4) T-DISC ind (A 5)	0.1
1.4		R-TCA (E 3)													0.3	STOP T1.1 (A 1)		T-CONN conf (A 8)	2.1
1.5		R-TBR (E 4)													0.3	STOP T1.1 (A 1)		T-DISC ind (A 5) N-DISC req (A 4)	0.1
1.6		R-invalid TPDU (E 5)													0.3	STOP T1.1 (A 1)		T-DISC ind (A 5) N-DISC req (A 4)	0.1

TABLE B.1/T.70 *(end)*

State table for calling side

	State			Idle												Waiting			
	Event			0.1				0.2				0.3				1.1			
No.	Local	Protocol event	Service primitive	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state
1.7			T-CONN req (E 6)			T-CONN req (A 10)	0.2												
1.8			N-CONN conf (E 7)					START T1.1 (A 12)	S-TCR (A 7)		1.1								
1.9			N-DISC ind (E 8)							T-DISC ind (A 5)	0.1	STOP T0.3 (A 13)		T-DISC ind. (A 5)	0.1	STOP T1.1 (A 1)		T-DISC ind. (A 5)	0.1
1.10			N-RESET ind (E 9)									STOP T0.3 (A 13)		N-DISC req. (A 4) T-DISC ind. (A 5)	0.1	STOP T1.1 (A 1)		T-DISC ind. (A 5) N-DISC req. (A 4)	0.1
1.11			T-DISC req (E 10)							N-DISC req (A 4)	0.1	STOP T0.3 (A 13)		N-DISC req. (A 4)	0.1	STOP T1.1 (A 1)		N-DISC req. (A 4)	0.1
1.12	TIME OUT (E 11)											STOP T0.3 (A 13)		N-DISC req. (A 4) T-DISC ind. (A 5)	0.1	STOP T1.1 (A 1)		T-DISC ind. (A 5) N-DISC req. (A 4)	0.1

Req	Request	CONN	CONNECTION
Ind	Indication	DISC	DISCONNECTION
Conf	Confirmation		

TABLE B.2/T.70

State table for called side

	State			Idle												Waiting			
	Event			0.1				0.2				0.3				1.1			
No.	Local	Protocol event	Service primitive	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state
2.1		R-TCR (E 1) Acceptable (C 3)						STOP T0.2 (A 11)		T-CONN ind (A 15)	1.1		Discard any R-TPDU (A 14)		0.3				
2.2		R-TCR (E 1) Not acceptable (C 4)						RESTART T0.2 (A 16)	S-TCC (A 17)		0.2				0.3				
2.3		R-invalid TPDU (E 5)						STOP T0.2 (A 11)	N-DISC req (A 4)		0.1				0.3	START T0.3 (A 2)	S-TBR (A 3)		0.3
2.4			N-CONN ind (E 12) Acceptable (C 5)	START T0.2 (A 9)		N-CONN resp (A 22)	0.2												
2.5			N-CONN ind (E 12) Not acceptable (C 6)			N-DISC req (A 4)	0.1												
2.6			T-CONN resp (E 13)														S-TCA (A 24)		2.1
2.7			N-DISC ind (E 8)					STOP T0.2 (A 11)			0.1	STOP T0.3 (A 13)		T-DISC ind (A 5)	0.1			T-DISC ind (A 5)	0.1

TABLE B.2/T.70 *(end)*

State table for called side

	State			Idle												Waiting			
	Event			0.1				0.2				0.3				1.1			
No.	Local	Protocol event	Service primitive	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state	Local	Protocol action	Service primitive	Final state
2.8			N-RESET ind (E 9)					STOP T0.2 (A 11)		N-DISC req (A 4)	0.1	STOP T0.3 (A 13)		T-DISC ind (A 5) N-DISC req (A 4)	0.1			T-DISC ind (A 5) N-DISC req (A 4)	0.1
2.9			T-DISC req (E 10)									STOP T0.3 (A 13)		N-DISC req (A 4)	0.1	START T0.2 (A 9)	S-TCC (A 17)		0.2
2.10	TIME OUT (E 11)							STOP T0.2 (A 11)		N-DISC req (A 4)	0.1	STOP T0.3 (A 13)		T-DISC ind. (A 5) N-DISC req. (A 4)	0.1				

Req	Request	CONN	CONNECTION
Ind	Indication	DISC	DISCONNECTION
Resp	Response		

TABLE B.3/T.70

Data phase (symmetrical protocol)

	Event			State	Data phase			
					2.1			
	Local	Protocol event	Service primitive	Local	Protocol action	Service primitive	Final state
3.1		R-TDT (E 14) EM = 0 (C 7)					2.1
3.2		R-TDT (E 14) EM = 1 (C 8)				T-DATA ind (A 18)	2.1
3.3		R-TBR (E 4) Recovery (C 9)				T-EXCEPT ind (A 19)	2.1
3.4		R-TBR (E 4) No recovery (C 10)				T-DISC ind (A 5) N-DISC req (A 4)	0.1
3.5		R-invalid TPDU (E 5) Recovery (C 9)			S-TBR (A 3)	T-EXCEPT (A 19)	2.1
3.6		R-invalid TPDU (E 5) No recovery (C 10)		START T0.3 (A 2)	S-TBR (A 3)		0.3
3.7			T-DATA req (E 15) Segm. (C 11)		S-TDT (EM = 0) (A 20)		2.1
3.8			T-DATA req (E 15) No segm. (C 12)		S-TDT (EM = 1) (A 21)		2.1
3.9	TSDU part(s) outsand (E 16)	Segm. (C 11)			S-TDT (EM = 0) (A 20)		2.1
3.10		No segm. (C 12)			S-TDT (EM = 1) (A 21)		2.1
3.11			N-RESET ind (E 9) Recovery (C 9)			T-EXCEPT ind (A 19)	2.1
3.12			N-RESET ind (E 9) No recovery (C 10)			T-DISC ind (A 5) N-DISC req (A 4)	0.1
3.13			N-DISC ind (E 8)			T-DISC ind (A 5)	0.1
3.14			T-DISC ind (E 10)			N-DISC ind (A 4)	0.1

Ind	Indication	DISC	DISCONNECTION
Req	Request	EXCEPT	EXCEPTION

TABLE B.4/T.70

List of events

No.	Name	Type	Description
E 1	R-TCR	TP	Layer 4 receives via the NS N-DATA indication a TPDU including the transport block TCR.
E 2	R-TCC	TP	Layer 4 receives via the NS N-DATA indication a TPDU including the transport block TCC.
E 3	R-TCA	TP	Layer 4 receives via the NS N-DATA indication a TPDU including the transport block TCA.
E 4	R-TBR	TP	Layer 4 receives via the NS N-DATA indication a TPDU including the transport block TBR.
E 5	R-invalid TPDU	TP	Layer 4 receives via the NS N-DATA indication a TPDU whose validity check fails due to the following reasons: – syntactical errors – procedure errors 1. *Invalid TPDUs due to syntactical errors* 1.1 TCR: 1.1.1 The value of octet 1 (LI): 1.1.1.1 ≠ the number of the TCR block octets minus 1 OR 1.1.1.2 is greater than 127 OR 1.1.1.3 is smaller than 6 OR 1.1.2 see 1.6 1.2 TCA: 1.2.1 The value of octet 1 (LI): 1.2.1.1 ≠ the number of the TCA block octets minus 1 OR 1.2.1.2 is greater than 127 OR 1.2.1.3 is smaller than 6 OR 1.2.2 see 1.6 OR 1.2.3 The value of octet 3 (4 resp.) ≠ octet 5 (6 resp.) of the appropriate TCR block OR 1.2.4 The value of octet 7 ≠ 0 OR 1.2.5 The parameter “Transport Data Block Size” is present: 1.2.5.1 AND its value ≠ 07 (hexadecimal), in response to a TCR block without the transport data block size parameter OR 1.2.5.2 AND its value does not respond to the rules according to subclause 5.2.3.2 OR 1.2.5.3 AND its value is different from the values (hexadecimal): 07, 08, 09, 0A, 0B OR 1.2.5.4 AND the PLI > 1 OR 1.2.6 $LI \neq 6 + 2N + \sum_{i=1}^{N} PLI$ where N is the number of parameters 1.3 TCC: 1.3.1 The value of the LI (octet 1): 1.3.1.1 ≠ the number of the TCC block octets minus 1 OR 1.3.1.2 is greater than 127 OR 1.3.1.3 is smaller than 6 OR 1.3.2 see 1.6 OR 1.3.3 The value of octet 3 (4 resp.) ≠ octet 5 (6 resp.) of the appropriate TCR block OR 1.3.4 $LI \neq 6 + 2N + \sum_{i=1}^{N} PLI$ where N is the number of parameters 1.4 TBR: (also see subclause 5.4.1, Note 1) 1.4.1 The value of the LI: 1.4.1.1 ≠ the number of the TBR block octets minus 1 OR 1.4.1.2 is greater than 127 OR 1.4.1.3 is smaller than 7 OR 1.4.2 see 1.6 OR

TABLE B.4/T.70 *(continued)*

List of events

<table>
<tr><th>No.</th><th>Name</th><th>Type</th><th>Description</th></tr>
<tr><td>E 5</td><td>R-invalid TPDU</td><td>TP</td><td>1.4.3 The value of octet 3 (4 resp.) ≠ octet 5 (6 resp.) of the appropriate TC establishment block (TCR resp. TCA) received from the peer entity OR
1.4.4 The value of LI minus 6 ≠ value of the PLI OR
1.4.5 The Rejected block parameter is not present
1.5 TDT:
1.5.1 The value of the LI ≠ 2 OR
1.5.2 The TSDU end mark is 0 AND the information field is empty OR
1.5.3 The TDT block size is larger than negotiated in the establishment phase
1.6 No identified block:
The value of the TPDU octet 2 is not equal to one of the following values (hexadecimal): EX, DO, 80, 70, FO.
X may be in the range of 0 ≤ X ≤ F
2. Invalid TPDUs due to procedure errors
Failure cases:
2.1 After S-TCR:
2.1.1 NOT R-TCA OR
2.1.2 NOT R-TCC OR
2.1.3 NOT R-TBR OR
2.2 After S-TCA:
2.2.1 NOT R-TDT OR
2.2.2 NOT R-TBR OR
2.3 After S-TDT:
2.3.1 Not R-TDT OR
2.3.2 Not R-TBR OR
2.4 After S-TCC: NOT R-TCR OR
2.5 After S-TBR: NOT R-TDT (in state 2.1) OR
2.6 After R-TDT (EM = 1): R-empty TDT (EM = 1) OR
2.7 After R-empty (EM = 1): R-empty TDT (EM = 1) OR
2.8 After N-CONNECT response: NOT R-TCR</td></tr>
<tr><td>E 6</td><td>T-CONNECT request</td><td>TS</td><td>Layer 5 requests a TC from layer 4.</td></tr>
<tr><td>E 7</td><td>N-CONNECT confirm</td><td>NS</td><td>Affirmative answer to N-CONNECT request (A 10); an NC is existing now.</td></tr>
<tr><td>E 8</td><td>N-DISCONNECT indication</td><td>NS</td><td>Report from layer 3 to layer 4 that the NC is not existing (any more).</td></tr>
<tr><td>E 9</td><td>N-RESET indication</td><td>NS</td><td>Indication to layer 4 that an error has occurred in layer 1, 2 or 3, possibly with data loss. The NC is kept existing.</td></tr>
<tr><td>E 10</td><td>T-DISCONNECT request</td><td>TS</td><td>Layer 5 requests a TC clearing from layer 4.</td></tr>
<tr><td>E 11</td><td>TIMEOUT</td><td>loc.</td><td>The timer presently surveying a state reached its limit. Following value ranges are defined:
<table><tr><td></td><td colspan="2">Values</td></tr><tr><td>States</td><td>Calling side</td><td>Called side</td></tr><tr><td>0.2</td><td>Not applicable</td><td>45 s ± 30 s</td></tr><tr><td>0.3</td><td>6 s ± 4 s</td><td>6 s ± 4 s</td></tr><tr><td>1.1</td><td>45 s ± 30 s</td><td>Not applicable</td></tr></table></td></tr>
</table>

TABLE B.4/T.70 *(end)*

List of events

No.	Name	Type	Description
E 12	N-CONNECT indication	NS	Indication to layer 4 by the layer 3 that an NC is being established; the answer to this is N-CONNECT response (A 22) or N-DISCONNECT request (A 4).
E 13	T-CONNECT response	TS	Affirmative answer by the layer 5 to T-CONNECT indication (A 15).
E 14	R-TDT	TP	Layer 4 receives via the NS N-DATA indication, an NSDU including the transport block TDT.
E 15	T-DATA request	TS	Layer 5 requests the transmission of data. Whether this is a complete TSDU or not, is a local matter, and not subject of this definition.
E 16	TSDU part(s) outstanding	loc.	Layer 4 is ready to send the next TDT block.

TABLE B.5/T.70

List of actions

No.	Name	Type	Description
A 1	STOP Timer T1.1	loc.	Timer T1.1 surveying the state 1.1 is stopped.
A 2	START Timer T0.3	loc.	Timer T0.3 surveying the state 0.3 is started after having been reset.
A 3	S-TBR	TP	Via the NS N-DATA request an NSDU including the transport block TBR is sent to the peer entity.
A 4	N-DISCONNECT request	NS	Layer 4 requests the layer 3 to release the offered or existing NC.
A 5	T-DISCONNECT indication	TS	Layer 5 is informed by the layer 4 that the TC being established or existing is cleared.
A 6	RESTART T1.1	loc.	Timer T1.1 surveying the state 1.1 is reset and started again. Moreover, it is necessary either to limit the number of T1.1-restarts or to limit the sum of all the times of T1.1; otherwise, an infinite loop S-TCR – R-TCC – S-TCR – etc., would be allowed.
A 7	S-TCR	TP	Via the NS N-DATA request an NSDU including the transport block TCR is sent to the peer entity.
A 8	T-CONNECT confirm	TS	Affirmative answer to the event T-CONNECT request (E 6) indicating that the data phase of the TC has been entered.
A 9	START T0.2	loc.	Timer T0.2 surveying the state 0.2 is started after having been reset.
A 10	N-CONNECT request	NS	Layer 4 requests the layer 3 for an NC to be established.
A 11	STOP T0.2	loc.	Timer T0.2 surveying the state 0.2 is stopped.
A 12	START T1.1	loc.	Timer T1.1 surveying the state 1.1 is started after having been reset.
A 13	STOP T0.3	loc.	Timer T0.3 surveying the state 0.3 is stopped.
A 14	DISCARD any R-TPDU	TS	Any data received by N-DATA indication are discarded. The transmission of further data is stopped.
A 15	T-CONNECT indication	TS	Layer 4 indicates a request for a TC-establishment to the layer 5.
A 16	RESTART T0.2	loc.	Timer T0.2 surveying the state 0.2 is reset and started again.
A 17	S-TCC	TP	Via the NS N-DATA request, an NSDU including the transport block TCC is sent to the peer entity.
A 18	T-DATA indication	TS	Layer 4 indicates the receipt of a complete TSDU to the layer 5. How and when the contents are transferred is a local matter, and therefore, not shown here.
A 19	T-EXCEPTION indication	TS	Layer 5 is informed of an error which occurred between the layer 1 and layer 4, possibly with data loss; the TC is kept existing. Due to this error it is possible that the following TSDU transferred to the layer 5 contains errors or deficiencies.
A 20	S-TDT (EM = 0)	TP	A TPDU with TSDU end mark set to 0 is sent to the peer entity and further parts of the TSDU will follow (i.e. segmenting occurs).
A 21	S-TDT (EM = 1)	TP	See A 20, but the TSDU end mark is set to 1 (i.e. this TPDU contains a complete TSDU or the last part of a TSDU).
A 22	N-CONNECT response	NS	Affirmative answer to N-CONNECT indication (E 12).
A 23	S-TBR	TP	The called side sends a TBR block to the calling side in order to point to a received failure TPDU. In this case the destination reference can be set to 0.
A 24	S-TCA	TP	Via the NS N-DATA request an NSDU including the transport block TCA is sent to the peer entity.

TABLE B.6/T.70

List of conditions

No.	Name	Description
C 1	Retry	The TC establishment is tried once more.
C 2	No retry	NOT C 1
C 3	TC acceptable	The TC offered by the peer entity is accepted by the layer 4 due to local circumstances.
C 4	TC not acceptable	NOT C 3
C 5	NC acceptable	The NC offered by the layer 3 is accepted by the layer 4 due to local circumstances.
C 6	NC not acceptable	NOT C 5
C 7	EM = 0	TSDU end mark of the TDT block is 0
C 8	EM = 1	TSDU end mark of the TDT block is 1
C 9	Recovery	The terminal provides the TS T-EXCEPTION indication
C 10	No recovery	NOT C 9
C 11	Segmentation	The TSDU received from layer 5 is longer than the negotiated TDT block size and has, therefore, to be segmented and consequently, to be reassembled on the receiver side.
C 12	No segmentation	NOT C 11

Annex C

Recommendations for implementation of Recommendation X.21

(This annex forms an integral part of this Recommendation)

C.1 General

This Annex deals with recommended actions to be taken by a telematic DTE in relation to the receipt of call progress (CP) signals from the network and in relation to the handling of optional user facilities. The adherence to these recommendations is not mandatory in order to conform to this Recommendation but may be of importance for the performance of the DTE.

Telematic terminals are in general assumed to make automatic repeated call attempts and sequential automatic calls to a number of addresses for which the following actions apply.

C.2 Receipt of call progress signals 01 or 04

When one of the CPS 01 or 04 is received the DTE should use the timer T3B and wait up to 60s for the completion of the call.

C.3 Receipt of call progress signal 03

The DTE should use either timer T3A or T3B in this case, depending on the time the DTE is prepared to wait for the completion of the call. Observe that the queuing time is charged as communication time in some networks.

C.4 Receipt of call progress signals of the group 2 to 8

See Table C.1.

NOTE – Some networks charge for call attempts, when the call is unsuccessful due to the condition of the called DTE. Examples of such situations are the receipt of the call progress signals 21 (busy) and 45 (controlled not ready).

TABLE C.1/T.70

Code group/Code	Delay for reattempts (s)	Number of reattempts	Delay between series of reattempts (s)
2, 6	≥ 5	≤ 7	≥ 60
41, 42, 43, 48 5, 8	≥ 5	≤ 1	Reattempts are not recommended
44, 45, 46, 47, 49 7	≥ 5	≤ 1	≥ 600

Annex D

Service definitions and state transition diagrams for the HDLC procedure and the network layer defined for CSPDN

(This annex forms an integral part of this Recommendation)

D.1 Service definitions

D.1.1 Physical service used by HDLC

See Figure D.1.

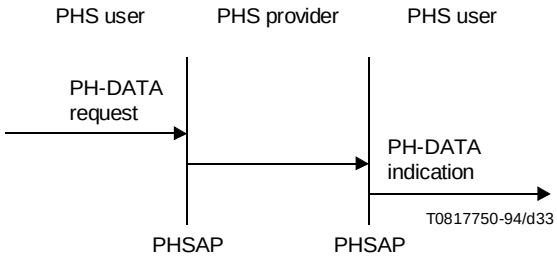


FIGURE D.1/T.70

PH-data-transfer

D.1.2 Data link service (HDLC)

D.1.2.1 Data link connection establishment

See Figures D.2 and D.3.

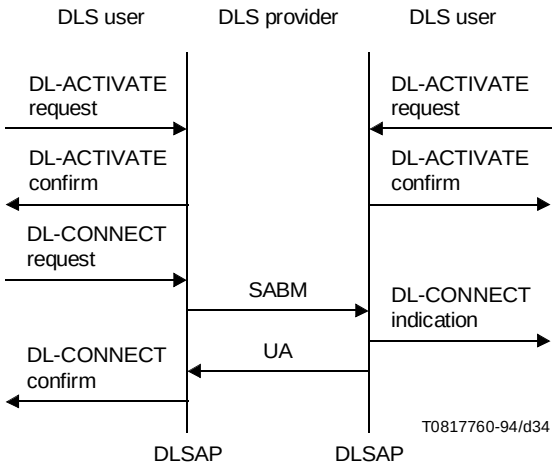


FIGURE D.2/T.70

Successful DLC-establishment

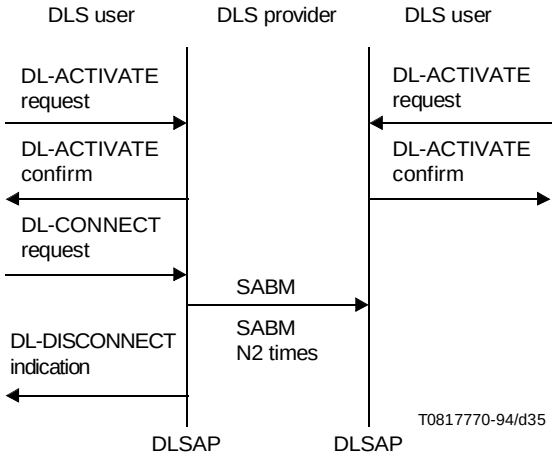


FIGURE D.3/T.70

Not successful DLC-establishment

D.1.2.2 Data link transfer phase

See Figure D.4.

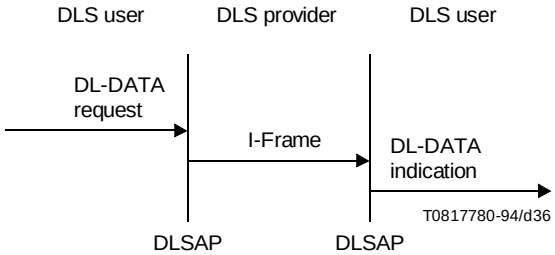


FIGURE D.4/T.70

DL-data transfer

D.1.2.3 Data link release

See Figures D.5 and D.6.

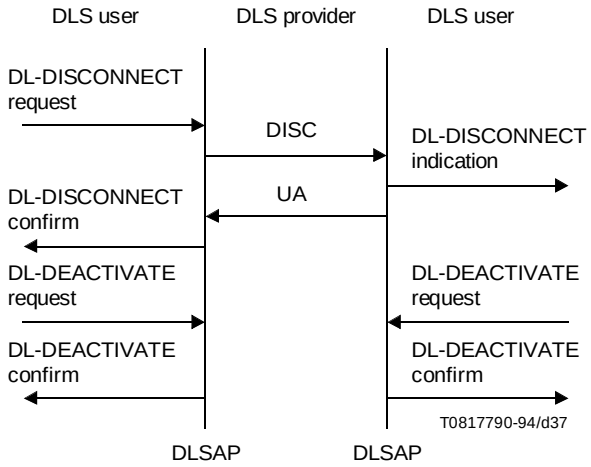


FIGURE D.5/T.70

DL-release initiated by DL-user

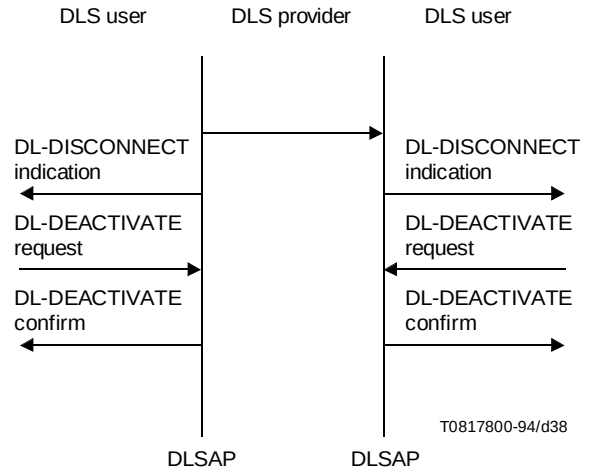


FIGURE D.6/T.70

DL-release initiated by DL-provider

D.1.2.4 Data link resetting

See Figures D.7 to D.10.

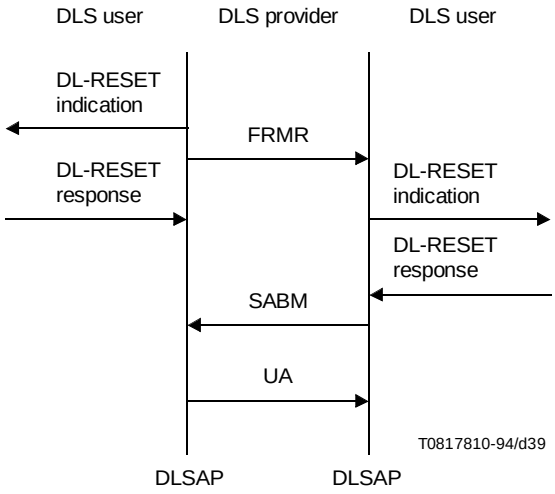


FIGURE D.7/T.70

Successful resetting

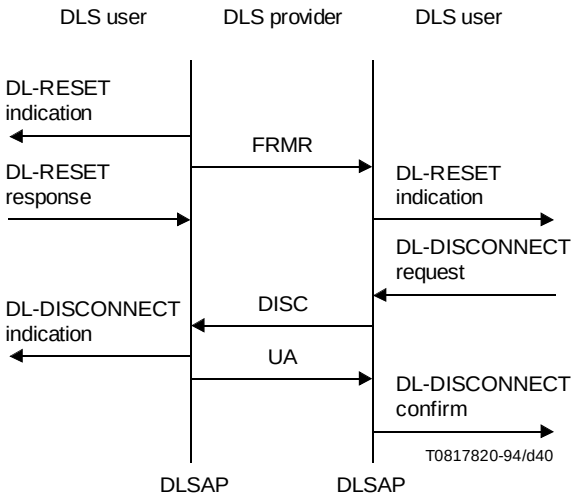


FIGURE D.8/T.70

Resetting not accepted by the receiver of FRMR

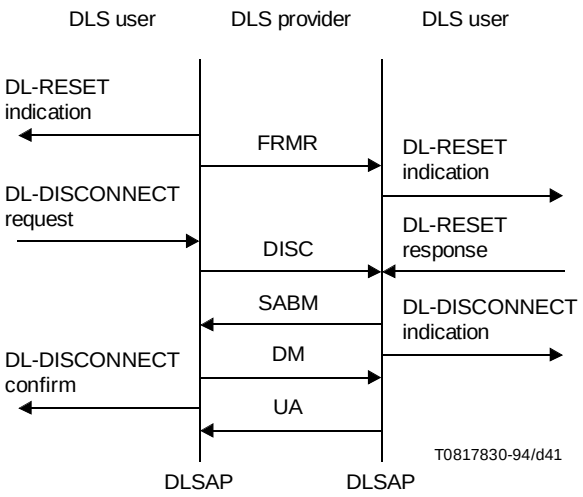


FIGURE D.9/T.70

Resetting not supported by the transmitter of FRMR

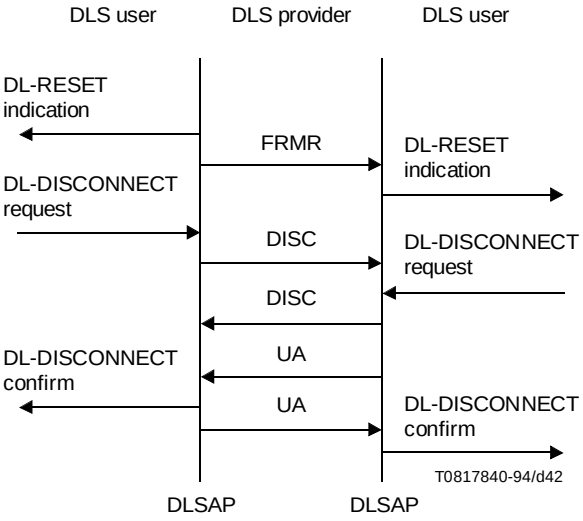


FIGURE D.10/T.70

Resetting not accepted by both

D.2 State transition diagrams HDLC

D.2.1 The relation between the diagrams

The following diagrams (See Figures D.11 to D.16) describe the HDLC procedure as one functional unit. The first page comprises the whole protocol and the following page gives the details to specific states.

D.2.2 Abbreviations

ABM	Asynchronous balanced mode
ADM	Asynchronous disconnected mode
R:xxx	Receive xxx (command or response)
R:Cxxx	Receive a command
R:Rxxx	Receive a response
S:xxx	Send xxx
F	Final bit
P	Poll bit
XXX	Not this condition
RC	Redrive counter
RCB	Redrive counter busy
IC	I-Frame counter
V_{su}	Variable for sequence updating

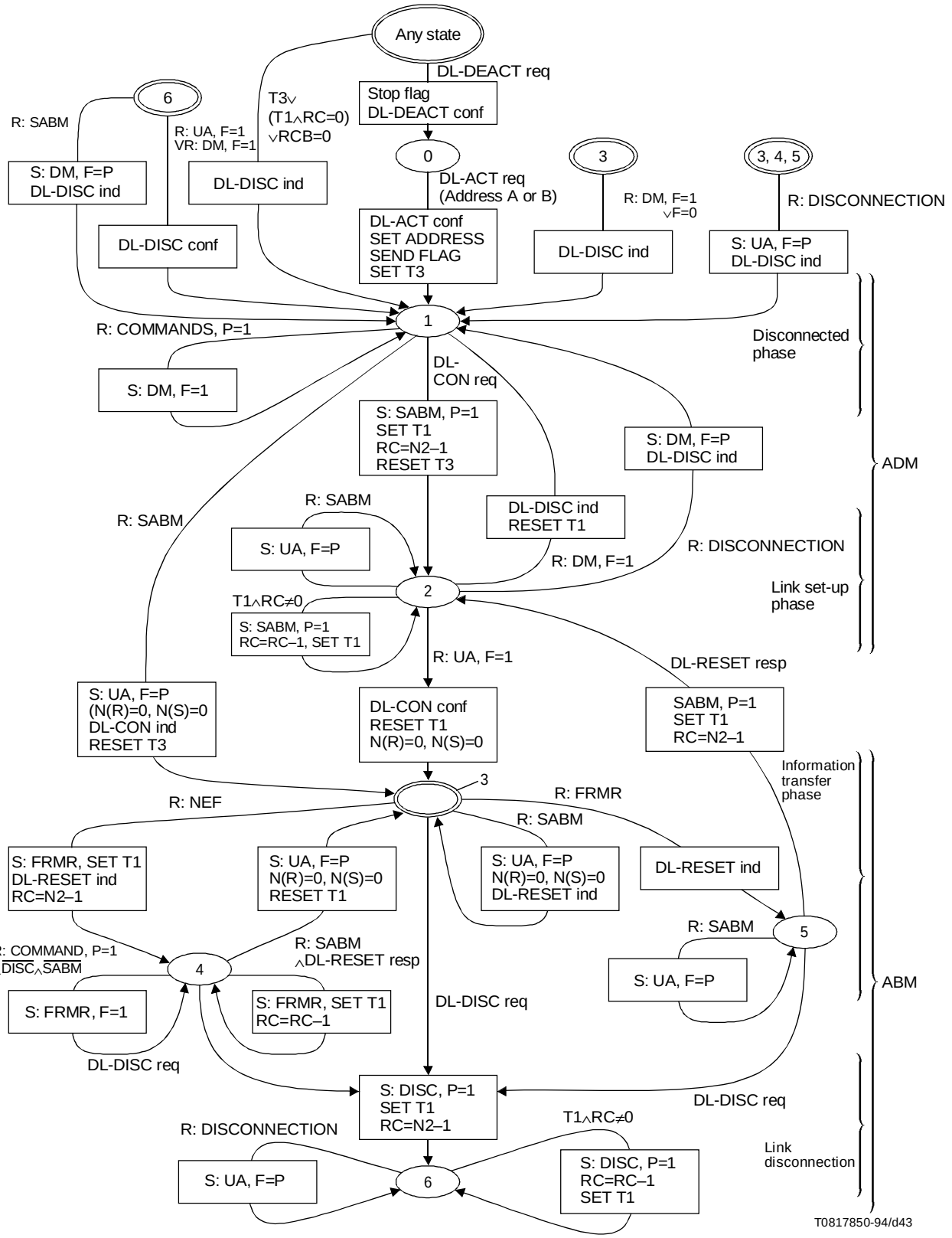
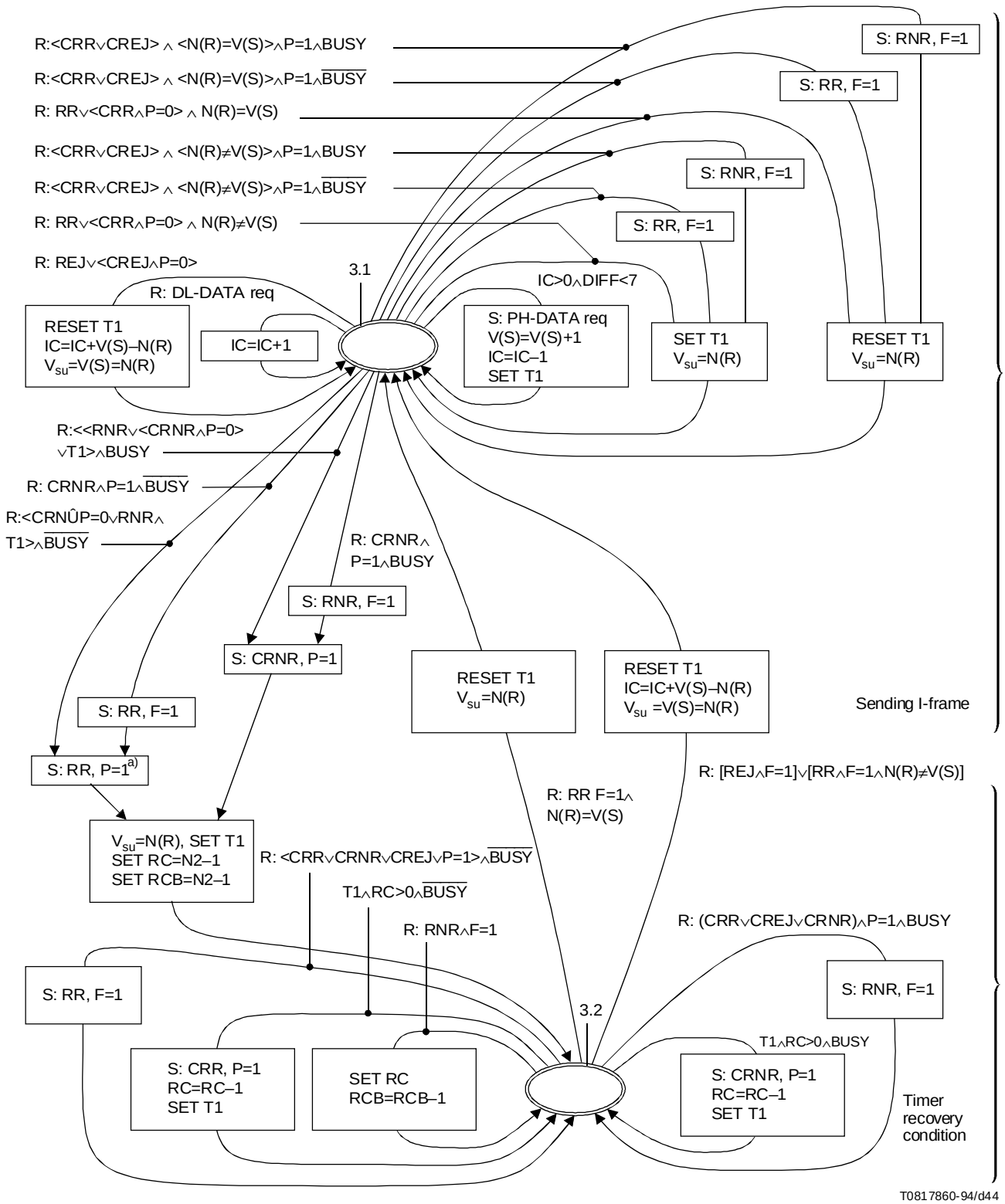


FIGURE D.11/T.70

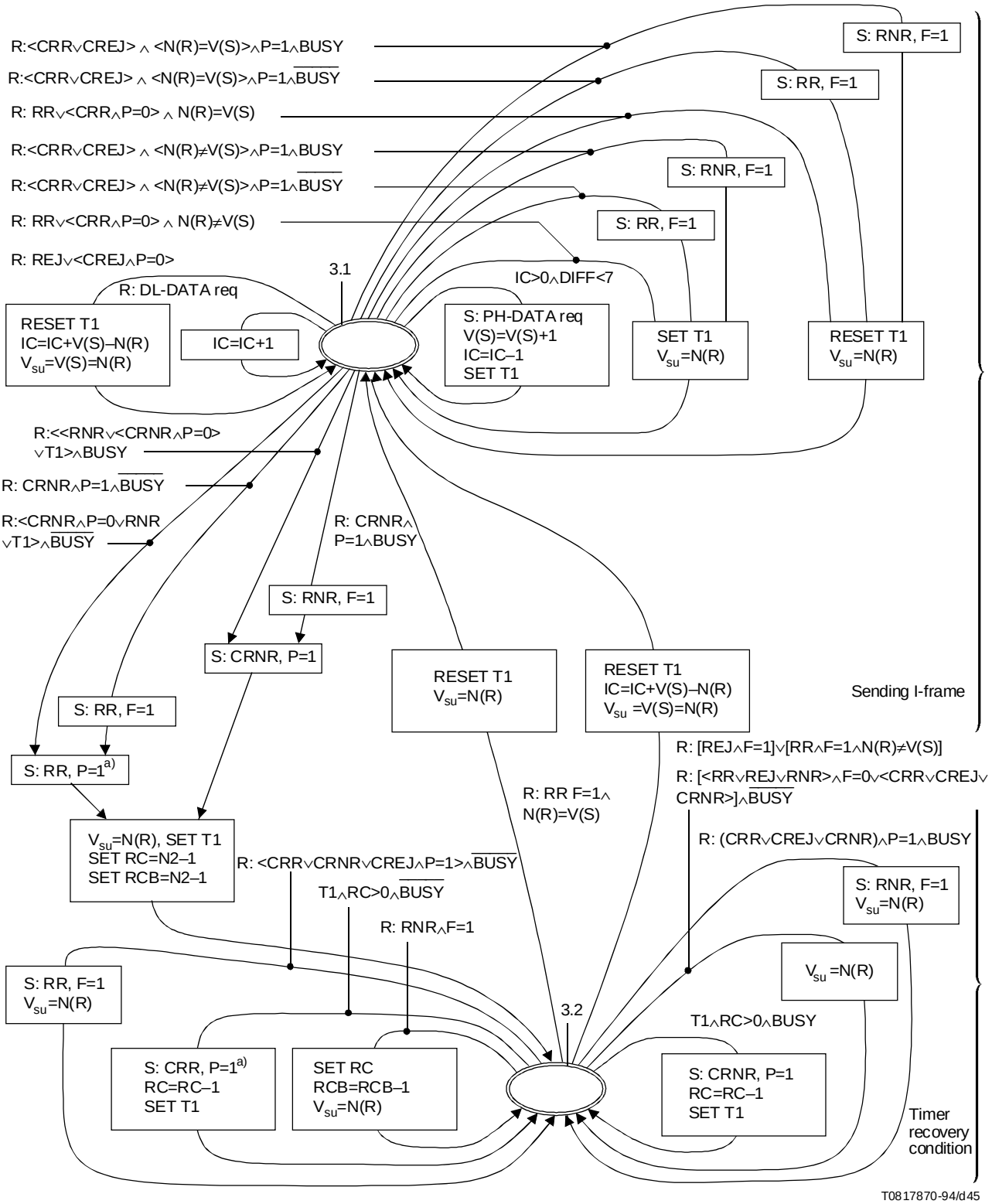
State transition diagram HDLC
(Data link control)



a) Alternatively to RR, P = 1 it is allowed to send PH-DATA req P = 1 or CREJ, P = 1.

FIGURE D.12/T.70

State transition diagram HDLC
(3 information transfer phase, I-frame control)



a) Alternatively to RR, P = 1 it is allowed to send PH-DATA req P = 1 or CREJ, P = 1.

FIGURE D.13/T.70

State transition diagram HDLC
(3 information transfer phase, I-frame control with update of N(R)
in timer recovery condition)

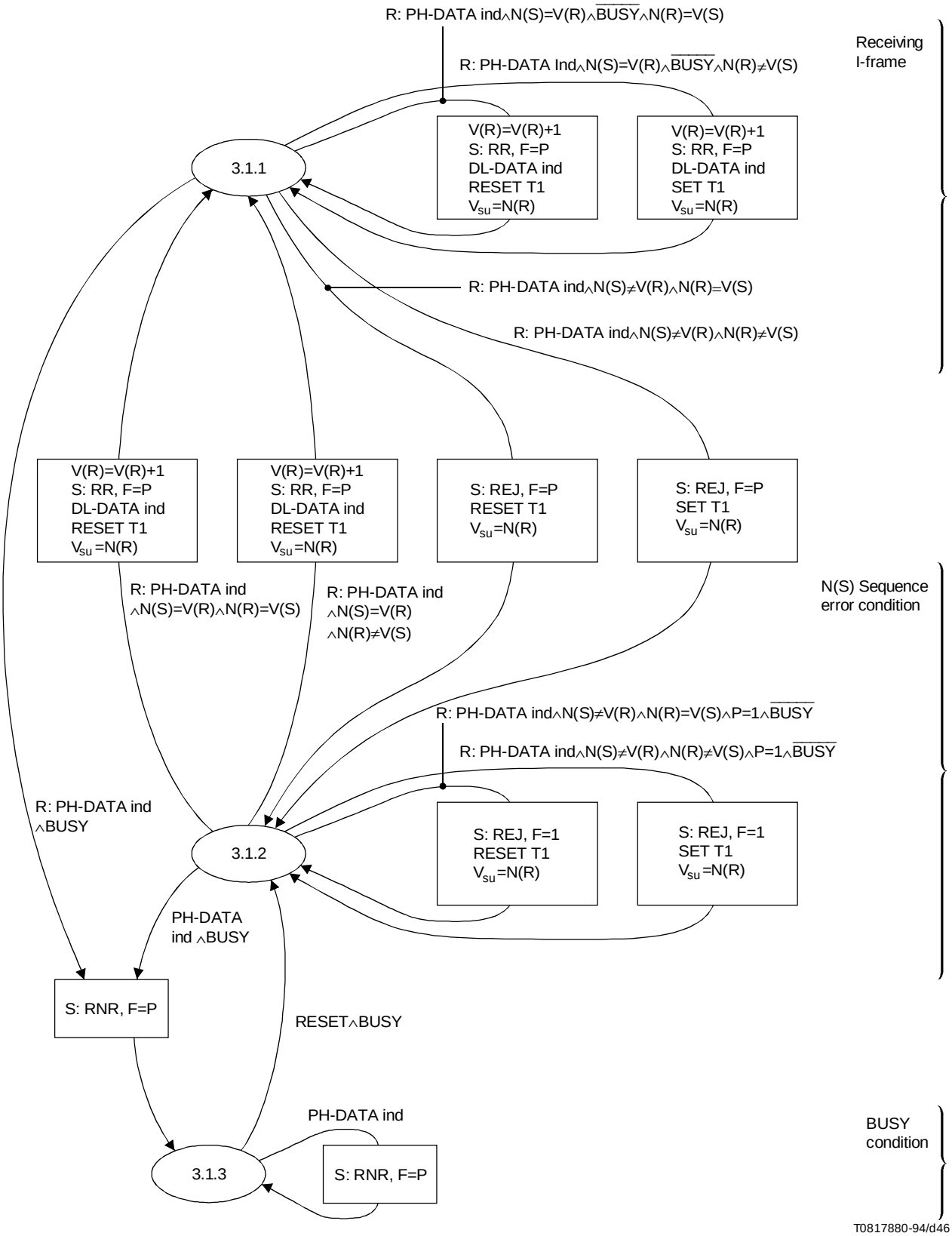


FIGURE D.14/T.70

State transition diagram HDLC
(3.1 information transfer phase, I-frame acknowledgement)

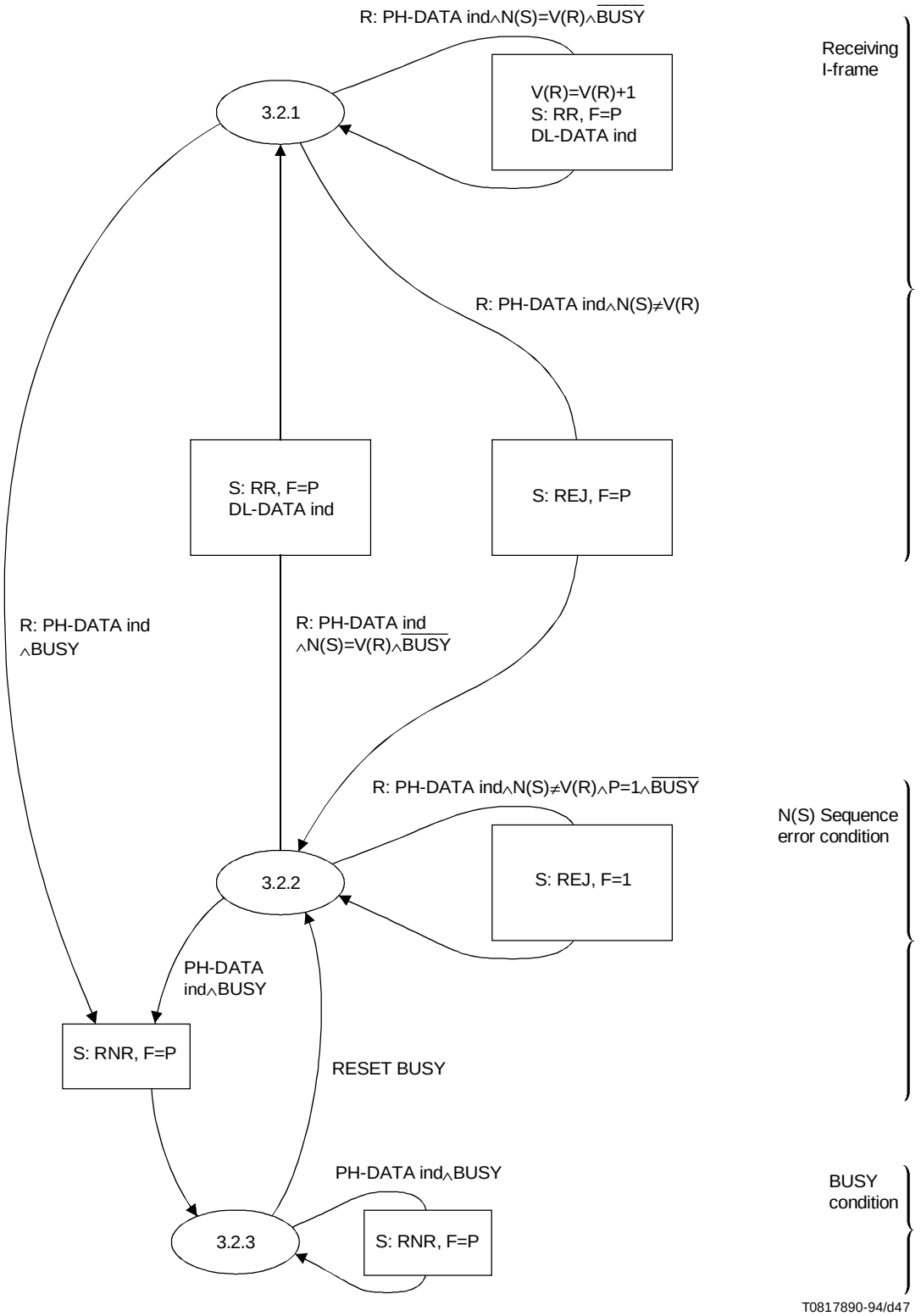


FIGURE D.15/T.70

State transition diagram HDLC
(3.2 information transfer phase, I-frame acknowledgement in exceptional conditions)

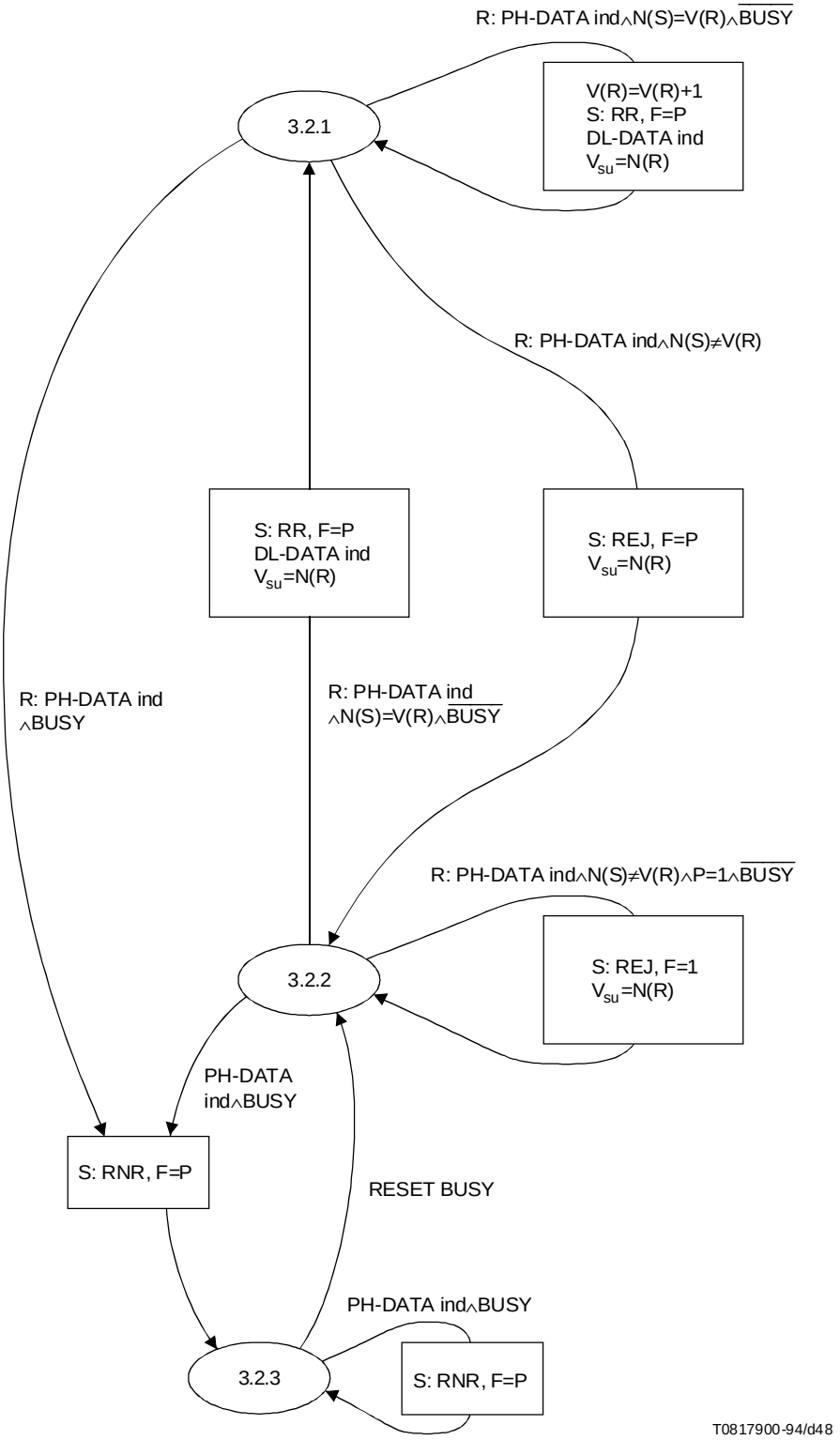


FIGURE D.16/T.70

State transition diagram HDLC
[3.2 information transfer phase, I-frame acknowledgement in exceptional conditions with update of N(R)]

D.3 Summary of frame definitions

D.3.1 Invalid frame

- frames not properly bounded by flags;
- frames containing addresses other than A or B;
- frames with frame check sequence (FCS) error;
- frames containing less than 32 bits between blags.

D.3.2 Valid frames

D.3.2.1 Not expected frames

NEF, not expected frames (for the receiver) which lead to a frame reject condition (excluding frames with an FRMR control field):

– a command or response control field that is undefined or not implemented;	Type W
– a frame with an information field which is not permitted or supervisory or unnumbered frame with incorrect length;	Type X
– an I-frame with an information field which exceeds the maximum established length;	Type Y
– a frame with an invalid N (R).	Type Z

D.3.2.2 Expected frames

- frames which must lead to a reaction (in accordance with the Recommendation) by the receiving station;
- frames which must be ignored only in determined states by the receiving station.

D.4 X.21 service, controlled by the network layer

D.4.1 X.21 connection establishment

See Figures D.17 and D.18.

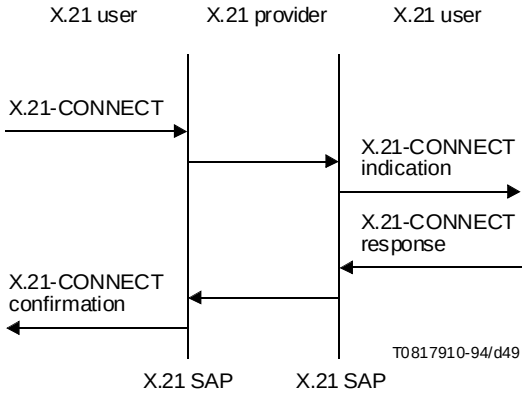


FIGURE D.17/T.70

Successful PHC establishment

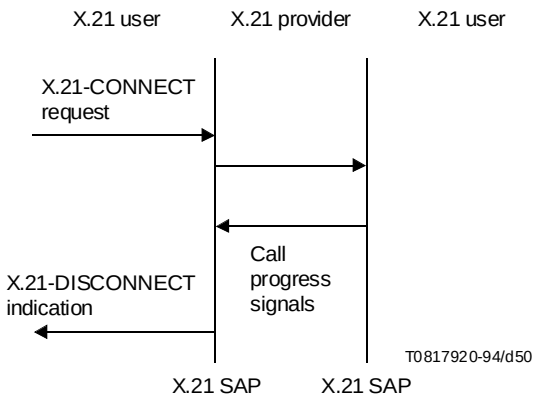


FIGURE D.18/T.70

Not successful PHC establishment

D.4.2 X.21 connection release

See Figures D.19 to D.22.

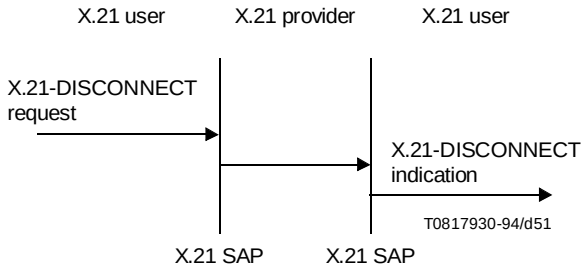


FIGURE D.19/T.70

Disconnection initiated by the X.21 user

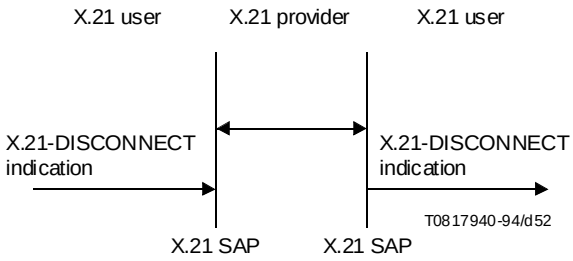


FIGURE D.20/T.70

Disconnection initiated by the X.21 provider

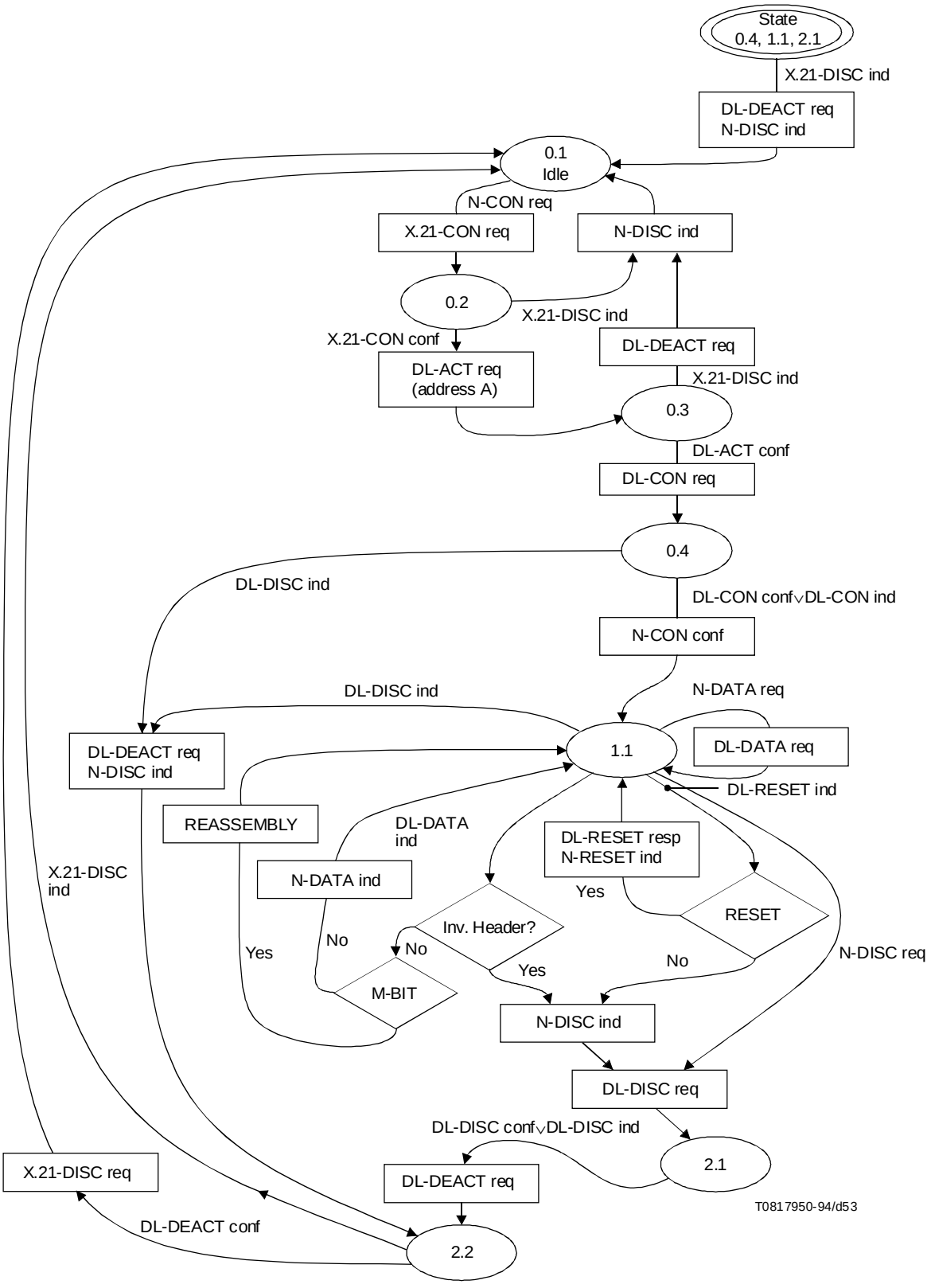


FIGURE D.21/T.70

State transition diagram for the network layer (calling side)

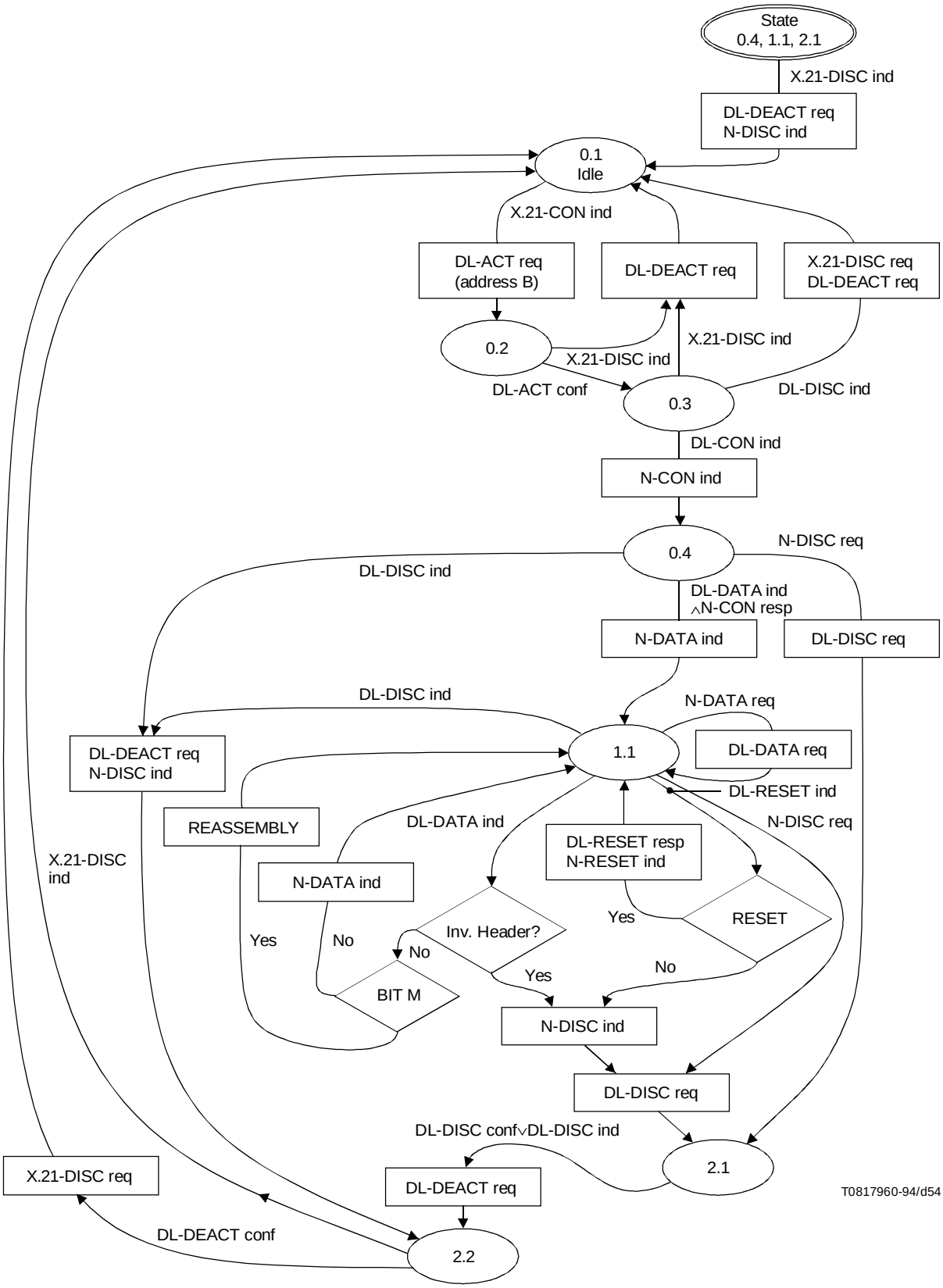


FIGURE D.22/T.70

State transition diagram for the network layer (called side)

TABLE D.1/T.70

Application rules regarding the network protocol data unit (NPDU)

Conditions ↓		Combination of conditions								
		a	b	c	d	e	f	g	h	i
C 1	Transmit/receive	T	T	T	T	T	R	R	R	R
C 2	NPDU length (octet)	> 2	> 2	> 2	> 2	< 3	> 2	> 2	> 2	< 3
C 3	1st octet 01/< >	01	01	01	< >	*	01	01	< >	*
C 4	2nd octet bits 1 to 7	0	0	< >	*	*	*	*	*	*
C 5	2nd octet bit 8 (M-bit)	0	1	*	*	*	0	1	*	*
Actions/applications rules										
A 1	Correct/acceptable	X				X (Note)				
A 2	N-DISC ind, DL-DISC req								X	X
A 3	Not allowed		X	X	X	X				
A 4	Error case								X	X

C Condition

A Action/application rule

T Transmit

R Receive

< > Not equal

* Not relevant

X Valid/applicable

NOTE – The Teletex system has to accept as many NPDUs, that at least, the same number of octets can be received as contained in the maximum negotiable transport block size.