American National Standard

ANSI T1.602-1989

for Telecommunications –

Integrated Services Digital Network (ISDN) – Data-Link Layer Signalling Specification for Application at the User-Network Interface

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Integrated Services Digital Network (ISDN) – Data-Link Layer Signalling Specification for Application at the User-Network Interface

Secretariat

Exchange Carriers Standards Association

Approved October 17, 1988

American National Standard Institute, Inc

Abstract

This standard specifies the Link Access Procedure on the D-channel, LAPD. The purpose of LAPD is to convey information between layer-3 entities across the ISDN user–network interface using the D-channel. LAPD is a protocol operating at the data link layer of the OSI architecture. This standard specifies the use of LAPD on a duplex, bit-transparent D-channel on an ISDN interface. The frame structure, elements of procedure, format of fields, and procedures for the proper operation of LAPD are specified.

Foreword (This Foreword is not part of the American National Standard T1.602-1989.)

The project on signalling requirements for the ISDN user-network interface was initiated under the auspices of Accredited Standards Committee T1 on Telecommunications in response to the requirements of industry. In ISDN, the signalling system provides the user and the network with a sophisticated method of controlling communication resources.

Two ISDN user-network interfaces are defined internationally in the International Telegraph and Telephone Consultative Committee (CCITT) I-series Recommendations: the basic interface and the primary rate interface. At each interface, the network supports a set of ISDN basic bearer services. The forthcoming American National Standards on the minimal set of basic bearer services for the ISDN user-network basic interface (to be designated ANSI T1.604) and the minimal set of basic bearer services for the ISDN user-network primary rate interface (to be designated ANSI T1.603) specify a number of these services, their attributes, and the protocols for information transfer and signalling. The services require the use of this LAPD specification at the ISDN user-network interface.

This standard was developed for Accredited Standards Committee T1 on Telecommunications by the ISDN Switching and Signalling Protocols Working Group, T1D1.2. The Working Group developed this specification through contributions and dedicated participation in the activities of the International Telegraph and Telephone Consultative Committee (CCITT) Study Group XI, ISDN and Telephone Networks Switching and Signalling Protocols during the VIIIth CCITT Study Period, 1985/1988.

Suggestions for improvement of this standard will be welcome. They should be sent to Exchange Carriers Standards Association, T1 Secretariat, 5430 Grosvenor Lane, Bethesda, MD 20814-2122.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee T1, Telecommunications. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, Accredited Standards Committee T1 had the following members:

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Contents

American National Standard for Telecommunications –

Integrated Services Digital Network (ISDN) – Data-Link Layer Signalling Specification for Application at the User-Network Interface

1. Scope, Purpose, and Field of Application

This standard contains the complete text of CCITT Recommendation Q.920, ISDN User-Network Interface Data-Link Layer - General Aspects, and CCITT Recommendation Q.921, ISDN User-Network Interface - Data-Link Layer Specification, as they will appear in the upcoming 1989 CCITT Blue Book.[1] This standard specifies the Link Access Procedure on the D-channel, LAPD. The purpose of LAPD is to convey information between layer-3 entities across the ISDN user-network interface using the D-channel. LAPD is a protocol operating at the data-link layer of the OSI architecture. This standard specifies the use of LAPD on a duplex, bit-transparent D-channel on an ISDN interface. The frame structure, elements of procedure, format of fields, and procedures for the proper operation of LAPD are specified.

2. Definitions

The following terminology is used within this document.

International Telegraph and Telephone Consultative Committee (CCITT). The CCITT is a permanent organ of the International Telecommunication Union (ITU), a specialized agency of the United Nations since 1948. As the oldest international treaty organization, the ITU traces its formal beginnings to 1865. The CCITT was founded in 1954 for the purpose of promoting and ensuring the operation of international telecommunication systems.

Integrated Services Digital Network (ISDN). A network, in general evolving from an existing telephony network, that provides end-to-end digital connectivity to support a wide range of both voice and nonvoice services. User access to an ISDN is via a limited set of standard multipurpose interfaces.

D-channel. A channel carrying control and signalling information and, optionally, packetized information and telemetry.

3. Referenced Standards

CCITT Recommendation I.320, ISDN Protocol Reference Model.[2]

CCITT Recommendation I.412, ISDN User-Network Interfaces, Interface Structure, and Access Capabilities.[2]

CCITT Recommendation I.430, Basic User-Network Interface Layer 1 Specification.[2]

[1] Contact the Secretariat for more recent information.

[2] This CCITT Recommendation is available in the 1984 Red Book, which is available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

CCITT Recommendation I.431, Primary Rate User-Network Interface Layer 1 Specification.[2]

CCITT Recommendation Q.930, ISDN User-Network Interface Layer 3: General Aspects.[2]

CCITT Recommendation Q.931, ISDN User-Network Interface Layer 3 Specification. [2]

CCITT Recommendation X.200, Reference Model of Open Systems Interconnection for CCITT Applications.[2]

CCITT Recommendation X.210, OSI Layer Service Conventions.[2]

CCITT Recommendation X.25, Interface between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Network by Dedicated Circuit.[2]

ISO 3309, High-Level Data Link Control Procedures - Frame Structure.[3]

ISO 4335, High-Level Data Link Control Procedures - Consolidation of Elements of Procedure.[3]

4. Abbreviations and Acronyms

AI	Action indicator
ASP	Assignment source point
CEI	Connection endpoint identifier
CES	Connection endpoint suffix
C/R	Command/response field bit
DISC	Disconnect
DL-	Communication between Layer 3 and the data link layer
DLCI	Data link connection identifier
DM	Disconnected mode
EA	Extended address field bit
ET	Exchange termination
FCS	Frame check sequence
FRMR	Frame reject
I	Information
ID	Identity
ISDN	Integrated service digital network
L3	Layer 3
L2	Layer 2
L1	Layer 1
LAPB	Link access procedure - balanced
LAPD	Link access procedure on the D-channel
M	Modifier function bit
MDL-	Communication between the management entity and the data link layer
MPH-	Communication between system management and the physical layer
N(R)	Receive sequence number
N(S)	Send sequence number
NT	Network termination
OSI	Open systems interconnection
P/F	Pool/final bit
PH-	Communication between the data link layer and the physical layer
RC	Retransmission counter
REC	Receiver
REJ	Reject
Ri	Reference number
RNR	Receive not ready
RR	Receive ready
S	Supervisory
S	Supervisory function bit
SABME	Set asynchronous balanced mode extended
SAP	Service access point
SAPI	Service access point identifier
TE	Terminal equipment
TEI	Terminal endpoint identifier
TX	Transmit
U	Unnumbered
UA	Unnmumbered acknowledgment
UI	Unnumbered information
V(A)	Acknowledge state variable
V(M)	Recovery state variable
V(R)	Receive state variable
V(S)	Send state variable
XID	Exchange identification

[3] Available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

5. Requirements

The American National Standard for signalling at the data link layer of the ISDN user-network interface shall be the 1988 CCITT Recommendations Q.920, ISDN User-Network Interface Data-Link Layer - General Aspects, and Q.921, ISDN User-Network - Data-Link Layer Specification.

CCITT Recommendation Q.920[1]
ISDN User-Network Interface Data Link Layer – General Aspects

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1) This Recommendation will be included in the Series I Recommendations of the CCITT Blue Book (1988) under the number I.440.

1 General

This Recommendation describes in general terms the Link Access Procedure on the D-channel, LAPD . The application of this protocol to other channel types is for further study. Details are provided in Recommendation Q.921(I.441) [1].

The purpose of LAPD is to convey information between layer 3 entities across the ISDN user-network interface using the D-channel.

The definition of LAPD takes into consideration the principles and terminology of:

- Recommendations X.200 [2] and X.210 [3] — the reference model and layer service conventions for Open Systems Interconnection (OSI);
- Recommendation X.25 [4] — LAPB user-network interface for packet mode terminals; and
- ISO 3309 [5] and ISO 4335 [6] — High-level Data Link Control (HDLC) standards for frame structure and elements of procedures.

LAPD is a protocol that operates at the data link layer of the OSI architecture. The relationship between the data link layer and other protocol layers is defined in Recommendation I.320 [7].

Note 1 — The physical layer is currently defined in Recommendations I.430 [8] and I.431 [9] and layer 3 is defined in Recommendations Q.930(I.450) [10], Q.931(I.451) [11], and X.25 [4]. References should be made to these Recommendations for the complete definition of the procotols and procedures across the ISDN user-network interface.

Note 2 — The term "data link layer" is used in the main text of this Recommendation. However, mainly in figures and tables, the terms "layer 2" and "L2" are used as abbreviations. Furthermore, in accordance with Recommendations Q.930(I.450) [10] and Q.931(I.451) [11], the term "layer 3" is used to indicate the layer above the data link layer.

LAPD is independent of transmission bit rate. It requires a duplex, bit transparent D-channel.

The characteristics of the D-channel are defined in Recommendation I.412 [12].

§ 2 below describes basic concepts used in this Recommendation and Recommendation Q.921.

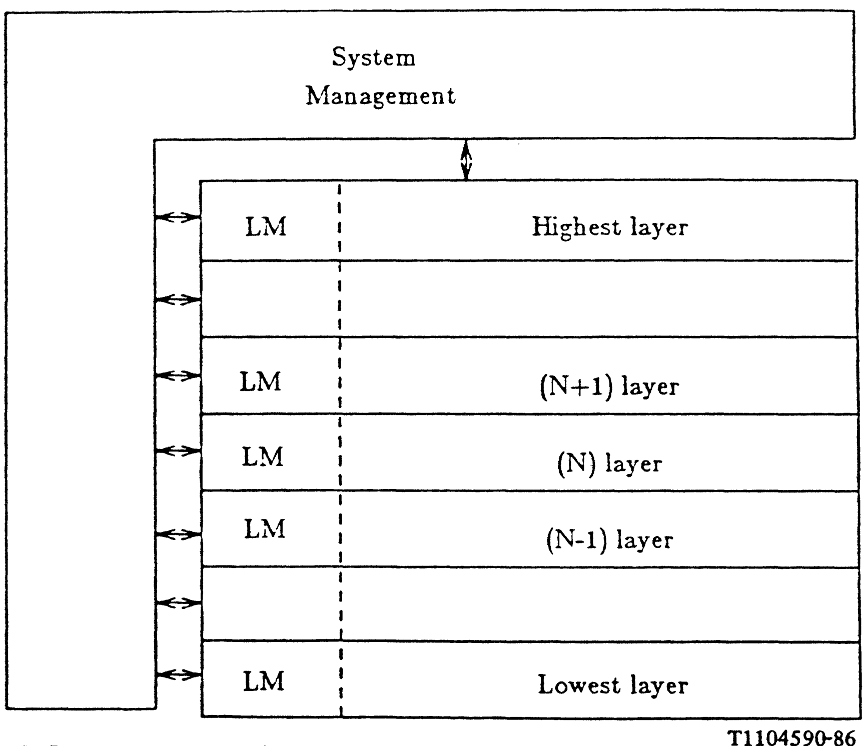
§ 3 gives an overview description of LAPD functions and procedures.

§ 4 summarizes the services that the data link layer provides to layer 3 and the services that the data link layer requires from the physical layer.

§ 5 provides an overview of the data link layer structure.

2 Concepts and terminology

The basic structuring technique in the OSI reference model is layering. According to this technique, communication among application processes is viewed as being logically partitioned into an ordered set of layers represented in a vertical sequence as shown in Figure 1/Q.920.



LM Layer management (see Figure 10/Q.920)

FIGURE 1/Q.920

Layering

A data link layer Service Access Point (SAP) is the point at which the data link layer provides services to layer 3. Associated with each data link layer SAP is one or more data link connection endpoint(s). See Figure 2/Q.920. A data link connection endpoint is identified by a data link connection endpoint identifier as seen from layer 3 and by a Data Link Connection Identifier (DLCI) as seen from the data link layer.

Entities exist in each layer. Entities in the same layer, but in different systems which must exchange information to achieve a common objective are called "peer entities". Entities in adjacent layers interact through their common boundary. The services provided by the data link layer are the combination of the services and functions provided by both the data link layer and the physical layer.

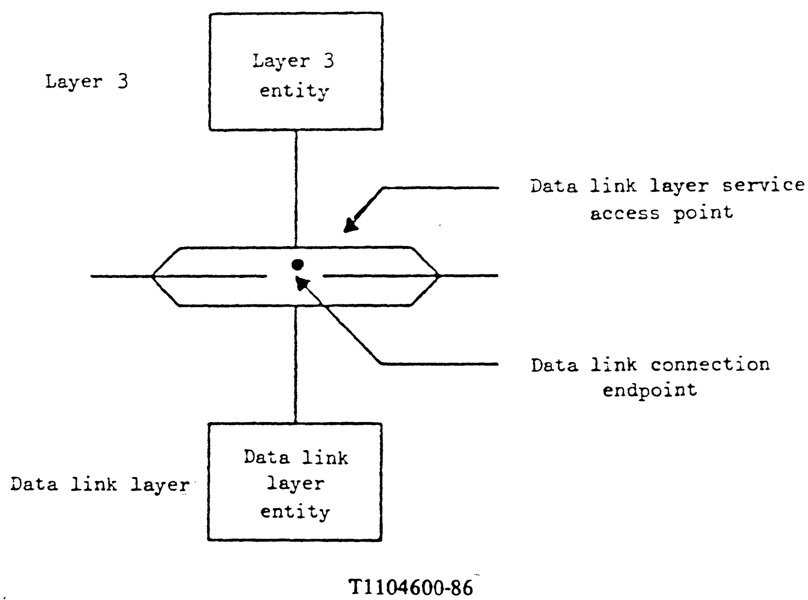


FIGURE 2/Q.920

Entities, service access points and endpoints

Cooperation between data link layer entities is governed by a peer-to-peer protocol specific to the layer. In order for information to be exchanged between two or more layer 3 entities, an association must be established between the layer 3 entities in the data link layer using a data link layer protocol. This association is called a data link connection. Data link connections are provided by the data link layer between two or more SAPs (see Figure 3/Q.920).

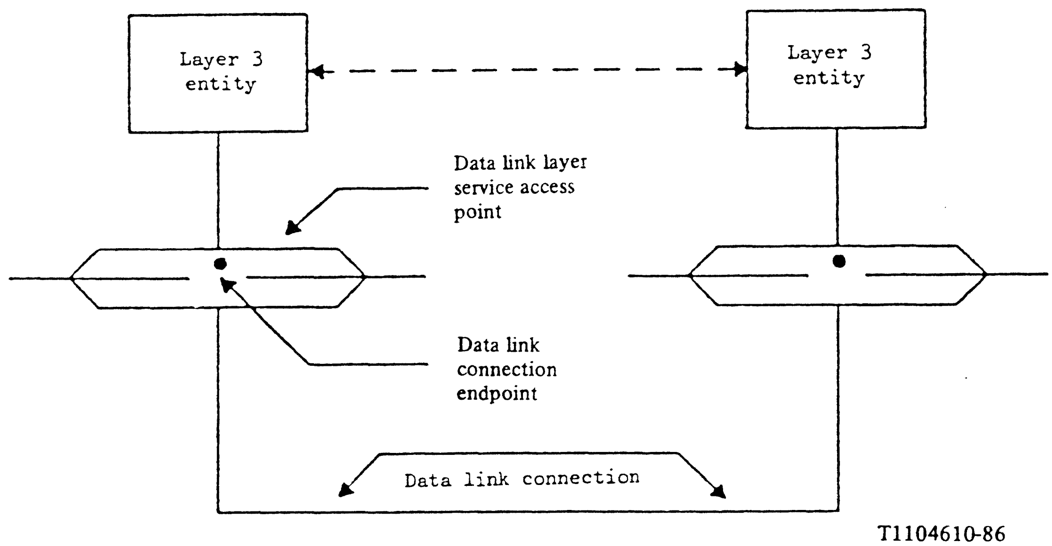


FIGURE 3/Q.920

Peer-to-peer relationship

Data link layer message units are conveyed between data link layer entities by means of a physical connection.

Layer 3 requests services from the data link layer via service primitives. The same applies for the interaction between the data link layer and the physical layer. The primitives represent, in an abstract way, the logical exchange of information and control between the data link layer and adjacent layers. They do not specify or constrain implementation.

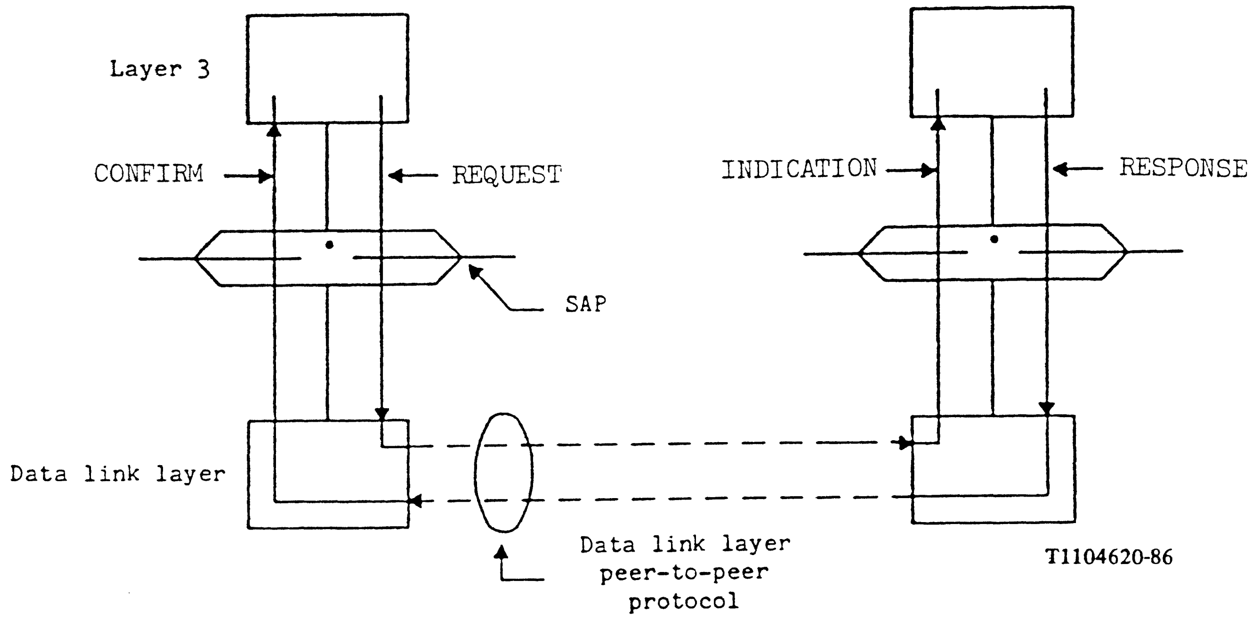
The primitives that are exchanged between the data link layer and adjacent layers are of the following four types (see also Figure 4/Q.920):

a) REQUEST;

b) INDICATION;

c) RESPONSE; and

d) CONFIRM.



Note - The same principle applies for data link layer-physical interactions.

FIGURE 4/Q.920

Primitive action sequence

The REQUEST primitive type is used when a higher layer is requesting a service from the next lower layer.

The INDICATION primitive type is used by a layer providing a service to notify the next higher layer of any specific activity which is service related. The INDICATION primitive may be the result of an activity of the lower layer related to the primitive type REQUEST at the peer entity.

The RESPONSE primitive type is used by a layer to acknowledge receipt, from a lower layer, of the primitive type INDICATION.

The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

Layer-to-layer interactions are specified in Recommendation Q.921.

Information is transferred, in various types of message units, between peer entities and between entities in adjacent layers that are attached to a specific SAP. The message units are of two types:

- message units of a peer-to-peer protocol; and

- message units that contain layer-to-layer information concerning status and specialized service requests.

The message units of the layer 3 peer-to-peer protocol are carried by the data link connection. The message units containing layer-to-layer information concerning status and specialized service requests are never conveyed over a data link connection or a physical connection.

This Recommendation specifies (see also Figure 5/Q.920):

a) the peer-to-peer protocol for the transfer of information and control between any pair of data link layer service access points; and

b) the interactions between the data link layer and layer 3, and between the data link layer and the physical layer.

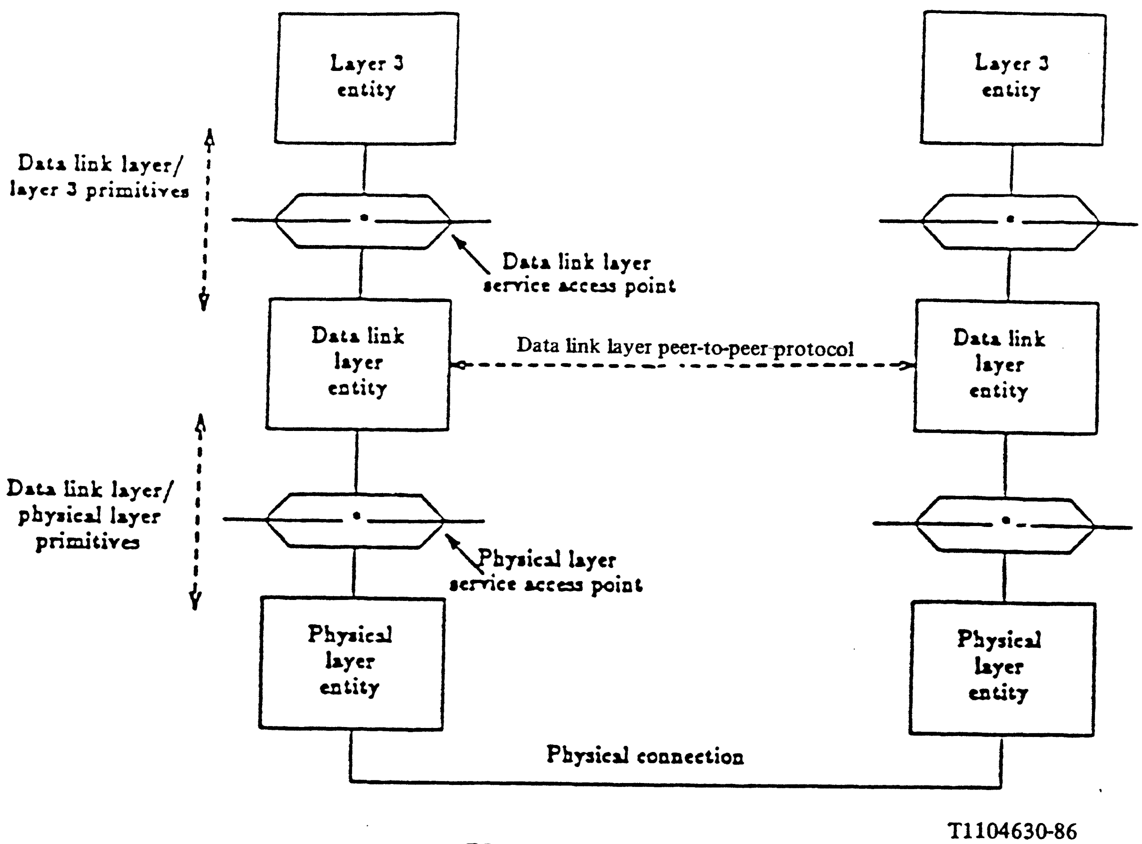


FIGURE 5/Q.920

Data link layer reference model

3 Overview description of LAPD functions and procedures

3.1 General

The purpose of LAPD is to convey information between layer 3 entities across the ISDN user-network interface using the D-channel. Specifically LAPD will support:

- multiple terminal installations at the user-network interface;
- multiple layer 3 entities.

All data link layer messages are transmitted in frames which are delimited by flags. (A flag is a unique bit pattern.) The frame structure is defined in Recommendation Q.921.

LAPD includes functions for:

a) the provision of one or more data link connections on a D-channel. Discrimination between the data link connections is by means of a data link connection identifier (DLCI) contained in each frame;

b) frame delimiting, alignment and transparency, allowing recognition of a sequence of bits transmitted over a D-channel as a frame;

c) sequence control, to maintain the sequential order of frames across a data link connection;

d) detection of transmission, format and operational errors on a data link connection;

e) recovery from detected transmission, format, and operational errors;

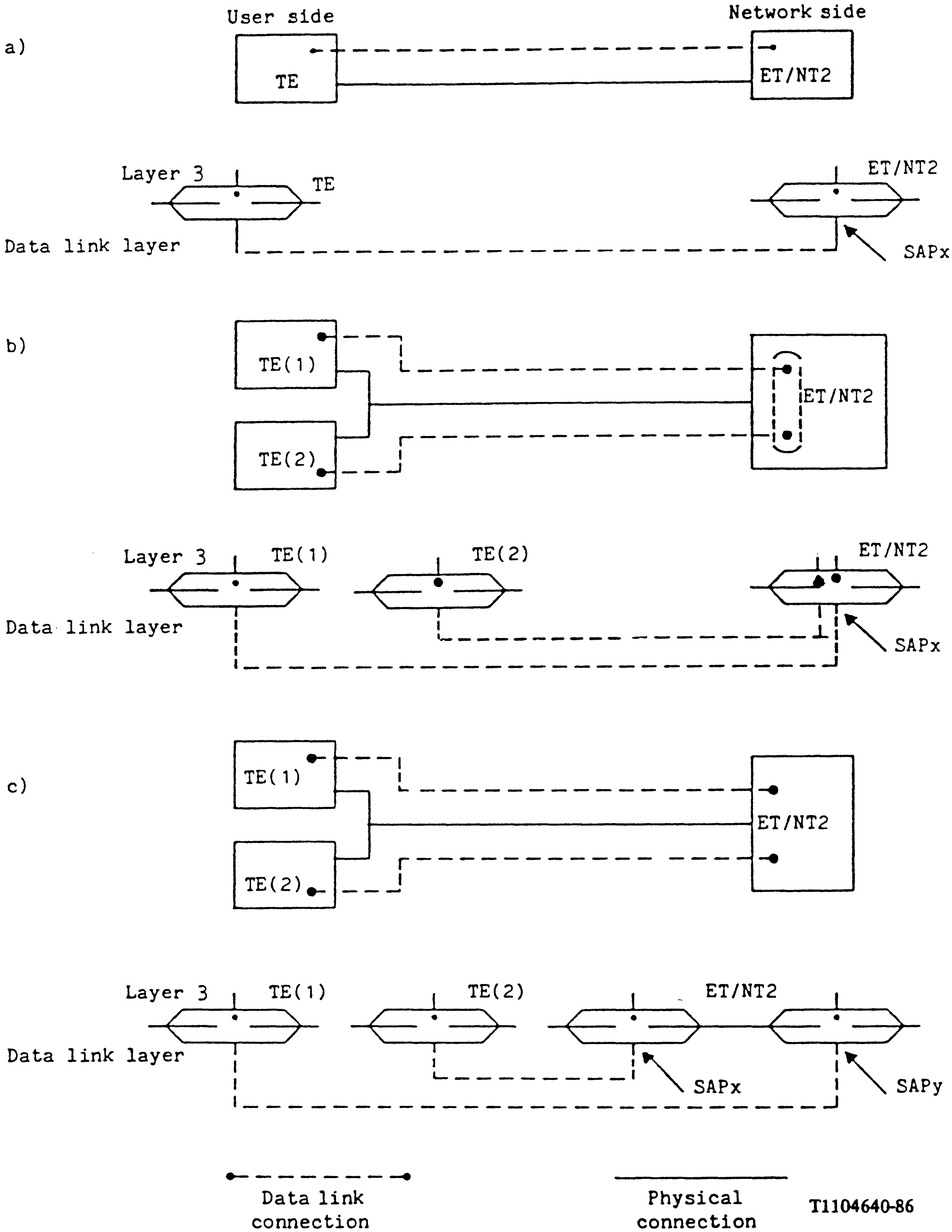
f) notification to the management entity of unrecoverable errors; and

g) flow control.

Data link layer functions provide the means for information transfer between multiple combinations of data link connection endpoints. The information transfer may be via point-to-point data link connections or via broadcast data link connections. In the case of point-to-point information transfer, a frame is directed to a single endpoint, while in the case of broadcast information transfer, a frame is directed to one or more endpoints.

Figure 6/Q.920 shows three examples of point-to-point information transfer. Figure 7/Q.920 shows an example of broadcast information transfer.

Two types of operation of the data link layer are defined for layer 3 information transfer: unacknowledged and acknowledged. They may coexist on a single D-channel.



ET Exchange termination
NT Network termination

TE Terminal equipment
SAP Service access point

FIGURE 6/Q.920

Point-to-point data link connections

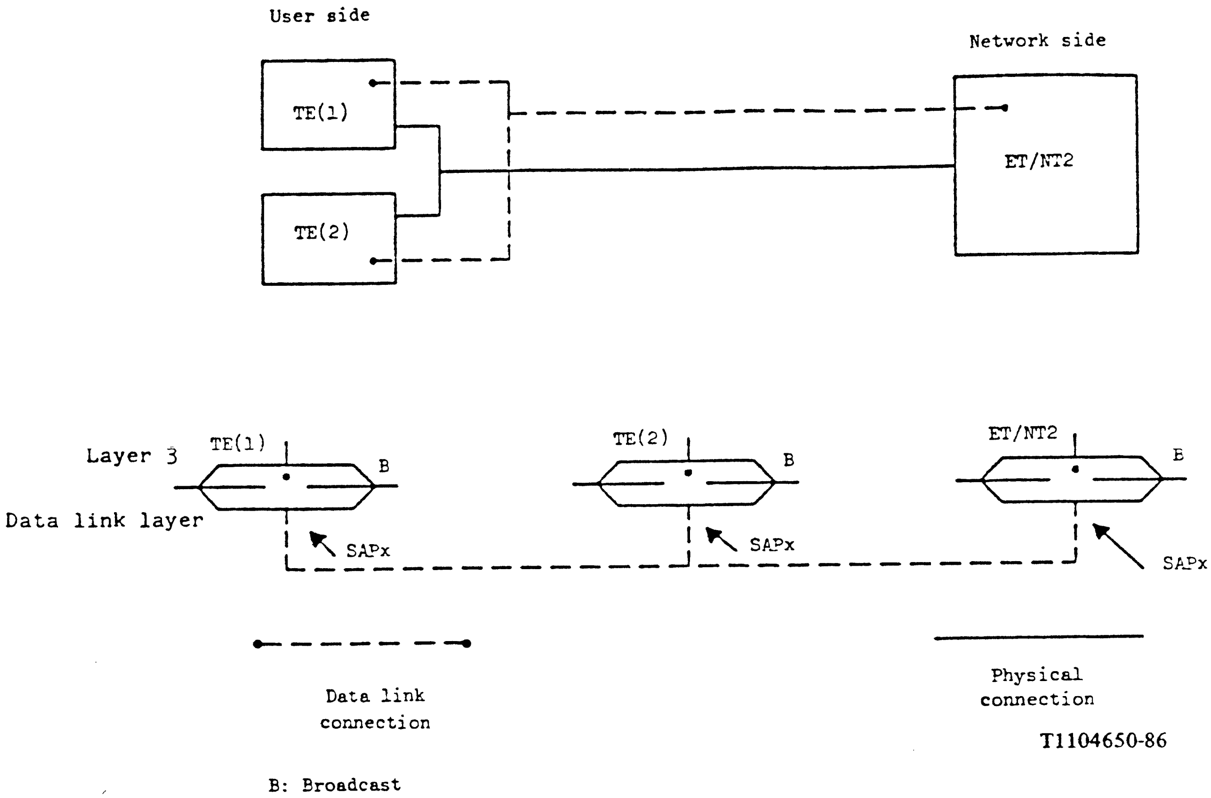


FIGURE 7/Q.920

Broadcast data link connection

3.2 Unacknowledged operation

With this type of operation layer 3 information is transmitted in Unnumbered Information (UI) frames.

At the data link layer the UI frames are not acknowledged. Even if transmission and format errors are detected, no error recovery mechanism is defined. Flow control mechanisms are not defined.

Unacknowledged operation is applicable for point-to-point and broadcast information transfer; that is, a UI frame may be sent to a specific endpoint or broadcast to multiple endpoints associated with a specific Service Access Point Identifier (SAPI) .

3.3 Acknowledged operation

With this type of operation, layer 3 information is transmitted in frames that are acknowledged at the data link layer.

Error recovery procedures based on retransmission of unacknowledged frames are specified. In the case of errors which cannot be corrected by the data link layer, a report to the management entity is made. Flow control procedures are also defined.

Acknowledged operation is applicable for point-to-point information transfer.

One form of acknowledged information transfer is defined, multiple frame operation.

Layer 3 information is sent in numbered Information (I) frames. A number of I frames may be outstanding at the same time. Multiple frame operation is initiated by a multiple frame establishment procedure using a Set Asynchronous Balanced Mode Extended (SABME) command.

3.4 Establishment of information transfer modes

3.4.1 Data link connection identification

A data link connection is identified by a Data Link Connection Identifier (DLCI) carried in the address field of each frame.

The data link connection identifier is associated with a connection endpoint identifier at the two ends of the data link connection (see Figure 8/Q.920).

The connection endpoint identifier is used to identify message units passed between the data link layer and layer 3. It consists of the SAPI and the Connection Endpoint Suffix (CES) .

The DLCI consists of two elements: the SAPI and the Terminal Endpoint Identifier (TEI)

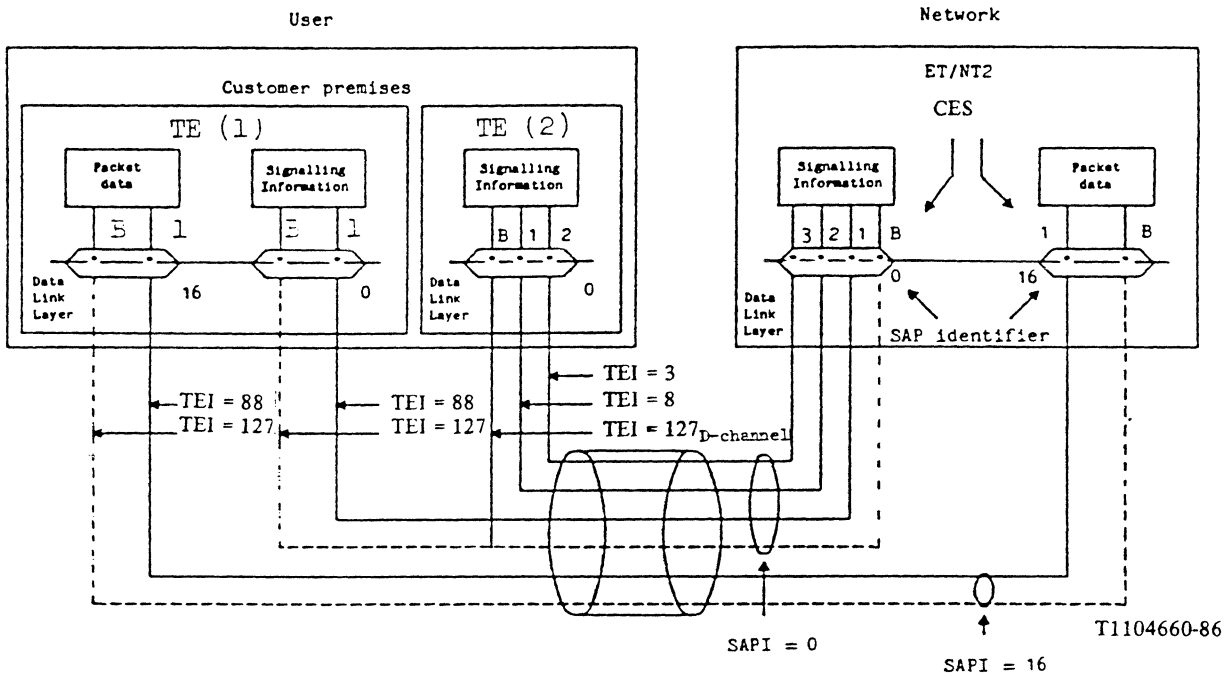
The SAPI is used to identify the service access point on the network side or the user side of the user-network interface.

The TEI is used to identify a specific connection endpoint within a service access point.

The TEI is assigned by the network, if the user equipment is of the automatic TEI assignment category or it is entered into the user equipment, for example, by the user or the manufacturer, if the user equipment is of the nonautomatic TEI assignment category (see § 3.4.3).

The DLCI is a pure data link layer concept. It is used internally by the data link layer entity and is not known by the layer 3 entity or management entity. In these latter entities, the concept of Connection Endpoint Identifier (CEI) will be used instead.

The CEI is composed of the SAPI information and a reference value named CES. The CES is a value selected by the layer 3 or management entity to address the data link layer entity. When the relevant TEI is known by this entity, it will internally associate the DLCI to the CEI. The layer 3 and management entities will use this CEI to address its peer entity.



Key:

------- Broadcast data link connection (B)

———— Point-to-point data link connection

DLCI = SAPI + TEI

CEI = SAPI + CES

Note 1 – The management entity is not shown in this figure.

Note 2 – The selection of the SAPI and TEI values is based on Recommendation Q.921, § § 3.3.3 and 3.3.4.2, respectively.

FIGURE 8/Q.920

Overview description of the relationship between SAPI, TEI and DLCI

3.4.2 Data link states

A point-to-point data link entity may be in one of three basic states:

a) TEI-unassigned state. In this state a TEI has not been assigned. No layer 3 information transfer is possible; or

b) TEI-assigned state. In this state a TEI has been assigned by means of the TEI assignment procedure. Unacknowledged information transfer is possible; or

c) multi-frame-established state. This state is established by means of a multiple frame establishment procedure. Acknowledged and unacknowledged information transfer are possible.

Note — For the detailed description of procedures in Recommendation Q.921, an expansion of the basic set of states listed above is required.

A broadcast data link entity is always in an information transfer state capable of only unacknowledged information transfer (that is, TEI-assigned state).

3.4.3 TEI administration

The purpose of the TEI assignment procedure is to allow a user equipment to obtain a TEI value that the data link layer entities within the user equipment will use in subsequent communications over the data link connections.

The assigned TEI value is typically common to all SAPs (if more than one) in a user equipment. The procedure is conceptually located in the management entity.

When a TEI has been assigned, the user equipment establishes an association between the TEI and a CES in each SAP (that is, the DLCI is associated with a CEI). In the network, the corresponding association is made upon reception of the first frame containing the assigned TEI, or at the time of TEI assignment.

At that point in time, a data link layer peer-to-peer association has been formed.

The association between the DLCI and CEI will be removed by the TEI removal procedures on request from the management entity when recognizing that the TEI value is no longer valid.

When in the TEI-assigned state or the multiple-frame-established state, the TEI check procedure may be used by the network to check the status of a TEI (for example, to determine if a user equipment has been disconnected from an installation). Optionally, the user equipment may request the network to initiate the TEI check procedure.

Examples of criteria for initiation of the TEI assignment procedure, the TEI check procedure, and the TEI removal procedures are described in Recommendation Q.921.

Note — This section is not intended to provide a complete specification of possible criteria for establishing and removing an association between the DLCI and CEI.

3.4.4 Establishment of multiple frame operation

Before point-to-point acknowledged information transfer can start, an exchange of a SABME frame and an Unnumbered Acknowledgement (UA) frame must take place.

The multiple frame establishment procedure is specified in detail in Recommendation Q.921.

4 Service characteristics

4.1 General

The data link layer provides services to layer 3 and to the layer 2 management entity and utilizes the services provided by the physical layer and layer management. A formal description of the data link layer service provided to layer 3 and layer management is given in § 4.2 and § 4.3, respectively. The layer management service provided to the data link layer is given in § 4.4.

Note — Communication between different layers in the OSI reference model makes use of primitives which are passed across the layer boundaries. The data link layer primitives defined in this Recommendation represent, in an abstract way, the logical exchange of information and control between the data link layer and adjacent layers. They do not specify nor constrain implementations.

4.2 Services provided to layer 3

The specification of the interactions with layer 3, (primitives) provides a description of the services that the data link layer, plus the physical layer, offer to layer 3, as viewed from layer 3.

Two forms of information transfer service are associated with layer 3. The first is based on unacknowledged information transfer at the data link layer while the second service is based on acknowledged information transfer at the data link layer.

Layer 3 message units are handled according to their respective layer 2 priority (see § 5.2).

4.2.1 Unacknowledged information transfer service

Note — In this case the information transfer is not acknowledged at the data link layer. Acknowledgement procedures may be provided at higher layers.

The information transfer is via broadcast or point-to-point data link connections.

The characteristics of the unacknowledged information transfer service are summarized in the following:

a) provision of a data link connection between layer 3 entities for unacknowledged information transfer of layer 3 message units;

b) identification of data link connection endpoints; and

c) no verification of message arrival within the peer data link layer entity.

The primitives associated with the unacknowledged information transfer service are:

DL-UNIT DATA-REQUEST/INDICATION

The DL-UNIT DATA-REQUEST primitive is used to request that a message unit be sent using the procedures for unacknowledged information transfer service. The DL-UNIT DATA-INDICATION primitive indicates the arrival of a message unit received by means of an unacknowledged information transfer service.

4.2.2 Acknowledged information transfer service

One mode of operation is defined, multiple frame.

The characteristics of the acknowledged information transfer service are summarized in the following:

a) provision of a data link connection between layer 3 entities for acknowledged information transfer of layer 3 message units;

b) identification of data link connection endpoints;

c) sequence integrity of data link layer message units in the absence of malfunctions;

d) notification to the peer entity in the case of errors, for example, loss of sequence;

e) notification to the management entity of unrecoverable errors detected by the data link layer; and

f) flow control.

The primitives associated with the acknowledged information transfer services are:

i) Data transfer

DL-DATA-REQUEST/INDICATION

The DL-DATA-REQUEST primitive is used to request that a message unit be sent using the procedures for the acknowledged information transfer service. The DL-DATA-INDICATION primitive indicates the arrival of a message unit received by means of the acknowledged information transfer service.

ii) Establishment of multiple frame operation

DL-ESTABLISH-REQUEST/INDICATION/CONFIRM

These primitives are used, respectively, to request, indicate and confirm the establishment of multiple frame operation between two service access points.

iii) Termination of multiple frame operation

DL-RELEASE-REQUEST/INDICATION/CONFIRM

These primitives are used, respectively, to request, indicate and confirm an attempt to terminate multiple frame operation between two service access points.

4.3 Services provided to layer management

Only the unacknowledged information transfer service is provided to layer management in order that the data link layer management can communicate with its peer layer management.

Note — In this case the information transfer is not acknowledged at the data link layer. Acknowledgement procedures may be provided by layer management.

The information transfer is via broadcast connections, but in principle information transfer can also be via point-to-point connections (no application for data transfer via point-to-point connections has been identified or included in Recommendation Q.921).

The characteristics of the unacknowledged information transfer service are summarized in the following:

a) provision of a data link connection between layer management entities for unacknowledged information transfer of data units;

b) identification of data link connection endpoints; and

c) no verification of message arrival within the peer data link layer entity.

The primitives associated with the unacknowledged information transfer service provided for layer management are:

MDL-UNIT DATA-REQUEST/INDICATION

The MDL-UNIT DATA-REQUEST primitive is used to request that a message unit be sent using the procedure for unacknowledged information transfer service for layer management. The MDL-UNIT DATA-INDICATION primitive indicates the arrival of a message unit received by means of the unacknowledged information transfer service to layer management.

4.4 Administrative services

The characteristics of the administrative services currently recognized are summarized in the following:

a) assignment, checking, and removal of TEI values; and

b) data link connection parameter passing (an optional service performed on a per connection basis).

These services are considered to be conceptually provided by layer management either on the user side or the network side. The method of describing these administrative functions uses service primitives.

The primitives associated with these services are:

i) Assignment of TEI value

MDL-ASSIGN-REQUEST/INDICATION

The MDL-ASSIGN-INDICATION primitive is used to indicate to layer management the need for a TEI value. The MDL-ASSIGN-REQUEST primitive is used to pass the TEI value from layer management to the data link layer in order that the user data link layer entities can begin to communicate with the network data link layer entities.

ii) Removal of TEI value

MDL-REMOVE-REQUEST

This primitive is used to convey a layer management function request for removal of a TEI value that has been previously assigned via the MDL-ASSIGN primitives.

iii) Notification of error

MDL-ERROR-INDICATION/RESPONSE

These primitives are used to report error situations between layer management and the data link layer entities.

4.5 Model of the data link service

4.5.1 General

The ability of the data link layer to execute a service request by layer 3 depends on the internal state of the data link layer. For the layer 3 entity, the internal state of the data link layer is represented by the state of that data link connection endpoint within a data link service access point which is used by this layer 3 entity to invoke a service.

Consequently, the data link service may be defined by means of data link connection endpoint states, whereby the capabilities provided by the data link layer and the service primitives may be related to these states.

In order to allow a data link service user to invoke a service by making use of primitives, the DL-primitives defined in Recommendation Q.921 have to be related to: point-to-point data link connections (acknowledged or unacknowledged transfer of information) and/or broadcast data link connections (unacknowledged transfer of information) (see Table 1/Q.920).

An unconfirmed service is defined as a service which does not result in an explicit confirmation. A confirmed service is defined as a service which results in an explicit confirmation from the service-provider. There is not necessarily any relationship to a response from the peer service-user.

TABLE 1/Q.920

Applicability of DL-Primitives to information transfer modes

Generic name of the DL-primitive	POINT-TO-POINT INFORMATION TRANSFER MODE		BROADCAST INFORMATION TRANSFER MODE
	ACKNOWLEDGED	UNACKNOWLEDGED	
ESTABLISH	CONFIRMED SERVICE		
RELEASE	CONFIRMED SERVICE		
DATA	UNCONFIRMED SERVICE		
UNIT DATA		UNCONFIRMED SERVICE	UNCONFIRMED SERVICE

4.5.2 Data link layer representation as seen by layer 3

4.5.2.1 Data link connection endpoint states

The states of a data link connection endpoint may be derived from the internal states of the data link layer entity supporting this type of a data link connection.

4.5.2.2 Broadcast data link layer connection services

A broadcast data link connection provides an unacknowledged information transfer service.

The broadcast data link connection endpoint is always in the information transfer state.

4.5.2.3 Point-to-point data link connection endpoint services

A point-to-point data link connection provides both an unacknowledged and acknowledged information transfer service. Within each data link service access point, one or more than one data link connection endpoint may be present, each identified by a CES.

The acknowledged information transfer service, in addition, implies the presence of the link establishment, link re-establishment and link release services.

The point-to-point data link connection endpoint states are:

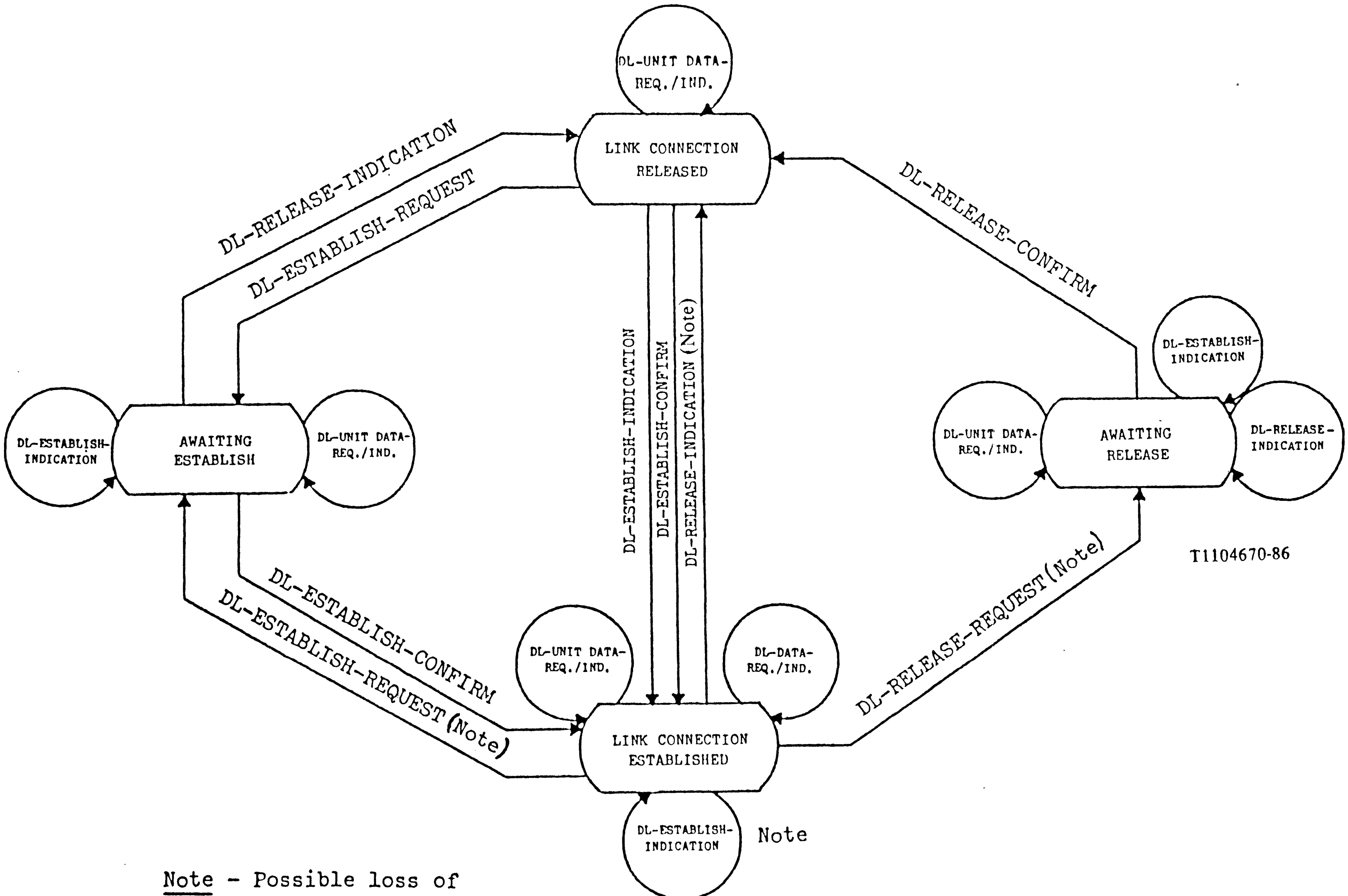
- link connection released state;
- awaiting establish state;
- awaiting release state;
- link connection established state.

4.5.2.4 Sequences of primitives at one point-to-point data link connection endpoint

The primitives provide the procedural means to specify conceptually how a data link service user can invoke a service.

This section defines the constraints on the sequence in which the primitives may occur. The sequences are related to the states at one point-to-point data link connection endpoint.

The possible overall sequences of primitives at a point-to-point data link connection endpoint are defined in the state transition diagram, Figure 9/Q.920. The link connection released and link connection established states are stable states whilst the awaiting establish and awaiting release are transition states.



Note - Possible loss of information.

FIGURE 9/Q.920

State transition diagram for sequences of primitives at a point-to-point data link connection endpoint as seen by Layer 3

4.6 Services required from the physical layer

The services provided by the physical layer are described in detail in Recommendation I.430 [8] or I.431 [9]. They are summarized in the following:

a) physical layer connection for the transparent transmission of bits in the same order in which they are submitted to the physical layer;

b) indication of the physical status of the D-channel; and

c) transmission of data link layer message units according to their respective data link layer priority.

Some of the above services may be implemented in the management entity on the user side or network side. The method of describing these services is by means of service primitives. The primitives between the data link layer and the physical layer are:

i) PH-DATA-REQUEST/INDICATION

These primitives are used to request that a message unit be sent and to indicate the arrival of a message unit.

ii) Activation

PH-ACTIVATE-REQUEST/INDICATION

These primitives are used to request activation of the physical layer connection, and to indicate that the physical layer connection has been activated.

iii) Deactivation

PH-DEACTIVATE-REQUEST/INDICATION

This primitive is used to indicate that the physical layer connection has been deactivated.

5 Data link layer — management structure

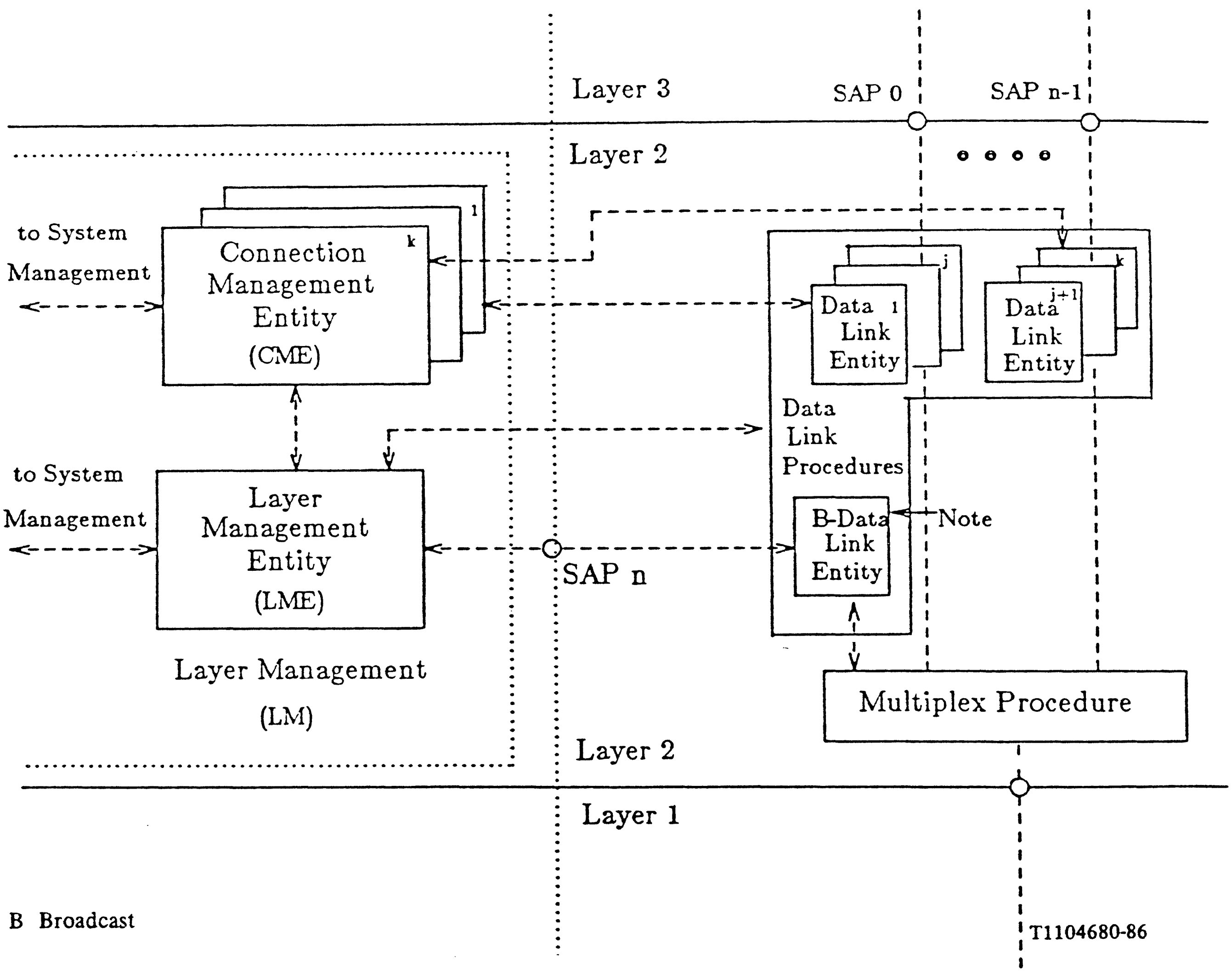
The data link layer — management structure is shown in Figure 10/Q.920. This figure is a model shown for illustrative purposes only, and does not constrain implementations.

The layer management entity (LME) provides for the management of resources that have a layer-wide impact. Access to the LME is provided by means of a specific SAPI. Functions provided by the LME are:

- TEI assignment
- TEI check
- TEI removal

The connection management entity (CME) provides for the management of resources that have an impact on individual connections. Selection of the CME is based on a specific data link layer frame type not used in the acknowledged or unacknowledged information transfer services. Functions provided by the CME are:

- parameter initialization (optional);
- error processing;
- connection flow control invocation.



Note – The broadcast links for SAPs other than SAP 63 are not shown.

FIGURE 10/Q.920

Functional Model of the data link layer - Management

5.1 Data link procedure

This procedure analyzes the control field of the received frame (see Recommendation Q.921) and provides appropriate peer-to-peer responses and layer-to-layer indications. In addition, it analyzes the data link layer service primitives and transmits the appropriate peer-to-peer commands and responses.

5.2 Multiplex procedure

This procedure analyzes the flag, Frame Check Sequence (FCS) , and address octets of a received frame. If the frame is correct, it distributes the frame to the appropriate data link procedures block based on the DLCI (see Recommendation Q.921).

On frame transmission, this procedure may provide data link layer contention resolution between the various data link procedure blocks. The contention resolution is based on the SAPI value, giving priority to SAPI = 0 information.

5.3 Structure of the data link procedure

The functional model of the data link procedure is shown in Figure 11/Q.920. The model consists of several functional blocks for point-to-point and broadcast connections.

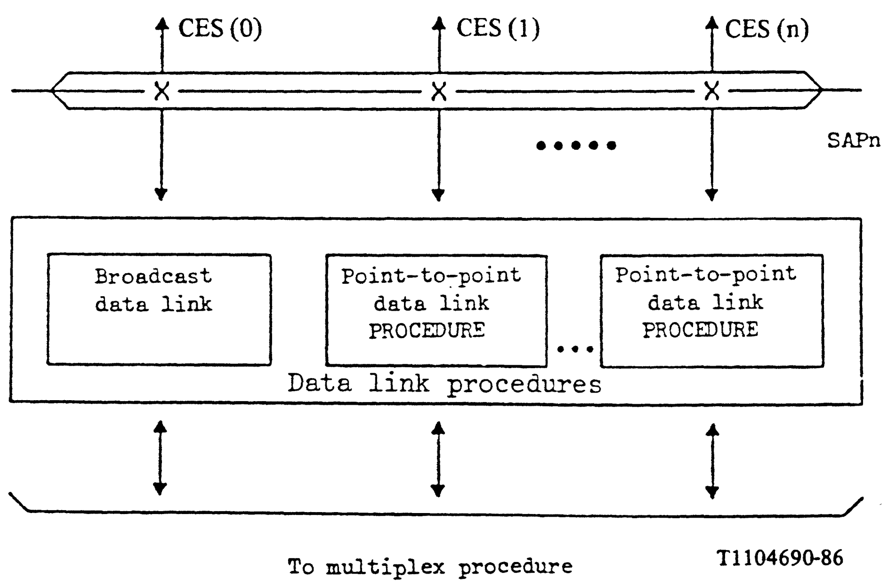


FIGURE 11/Q.920

Data link procedure structure

References

[1] CCITT Recommendation Q.921(I.441) ISDN user-network interface data link layer specification.

[2] CCITT Recommendation X.200 Reference model of open systems interconnection for CCITT applications.

[3] CCITT Recommendation X.210 OSI layer service conventions.

[4] CCITT Recommendation X.25 Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.

[5] ISO 3309 Data communication — High-level data link control procedures — Frame structure.

[6] ISO 4335 Data communication — High-level data link control procedures — Consolidation of elements of procedures.

[7] CCITT Recommendation I.320 ISDN protocol reference model.

[8] CCITT Recommendation I.430 Basic user-network interface layer 1 specification.

[9] CCITT Recommendation I.431 Primary rate user-network interface layer 1 specification.

[10] CCITT Recommendation Q.930(I.450) ISDN user-network interface layer 3 — general aspects.

[11] CCITT Recommendation Q.931(I.451) ISDN user-network interface layer 3 specification.

[12] CCITT Recommendation I.412 ISDN user-network interfaces interface structure and access capabilities.

CCITT Recommendation Q.921[1]
ISDN User-Network Interface Data Link Layer – Specification

1) This Recommendation will be included in the Series I Recommendations of the CCITT Blue Book (1988) under the number I.441.

1 General

This Recommendation specifies the frame structure, elements of procedure, format of fields and procedures for the proper operation of the Link Access Procedure on the D-channel, LAPD.

The concepts, terminology, overview description of LAPD functions and procedures, and the relationship with other Recommendations are described in general terms in Recommendation Q.920(I.440) [1].

Note 1 – As stated in Recommendation Q.920(I.440), the term "data link layer" is used in the main text of this Recommendation. However, mainly in figures and tables, the terms "layer 2" and "L2" are used as abbreviations. Furthermore, in accordance with Recommendations Q.930(I.450) [2] and Q.931(I.451) [3], the term "layer 3" is used to indicate the layer above the data link layer.

Note 2 – All references within this document to "layer management entity" and/or "connection management entity" refer to those entities at the data link layer.

2 Frame structure for peer-to-peer communication

2.1 General

All data link layer peer-to-peer exchanges are in frames conforming to one of the formats shown in Figure 1/Q.921. Two format types are shown in the figure: format A for frames where there is no information field and format B for frames containing an information field.

2.2 Flag sequence

All frames shall start and end with the flag sequence consisting of one 0 bit followed by six contiguous 1 bits and one 0 bit. The flag preceding the address field is defined as the opening flag. The flag following the Frame Check Sequence (FCS) field is defined as the closing flag. The closing flag may also serve as the opening flag of the next frame, in some applications. However, all receivers must be able to accommodate receipt of one or more consecutive flags. See ISDN User-Network Interfaces: Layer 1 Recommendations (I.43x series) [4], [5] for applicability.

2.3 Address field

The address field shall consist of two octets as illustrated in Figure 1/Q.921. The address field identifies the intended receiver of a command frame and the transmitter of a response frame. The format of the address field is defined in § 3.2.

A single octet address field is reserved for LAPB operation in order to allow a single LAPB [6] data link connection to be multiplexed along with LAPD data link connections.

Format A

8 7 6 5 4 3 2 1	
Flag 0 1 1 1 1 1 1 0	Octet 1
Address (high order octet)	2
Address (low order octet)	3
Control[a)] Control[a)]	4
FCS (first octet)	N - 2
FCS (second octet)	N - 1
Flag 0 1 1 1 1 1 1 0	N

Format B

8 7 6 5 4 3 2 1	
Flag 0 1 1 1 1 1 1 0	Octet 1
Address (high order octet)	2
Address (low order octet)	3
Control[a)] Control[a)]	4
Information	• • • •
FCS (first octet)	N - 2
FCS (second octet)	N - 1
Flag 0 1 1 1 1 1 1 0	N

a) Unacknowledged operation – one octet
Multiple frame operation – two octets for frames with sequence numbers;
– one octet for frames without sequence numbers

FIGURE 1/Q.921

Frame formats

2.4 Control field

The control field shall consist of one or two octets. Figure 1/Q.921 illustrates the two frame formats (A and B), each with a control field of one or two octets, depending upon the type of frame.

The format of the control field is defined in § 3.4.

2.5 Information field

The information field of a frame, when present, follows the control field (see § 2.4 above) and precedes the frame check sequence (see § 2.7 below). The contents of the information field shall consist of an integer number of octets.

The maximum number of octets in the information field is defined in § 5.9.3.

2.6 Transparency

A transmitting data link layer entity shall examine the frame content between the opening and closing flag sequences, (address, control, information and FCS fields) and shall insert a 0 bit after all sequences of five contiguous 1 bits (including the last five bits of the FCS) to ensure that a flag or an abort sequence is not simulated within the frame. A receiving data link layer entity shall examine the frame contents between the opening and closing flag sequences and shall discard any 0 bit which directly follows five contiguous 1 bits.

2.7 Frame check sequence (FCS) field

The FCS field shall be a 16-bit sequence. It shall be the ones complement of the sum (modulo 2) of:

a) the remainder of x^k $(x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency, and

b) the remainder of the division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the product of x^{16} by the content of the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.

As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all 1s and is then modified by division by the generator polynomial (as described above) on the address, control and information fields; the ones complement of the resulting remainder is transmitted as the 16-bit FCS.

As a typical implementation at the receiver, the initial content of the register of the device computing the remainder is preset to all 1s. The final remainder, after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the serial incoming protected bits and the FCS, will be 0001110100001111 (x^{15} through x^0, respectively) in the absence of transmission errors.

2.8 Format convention

2.8.1 Numbering convention

The basic convention used in this Recommendation is illustrated in Figure 2/Q.921. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1 to 8. Multiple octets are shown vertically and are numbered from 1 to n.

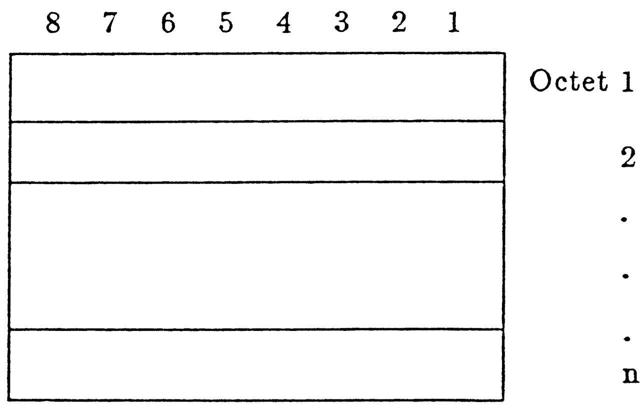


FIGURE 2/Q.921

Format convention

2.8.2 Order of bit transmission

The octets are transmitted in ascending numerical order; inside an octet bit 1 is the first bit to be transmitted.

2.8.3 Field mapping convention

When a field is contained within a single octet, the lowest bit number of the field represents the lowest order value.

When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the field represents the lowest order value.

For example, a bit number can be identified as a couple (o, b) where o is the octet number and b is the relative bit number within the octet. Figure 3/Q.921 illustrates a field that spans from bit (1, 3) to bit (2, 7). The high order bit of the field is mapped on bit (1, 3) and the low order bit is mapped on bit (2, 7).

8	7	6	5	4	3	2	1	
					2^4	2^3	2^2	1st octet of the field
2^1	2^0							2nd octet of the field

FIGURE 3/Q.921

Field mapping convention

An exception to the preceding field mapping convention is the data link layer FCS field, which spans two octets. In this case, bit 1 of the first octet is the high order bit and bit 8 of the second octet is the low order bit (Figure 4/Q.921).

8	7	6	5	4	3	2	1	
2^8							2^{15}	1st octet of the field
2^0							2^7	2nd octet of the field

FIGURE 4/Q.921

FCS mapping convention

2.9 Invalid frames

An invalid frame is a frame which:

a) is not properly bounded by two flags, or

b) has fewer than six octets between flags of frames that contain sequence numbers and fewer than five octets between flags of frames that do not contain sequence numbers, or

c) does not consist of an integral number of octets prior to zero bit insertion or following zero bit extraction, or

d) contains a frame check sequence error, or

e) contains a single octet address field.

Invalid frames shall be discarded without notification to the sender. No action is taken as the result of that frame.

2.10 Frame abort

Receipt of seven or more contiguous 1 bits shall be interpreted as an abort and the data link layer shall ignore the frame currently being received.

3 Elements of procedures and formats of fields for data link layer peer-to-peer communication

3.1 General

The elements of procedures define the commands and responses that are used on the data link connections carried on the D-channel.

Procedures are derived from these elements of procedures and are described in § 5.

3.2 Address field format

The address field format shown in Figure 5/Q.921 contains the address field extension bits, a command/response indication bit, a data link layer Service Access Point Identifier (SAPI) subfield, and a Terminal Endpoint Identifier (TEI) subfield.

8	7	6	5	4	3	2	1	
SAPI						C/R	EA 0	Octet 2
TEI							EA 1	3

EA = Address field extension bit

C/R = Command/response field bit

SAPI = Service access point identifier

TEI = Terminal endpoint identifier

FIGURE 5/Q.921

Address field format

3.3 Address field variables

3.3.1 Address field extension bit (EA)

The address field range is extended by reserving the first transmitted bit of the address field octets to indicate the final octet of the address field. The presence of a 1 in the first bit of an address field octet signals that it is the final octet of the address field. The double octet address field for LAPD operation shall have bit 1 of the first octet set to a 0 and bit 1 of the second octet set to 1.

3.3.2 Command/response field bit (C/R)

The C/R bit identifies a frame as either a command or a response. The user side shall send commands with the C/R bit set to 0, and responses with the C/R bit set to 1. The network side shall do the opposite; that is commands are sent with C/R set to 1, and responses are sent with C/R set to 0. The combinations for the network side and user side are shown in Table 1/Q.921.

In conformance with HDLC rules, commands use the address of the peer data link layer entity while responses use the address of their own data link layer entity. According to these rules, both peer entities on a point-to-point data link connection use the same Data Link Connection Identifier (DLCI) composed of a SAPI-TEI where SAPI and TEI conform to the definitions contained in §§ 3.3.3 and 3.3.4 and define the data link connection as described in Recommendation Q.920, § 3.4.1.

TABLE 1/Q.921

C/R field bit usage

Command/Response	*direction*	*C/R value*
Command	network side → user side	1
	user side → network side	0
Response	network side → user side	0
	user side → network side	1

3.3.3 Service access point identifier (SAPI)

The SAPI identifies a point at which data link layer services are provided by a data link layer entity to a layer 3 or management entity. Consequently, the SAPI specifies a data link layer entity that should process a data link layer frame and also a layer 3 or management entity which is to receive information carried by the data link layer frame. The SAPI allows 64 service access points to be specified, where bit 3 of the address field octet containing the SAPI is the least significant binary digit and bit 8 is the most significant. The SAPI values are allocated as shown in Table 2/Q.921.

TABLE 2/Q.921

SAPI Value	Related layer 3 or management entity
0	Call control procedures
1	Reserved for packet mode communications using Q.931 call control procedures
16	Packet communication conforming to X.25 Level 3 procedures
63	Layer 2 Management procedures
All Others	Reserved for future standardization

Note – The reservation of SAPI values for experimental purposes is for further study.

3.3.4 Terminal endpoint identifier (TEI)

The TEI for a point-to-point data link connection may be associated with a single Terminal Equipment (TE). A TE may contain one or more TEIs used for point-to-point data transfer. The TEI for a broadcast data link connection is associated with all user side data link layer entities containing the same SAPI. The TEI subfield allows 128 values where bit 2 of the address field octet containing the TEI is the least significant binary digit and bit 8 is the most significant binary digit. The following conventions shall apply in the assignment of these values.

3.3.4.1 TEI for broadcast data link connection

The TEI subfield bit pattern 111 1111 (= 127) is defined as the group TEI. The group TEI is assigned to the broadcast data link connection associated with the addressed Service Access Point (SAP).

3.3.4.2 TEI for point-to-point data link connection

The remaining TEI values are used for the point-to-point data link connections associated with the addressed SAP. The range of TEI values shall be allocated as shown in Table 3/Q.921.

Non-automatic TEI values are selected by the user, and their allocation is the responsibility of the user.

Automatic TEI values are selected by the network, and their allocation is the responsibility of the network.

For further information regarding point-to-point situations, see Annex A.

TABLE 3/Q.921

TEI Value	User Type
0-63	Non-automatic TEI assignment user equipment
64-126	Automatic TEI assignment user equipment

3.4 Control field formats

The control field identifies the type of frame, which will be either a command or response. The control field will contain sequence numbers, where applicable.

Three types of control field formats are specified: numbered information transfer (I format), supervisory functions (S format), and unnumbered information transfers and control functions (U format). The control field formats are shown in Table 4/Q.921.

TABLE 4/Q.921

Control field formats

Control field bits (modulo 128)	8	7	6	5	4	3	2	1	
I format	N(S)							0	Octet 4
	N(R)							P	5
S format	X	X	X	X	S	S	0	1	Octet 4
	N(R)							P/F	5
U format	M	M	M	P/F	M	M	1	1	Octet 4

N(S)	Transmitter send sequence number	M	Modifier function bit
N(R)	Transmitter receive sequence number	P/F	Poll bit when issued as a command, final bit when issued as a response
S	Supervisory function bit	X	Reserved and set to 0

3.4.1 Information transfer (I) format

The I format shall be used to perform an information transfer between layer 3 entities. The functions of N(S), N(R) and P (defined in § 3.5) are independent; that is, each I frame has an N(S) sequence number, an N(R) sequence number which may or may not acknowledge additional I frames received by the data link layer entity, and a P bit that may be set to 0 or 1.

The use of N(S), N(R), and P is defined in § 5.

3.4.2 Supervisory (S) format

The S format shall be used to perform data link supervisory control functions such as: acknowledge I frames, request retransmission of I frames, and request a temporary suspension of transmission of I frames. The functions of N(R) and P/F are independent, that is, each supervisory frame has an N(R) sequence number which may or may not acknowledge additional I frames received by the data link layer entity, and a P/F bit that may be set to 0 or 1.

3.4.3 Unnumbered (U) format

The U format shall be used to provide additional data link control functions and unnumbered information transfers for unacknowledged information transfer. This format does not contain sequence numbers. It does include a P/F bit that may be set to 0 or 1.

3.5 Control field parameters and associated state variables

The various parameters associated with the control field formats are described in this section. The coding of the bits within these parameters is such that the lowest numbered bit within the parameter field is the least significant bit.

3.5.1 Poll/Final (P/F) bit

All frames contain the Poll/Final (P/F) bit. The P/F bit serves a function in both command frames and response frames. In command frames the P/F bit is referred to as the P bit. In response frames it is referred to as the F bit. The P bit set to 1 is used by a data link layer entity to solicit (poll) a response frame from the peer data link layer entity. The F bit set to 1 is used by a data link layer entity to indicate the response frame transmitted as a result of a soliciting (poll) command.

The use of the P/F bit is described in § 5.

3.5.2 Multiple frame operation — variables and sequence numbers

3.5.2.1 Modulus

Each I frame is sequentially numbered and may have the value 0 through *n* minus 1 (where *n* is the modulus of the sequence numbers). The modulus equals 128 and the sequence numbers cycle through the entire range, 0 through 127.

3.5.2.2 Send state variable V(S)

Each point-to-point data link connection endpoint shall have an associated V(S) when using I frame commands. V(S) denotes the sequence number of the next I frame to be transmitted. The V(S) can take on the value 0 through *n* minus 1. The value of V(S) shall be incremented by 1 with each successive I frame transmission, and shall not exceed V(A) by more than the maximum number of outstanding I frames *k*. The value of *k* may be in the range of $1 \leq k \leq 127$.

3.5.2.3 Acknowledge state variable V(A)

Each point-to-point data link connection endpoint shall have an associated V(A) when using I frame commands and supervisory frame commands/responses. V(A) identifies the last frame that has been acknowledged by its peer [V(A) − 1 equals the N(S) of the last acknowledged I frame]. V(A) can take on the value 0 through *n* minus 1. The value of V(A) shall be updated by the valid N(R) values received from its peer (see § 3.5.2.6). A valid N(R) value is one that is in the range $V(A) \leq N(R) \leq V(S)$.

3.5.2.4 Send sequence number N(S)

Only I frames contain N(S), the send sequence number of transmitted I frames. At the time that an in-sequence I frame is designated for transmission, the value of N(S) is set equal to V(S).

3.5.2.5 Receive state variable V(R)

Each point-to-point data link connection endpoint shall have an associated V(R) when using I frame commands and supervisory frame commands/responses. V(R) denotes the sequence number of the next in-sequence I frame expected to be received. V(R) can take on the value 0 through *n* minus 1. The value of V(R) shall be incremented by one with the receipt of an error-free, in-sequence I frame whose N(S) equals V(R).

3.5.2.6 Receive sequence number N(R)

All I frames and supervisory frames contain N(R), the expected send sequence number of the next received I frame. At the time that a frame of the above types is designated for transmission, the value of N(R) is set equal to V(R). N(R) indicates that the data link layer entity transmitting the N(R) has correctly received all I frames numbered up to and including N(R) – 1.

3.5.3 Unacknowledged operation – variables and parameters

No variables are defined. One parameter is defined, N201 (see § 5.9.3).

3.6 Frame types

3.6.1 Commands and responses

The following commands and responses are used by either the user or the network data link layer entities and are represented in Table 5/Q.921. Each data link connection shall support the full set of commands and responses for each application implemented. The frame types associated with each of the two applications are identified in Table 5/Q.921.

Frame types associated with an application not implemented shall be discarded and no action shall be taken as a result of that frame.

For purposes of the LAPD procedures in each application, those encodings not identified in Table 5/Q.921 are identified as undefined command and response control fields. The actions to be taken are specified in § 5.8.5.

The commands and responses in Table 5/Q.921 are defined in §§ 3.6.2-3.6.12.

TABLE 5/Q.921

Commands and responses - modulo 128

Application	Format	Commands	Responses	Encoding 8	7	6	5	4	3	2	1	Octet
Unacknowledged and Multiple Frame Acknowledged Information Transfer	Information Transfer	I (information)		N(S)							0	4
				N(R)							P	5
	Supervisory	RR (receive ready)	RR (receive ready)	0	0	0	0	0	0	0	1	4
				N(R)							P/F	5
		RNR (receive not ready)	RNR (receive not ready)	0	0	0	0	0	1	0	1	4
				N(R)							P/F	5
		REJ (reject)	REJ (reject)	0	0	0	0	1	0	0	1	4
				N(R)							P/F	5
	Unnumbered	SABME (set asynchronous balanced mode extended)		0	1	1	P	1	1	1	1	4
			DM (disconnected mode)	0	0	0	F	1	1	1	1	4
		UI (unnumbered information)		0	0	0	P	0	0	1	1	4
		DISC (disconnect)		0	1	0	P	0	0	1	1	4
			UA (unnumbered acknowledgement)	0	1	1	F	0	0	1	1	4
			FRMR (frame reject)	1	0	0	F	0	1	1	1	4
Connection Management		XID (Exchange Identification) See Note	XID (Exchange Identification) See Note	1	0	1	P/F	1	1	1	1	4

Note - Use of the XID frame other than for parameter negotiation procedures (see § 5.4) is for further study.

3.6.2 Information (I) command

The function of the information (I) command is to transfer, across a data link connection, sequentially numbered frames containing information fields provided by layer 3. This command is used in the multiple frame operation on point-to-point data link connections.

3.6.3 Set asynchronous balanced mode extended (SABME) command

The SABME unnumbered command is used to place the addressed user side or network side into modulo 128 multiple frame acknowledged operation.

No information field is permitted with the SABME command. A data link layer entity confirms acceptance of an SABME command by the transmission at the first opportunity of a UA response. Upon acceptance of this command, the data link layer entity's V(S), V(A), and V(R) are set to 0. The transmission of an SABME command indicates the clearance of all exception conditions.

Previously transmitted I frames that are unacknowledged when this command is processed remain unacknowledged and are discarded. It is the responsibility of a higher level (for example, layer 3) or the management entity to recover from the possible loss of the contents of such I frames.

3.6.4 Disconnect (DISC) command

The DISC unnumbered command is used to terminate the multiple frame operation.

No information field is permitted with the DISC command. The data link layer entity receiving the DISC command confirms the acceptance of a DISC command by the transmission of a UA response. The data link layer entity sending the DISC command terminates the multiple frame operation when it receives the acknowledging UA or DM response.

Previously transmitted I frames that are unacknowledged when this command is processed remain unacknowledged and are discarded. It is the responsibility of a higher level (for example, layer 3) or the management entity to recover from the possible loss of the contents of such I frames.

3.6.5 Unnumbered information (UI) command

When a layer 3 or management entity requests unacknowledged information transfer, the UI unnumbered command is used to send information to its peer without affecting data link layer variables. UI command frames do not carry a sequence number and therefore, the UI frame may be lost without notification.

3.6.6 Receive ready (RR) command/response

The RR supervisory frame is used by a data link layer entity to:

a) indicate it is ready to receive an I frame;

b) acknowledge previously received I frames numbered up to and including N(R) – 1 (as defined in § 5); and

c) clear a busy condition that was indicated by the earlier transmission of an RNR frame by that same data link layer entity.

In addition to indicating the status of a data link layer entity, the RR command with the P bit set to 1 may be used by the data link layer entity to ask for the status of its peer data link layer entity.

3.6.7 Reject (REJ) command/response

The REJ supervisory frame is used by a data link layer entity to request retransmission of I frames starting with the frame numbered N(R). The value of N(R) in the REJ frame acknowledges I frames numbered up to and including N(R) – 1. New I frames pending initial transmission shall be transmitted following the retransmitted I frame(s).

Only one REJ exception condition for a given direction of information transfer is established at a time. The REJ exception condition is cleared (reset) upon the receipt of an I frame with an N(S) equal to the N(R) of the REJ frame. An optional procedure for the retransmission of a REJ response frame is described in Appendix I.

The transmission of a REJ frame shall also indicate the clearance of any busy condition within the sending data link layer entity that was reported by the earlier transmission of an RNR frame by that same data link layer entity.

In addition to indicating the status of a data link layer entity, the REJ command with P bit set to 1 may be used by the data link layer entity to ask for the status of its peer data link layer entity.

3.6.8 Receive not ready (RNR) command/response

The RNR supervisory frame is used by a data link layer entity to indicate a busy condition; that is, a temporary inability to accept additional incoming I frames. The value of N(R) in the RNR frame acknowledges I frames numered up to and including N(R)-1.

In addition to indicating the status of a data link layer entity, the RNR command with the P bit set to 1 may be used by the data link layer entity to ask for the status of its peer data link layer entity.

3.6.9 Unnumbered acknowledgement (UA) response

The UA unnumbered response is used by a data link layer entity to acknowledge the receipt and acceptance of the mode-setting commands (SABME or DISC). Received mode-setting commands are not processed until the UA response is transmitted. No information field is permitted with the UA response. The transmission of the UA response indicates the clearance of any busy condition that was reported by the earlier transmission of an RNR frame by that same data link layer entity.

3.6.10 Disconnected mode (DM) response

The DM unnumbered response is used by a data link layer entity to report to its peer that the data link layer is in a state such that multiple frame operation cannot be performed. No information field is permitted with the DM response.

3.6.11 Frame reject (FRMR) response

The FRMR unnumbered response may be received by a data link layer entity as a report of an error condition not recoverable by retransmission of the identical frame, i.e. at least one of the following error conditions resulting from the receipt of a valid frame:

a) the receipt of a command or response control field that is undefined or not implemented;

b) the receipt of a supervisory or unnumbered frame with incorrect length;

c) the receipt of an invalid N(R); or

d) the receipt of an I frame with an information field which exceeds the maximum established length.

An undefined control field is any of the control field encodings that are not identified in Table 5/Q.921.

A valid N(R) value is one that is in the range $V(A) \leq N(R) \leq V(S)$.

An information field which immediately follows the control field and consists of five octets (modulo 128 operation) is returned with this response and provides the reason for the FRMR response. This information field format is given in Figure 6/Q.921.

8	7	6	5	4	3	2	1	
Rejected frame								Octet 5
Control field								6
V(S)							0	7
V(R)							C/R	8
0	0	0	0	Z	Y	X	W	9

— Rejected frame control field is the control field of the received frame which caused the frame reject. When the rejected frame is an unnumbered frame, the control field of the rejected frame is positioned in octet 5, with octet 6 set to 0000 0000 .

— V(S) is the current send state variable value on the user side or network side reporting the rejection condition.

— C/R is set to 1 if the frame rejected was a response and is set to 0 if the frame rejected was a command.

— V(R) is the current receive state variable value on the user side or network side reporting the rejection condition.

— W set to 1 indicates that the control field received and returned in octets 5 and 6 was undefined or not implemented.

— X set to 1 indicates that the control field received and returned in octets 5 and 6 was considered invalid because the frame contained an information field which is not permitted with this frame or is a supervisory or unnumbered frame with incorrect length. Bit W must be set to 1 in conjunction with this bit.

— Y set to 1 indicates that the information field received exceeded the maximum established information field length (N201) of the user side or network side reporting the rejection condition.

— Z set to 1 indicates that the control field received and returned in octets 5 and 6 contained an invalid N(R).

— Octet 7 bit 1 and octet 9 bits 5 through 8 shall be set to 0 .

FIGURE 6/Q.921

FRMR information field format - extended (modulo 128) operation

3.6.12 Exchange identification (XID) command/response

The XID frame may contain an information field in which the identification information is conveyed. The exchange of XID frames is a compelled arrangement used in connection management (i.e. when a peer entity receives an XID command, it shall respond with an XID response at the earliest time possible). No sequence numbers are contained within the control field.

The information field is not mandatory. However, if a valid XID command contains an information field and the receiver can interpret its contents, the receiver should then respond with an XID response also containing an information field. If the information field cannot be interpreted by the receiving entity, or a zero length information field has been received, an XID response frame shall be issued containing a zero length information field. The maximum length of the information field must conform to the value N201.

Sending or receiving an XID frame shall have no effect on the operational mode or state variables associated with the data link layer entities.

4 Elements for layer-to-layer communication

4.1 General

Communications between layers and, for this Recommendation, between the data link layer and the layer management are accomplished by means of primitives.

Primitives represent, in an abstract way, the logical exchange of information and control between the data link and adjacent layers. They do not specify or constrain implementations.

Primitives consist of commands and their respective responses associated with the services requested of a lower layer. The general syntax of a primitive is:

XX — Generic name — Type: Parameters

where XX designates the interface across which the primitive flows. For this Recommendation, XX is:

- DL for communication between layer 3 and the data link layer;
- PH for communication between the data link layer and the physical layer;
- MDL for communication between the layer management and the data link layer; or
- MPH for communication between the management entity and the physical layer.

4.1.1 Generic names

The generic name specifies the activity that should be performed. Table 6/Q.921 illustrates the primitives defined in this Recommendation. Note that not all primitives have associated parameters.

Table 6/Q.921, p. 59

The primitive generic names that are defined in this Recommendation are:

4.1.1.1 DL-ESTABLISH

The DL-ESTABLISH primitives are used to request, indicate and confirm the outcome of the procedures for establishing multiple frame operation.

4.1.1.2 DL-RELEASE

The DL-RELEASE primitives are used to request, indicate and confirm the outcome of the procedures for terminating a previously established multiple frame operation, or for reporting an unsuccessful establishment attempt.

4.1.1.3 DL-DATA

The DL-DATA primitives are used to request and indicate layer 3 messages which are to be transmitted, or have been received, by the data link layer using the acknowledged information transfer service.

4.1.1.4 DL-UNIT DATA

The DL-UNIT DATA primitives are used to request and indicate layer 3 messages which are to be transmitted, or have been received, by the data link layer using the unacknowledged information transfer service.

4.1.1.5 MDL-ASSIGN

The MDL-ASSIGN primitives are used by the layer management entity to request that the data link layer associate the TEI value contained within the message unit of the primitive with the specified Connection Endpoint Suffix (CES), across all SAPIs. The MDL-ASSIGN primitive is used by the data link layer to indicate to the layer management entity the need for a TEI value to be associated with the CES specified in the primitive message unit.

4.1.1.6 MDL-REMOVE

The MDL-REMOVE primitives are used by the layer management entity to request that the data link layer remove the association of the specified TEI value with the specified CES, across all SAPIs. The TEI and CES are specified by the MDL-REMOVE primitive message unit.

4.1.1.7 MDL-ERROR

The MDL-ERROR primitives are used to indicate to the connection management entity that an error has occurred, associated with a previous management function request or detected as a result of communication with the data link layer peer entity. The layer management entity may respond with an MDL-ERROR primitive if the layer management entity cannot obtain a TEI value.

4.1.1.8 MDL-UNIT DATA

The MDL-UNIT DATA primitives are used to request and indicate layer management entity messages which are to be transmitted, or have been received, by the data link layer using the unacknowledged information transfer service.

4.1.1.9 MDL-XID

The MDL-XID primitives are used by the connection management entity to request, indicate, respond and confirm the outcome of the actions for the use of the XID procedures.

4.1.1.10 PH-DATA

The PH-DATA primitives are used to request and indicate message units containing frames used for data link layer peer-to-peer communications passed to and from the physical layer.

4.1.1.11 PH-ACTIVATE

The PH-ACTIVATE primitives are used to request activation of the physical layer connection or to indicate that the physical layer connection has been activated.

4.1.1.12 PH-DEACTIVATE

The PH-DEACTIVATE primitive is used to indicate that the physical layer connection has been deactivated.

4.1.1.13 MPH-ACTIVATE (see Appendix III)

The MPH-ACTIVATE primitive is used to indicate that the physical layer connection has been activated.

4.1.1.14 MPH-DEACTIVATE (see Appendix III)

The MPH-DEACTIVATE primitives are used to request deactivation of the physical layer connection or to indicate that the physical layer connection has been deactivated. The —REQUEST primitive is for use by the network side system management entity.

4.1.1.15 MPH-INFORMATION

The MPH-INFORMATION primitive is for use by the user side management entity, and provides an indication as to whether the terminal is:

- connected; or
- disconnected or unable to provide sufficient power to support the TEI management procedures.

4.1.2 Primitive types

The primitive types defined in this Recommendation are:

4.1.2.1 REQUEST

The REQUEST primitive type is used when a higher layer or layer management is requesting a service from the lower layer.

4.1.2.2 INDICATION

The INDICATION primitive type is used by a layer providing a service to inform the higher layer or layer management.

4.1.2.3 RESPONSE

The RESPONSE primitive type is used by layer management as a consequence of the INDICATION primitive type.

4.1.2.4 CONFIRM

The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

Figure 7/Q.921 illustrates the relationship of the primitive types to layer 3 and the data link layer.

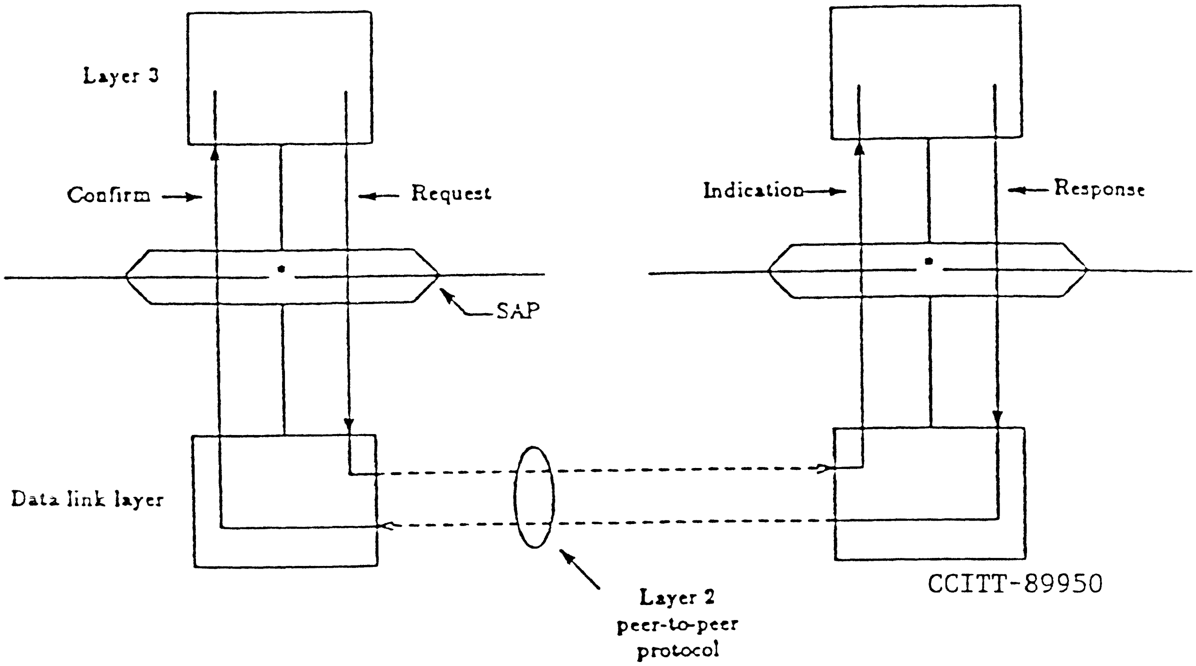


FIGURE 7/Q.921

Relationship of the primitive types to layer 3 and the data link layer

4.1.3 Parameter definition

4.1.3.1 Priority indicator

Since several SAPs may exist on the network side or user side, protocol messages units sent by one SAP may contend with those of other service access points for the physical resources available for message transfer. The priority indicator is used to determine which message unit will have greater priority when contention exists. The priority indicator is only needed at the user side for distinguishing message units sent by the SAP with a SAPI value of 0 from all other message units.

4.1.3.2 Message unit

The message unit contains additional layer-to-layer information concerning actions and results associated with requests. In the case of the DATA primitives, the message unit contains the requesting layer peer-to-peer messages. For example, the DL-DATA message unit contains layer 3 information. The PH-DATA message unit contains the data link layer frame.

Note — The operations across the data link layer/layer 3 boundary shall be such that the layer sending the DL-DATA or DL-UNIT DATA primitive can assume a temporal order of the bits within the message unit and that the layer receiving the primitive can reconstruct the message with its assumed temporal order.

TABLE 6/Q.921

Primitives associated with Recommendation Q.921

Generic name	*Type*				*Parameters*		*Message unit contents*
	Request	*Indication*	*Response*	*Confirm*	*Priority indicator*	*Message unit*	
L3 <-> L2							
DL-ESTABLISH	X	X	—	X	—	—	
DL-RELEASE	X	X	—	X	—	—	
DL-DATA	X	X	—	—	—	X	Layer 3 peer-to-peer message
DL-UNIT DATA	X	X	—	—	—	X	Layer 3 peer-to-peer message
M <-> L2							
MDL-ASSIGN	X	X	—	—	—	X	TEI value, CES
MDL-REMOVE	X	—	—	—	—	X	TEI value, CES
MDL-ERROR	—	X	X	—	—	X	Reason for error message
MDL-UNIT DATA	X	X	—	—	—	X	Management function peer-to-peer message
MDL-XID	X	X	X	X	—	X	Connection management information
L2 <-> L1							
PH-DATA	X	X	—	—	X	X	Data link layer peer-to-peer message
PH-ACTIVATE	X	X	—	—	—	—	
PH-DEACTIVATE	—	X	—	—	—	—	
M <-> L1							
MPH-ACTIVATE	—	X	—	—	—	—	
MPH-DEACTIVATE	X	X	—	—	—	—	
MPH-INFORMATION	—	X	—	—	—	X	connected/disconnected

L3 ↔ L2: Layer 3/data link layer boundary
L2 ↔ L1: Data link layer/physical layer boundary
M ↔ L2: Management entity/data link layer boundary
M ↔ L1: Management entity/physical layer boundary

4.2 Primitive procedures

4.2.1 General

Primitive procedures specify the interactions between adjacent layers to invoke and provide a service. The service primitives represent the elements of the procedures.

In the scope of this Recommendation the interactions between layer 3 and the data link layer are specified.

4.2.2 Layer 3 – data link layer interactions

The states of a data link connection endpoint may be derived from the internal states of the data link layer entity supporting this type of a data link connection.

Data link connection endpoint states are defined as follows:

a) Broadcast data link connection endpoint:

- information transfer state.

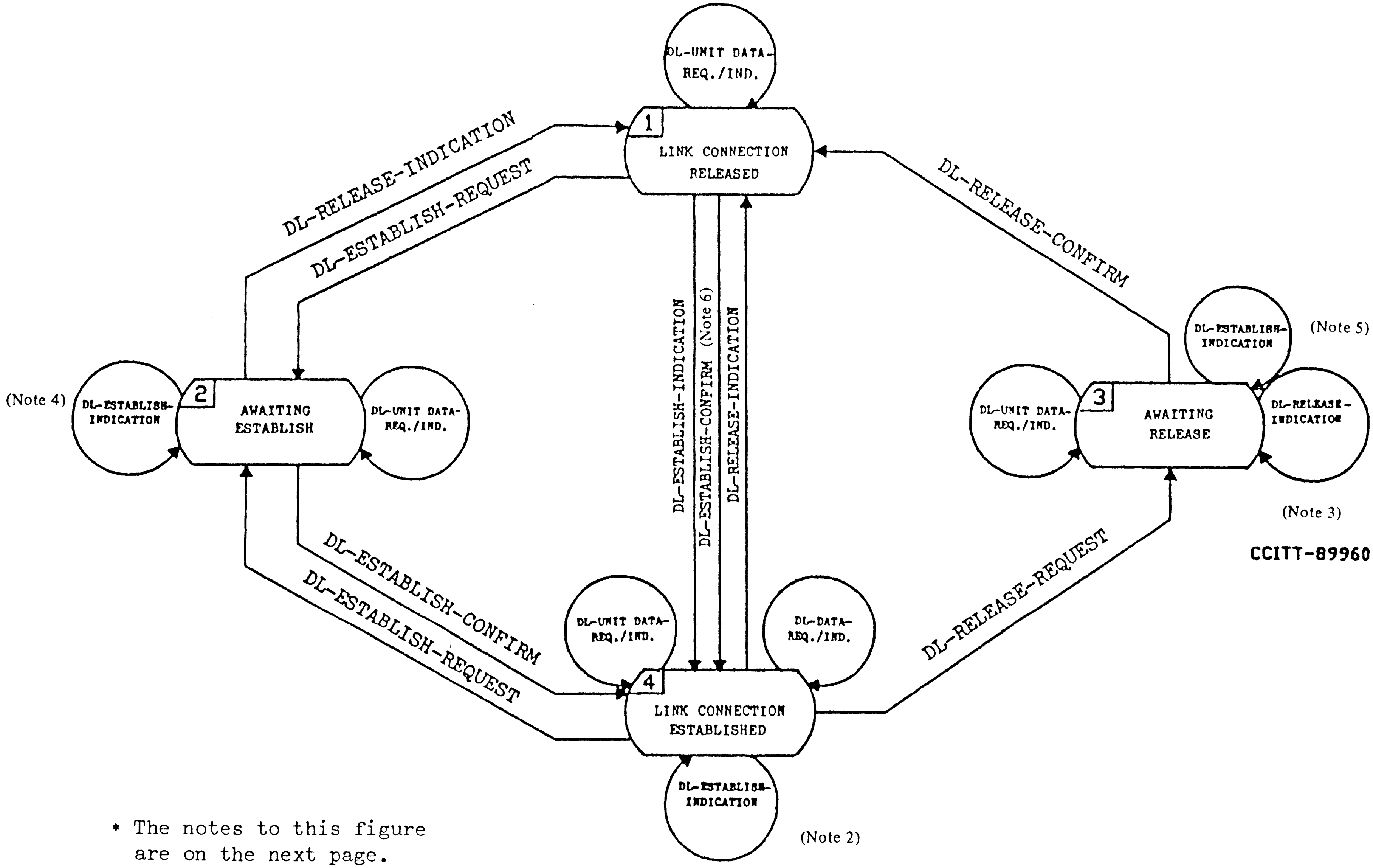
b) Point-to-point data link connection endpoint:

- link connection released state;
- awaiting establish state;
- awaiting release state;
- link connection established state.

The primitives provide the procedural means to specify conceptually how a data link service user can invoke a service.

This section defines the constraints on the sequences in which the primitives may occur. The sequences are related to the states at one point-to-point data link connection endpoint.

The possible overall sequences of primitives at a point-to-point data link connection endpoint are defined in the state transition diagram, Figure 8/Q.921. The link connection released and link connection established states are stable states whilst the awaiting establish and awaiting release states are transition states.



* The notes to this figure are on the next page.

FIGURE 8/Q.921

State Transition Diagram for sequences of Primitives at a point-to-point Data Link Connection as seen by Layer 3 (Note 1)

Notes to Figure 8/Q.921:

Note 1 — If the data link layer entity issues a DL-ESTABLISH-INDICATION (this applies to the case of data link layer initiated or peer system initiated re-establishment), DL-RELEASE-CONFIRM or DL-RELEASE-INDICATION, this indicates the discard of all the data link service data units representing DL-DATA-REQUESTs.

Note 2 — This primitive notifies layer 3 of link re-establishment.

Note 3 — This primitive will occur if a DL-RELEASE-REQUEST collides with a DL-RELEASE-INDICATION.

Note 4 — This primitive will occur if a DL-ESTABLISH-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note 5 — This primitive will occur if a DL-RELEASE-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note 6 — This primitive will occur if a DL-ESTABLISH-REQUEST (this applies to the case of layer 3 initiated re-establishment) collides with a DL-RELEASE-INDICATION. Since this DL-RELEASE-INDICATION is not related to the DL-ESTABLISH-REQUEST, the data link layer will establish the link and issue a DL-ESTABLISH-CONFIRM.

5 Definition of the peer-to-peer procedures of the data link layer

The procedures for use by the data link layer are specified in the following sections.

The elements of procedure (frame types) which apply are:

a) for unacknowledged information transfer (§ 5.2):

UI-command

b) for multiple frame acknowledged information transfer (§§ 5.5 to 5.8):

SABME-command

UA-response

DM-response

DISC-command

RR-command/response

RNR-command/response

REJ-command/response

I-command

FRMR-response

c) for connection management entity information transfer:

XID-command/response.

5.1 Procedure for the use of the P/F bit

5.1.1 Unacknowledged information transfer

For unacknowledged information transfer the P/F bit is not used and shall be set to 0.

5.1.2 Acknowledged multiple frame information transfer

A data link layer entity receiving an SABME, DISC, RR, RNR, REJ or I frame, with the P bit set to 1, shall set the F bit to 1 in the next response frame it transmits, as defined in Table 7/Q.921.

TABLE 7/Q.921

Immediate response operation of P/F bit

Command received with P bit = 1	Response transmitted with F bit = 1
SABME, DISC	UA, DM
I, RR, RNR, REJ	RR, RNR, REJ (note)

Note — A LAPB data link layer entity may transmit an FRMR or DM response with the F bit set to 1 in response to an I frame or supervisory command with the P bit set to 1.

5.2 Procedures for unacknowledged information transfer

5.2.1 General

The procedures which apply to the transmission of information in unacknowledged operation are defined below.

No data link layer error recovery procedures are defined for unacknowledged operation.

5.2.2 Transmission of unacknowledged information

Note — The term "transmission of a UI frame" refers to the delivery of a UI frame by the data link layer to the physical layer.

Unacknowledged information is passed to the data link layer by layer 3 or management entities using the primitives DL-UNIT DATA-REQUEST or MDL-UNIT DATA-REQUEST, respectively. The layer 3 or management message unit shall be transmitted in a UI command frame.

For broadcast operation, the TEI value in the UI command address field shall be set to 127 (binary 111 1111, the group value).

For point-to-point operation, the appropriate TEI value shall be used.

The P bit shall be set to 0.

In the case of persistent layer 1 deactivation, the data link layer will be informed by an appropriate indication. Upon receipt of this indication, all UI transmission queues shall be discarded.

Note — The network side system management deactivation procedures should ensure that layer 1 is not deactivated before all UI data transfer is completed.

5.2.3 Receipt of unacknowledged information

On receipt of a UI command frame with a SAPI and TEI which are supported by the receiver, the contents of the information field shall be passed to the layer 3 or management entity using the data link layer to layer 3 primitive DL-UNIT DATA-INDICATION or the data link layer to management primitive MDL-UNIT DATA-INDICATION, respectively. Otherwise, the UI command frame shall be discarded.

5.3 Terminal endpoint identifier (TEI) management procedures

5.3.1 General

TEI management is based on the following procedural means:

- TEI assignment procedures (see § 5.3.2);
- TEI check procedures (see § 5.3.3);
- TEI removal procedures (see § 5.3.4);
- optional user equipment initiated TEI Identity verify procedures (see § 5.3.5).

A user equipment in the TEI-unassigned state shall use the TEI assignment procedures to enter the TEI-assigned state. Conceptually, these procedures exist in the layer management entity. The layer management entity on the network side is referred to as the @Assignment Source Point (ASP)\ in this Recommendation.

The purpose of these procedures is to:

a) allow automatic TEI equipment to request the network to assign a TEI value that the data link layer entities within the requesting user equipment will use in their subsequent communications;

b) allow a network to remove a previously assigned TEI value from specific or all user equipments;

c) allow a network to check:

- whether or not a TEI value is in use, or

- whether multiple TEI assignment has occurred;

d) allow user equipment the option to request that the network invoke TEI check procedures.

The user side layer management entity shall instruct the user data link layer entities to remove all TEI values when it is notified that the terminal is disconnected at the interface (as defined in Recommendation I.430).

Additionally, the user side layer management entity should instruct the user data link layer entity to remove a TEI value for its own internal reasons (for example, losing the ability to communicate with the network). The layer management entity shall use the MDL-REMOVE-REQUEST primitive for these purposes.

§ 5.3.4.1 includes the actions taken by a data link layer entity receiving an MDL-REMOVE-REQUEST primitive.

Typically, one TEI value would be used by the user equipment (for example, a data link layer entity which has been assigned a TEI value could use that value for all SAPs which it supports). If required, a number of TEI values may be requested by multiple use of the procedures defined in § 5.3.2. It shall be the responsibility of the user to maintain the association between TEI and SAPI values.

The initiation of TEI assignment procedures occurs on the receipt of a request for establishment or unacknowledged information transfer while in the TEI-unassigned state. The data link layer entity shall inform the layer management entity using the MDL-ASSIGN-INDICATION primitive. Alternatively, the user side layer management entity may initiate the TEI assignment procedures for its own reasons.

Note — In the case of initialization from a no power condition, the user equipment should postpone the start of the TEI assignment procedure until an outgoing or incoming call is to be handled.

All layer management entity messages used for these TEI management procedures are transmitted to, or received from, the data link layer entity using the MDL-UNIT DATA-REQUEST primitive, or the MDL-UNIT DATA-INDICATION primitive, respectively. The data link layer entity shall transmit management entity messages in UI command frames. The SAPI value shall be 63. The TEI value shall be 127.

5.3.2 TEI assignment procedure

If the user equipment is of the non-automatic TEI assignment category, the user side layer management entity shall deliver the TEI value to be used to the data link layer entity(s) via the MDL-ASSIGN-REQUEST primitive.

If the user equipment is of the automatic TEI assignment category, upon initiation of the automatic TEI assignment procedure, the user side layer management entity shall transmit to its peer a message containing the following elements:

a) message type = Identity request;

b) Reference number (Ri); and

c) Action indicator (Ai).

The Reference number, Ri, shall be used to differentiate between a number of user equipments which may simultaneously request assignment of a TEI value. The Ri shall be 2 octets in length and shall be randomly generated for each request message by the user equipments.

All values in the range 0 to 65535 shall be available from the random number generator.

Note — The design of the random number generator should minimize the probability of identical reference numbers being generated by terminals which initiate their TEI assignment procedures simultaneously.

The single-octet Action indicator, Ai, shall be used to indicate a request to the ASP for the assignment of any TEI value available.

The coding of the Ai shall be Ai = Group address TEI = 127. This Ai value requests the ASP to assign any TEI value.

A timer T202 shall be started.

The ASP, on receipt of the Identity request message, shall either:

- select a TEI value;

- deny Identity requests with Ai values in the range 64-126, or ignore Identity requests with the Ai value in the range 0-63; or

- ignore the Identity request message if a previous Identity request message that contains an identical Ri has been received and no response has been issued. In this case, the ASP shall not assign a TEI value to either request.

Selection of a TEI value shall be on the basis of information stored at the ASP. This may consist of:

- a map of the full range of automatic TEI values; or

- an updated list of all automatic TEI values available for assignment, or a smaller subset.

The ASP, after having selected the TEI value, shall inform the network data link entities by means of the MDL-ASSIGN-REQUEST primitive and transmit to its peer a message containing the following elements:

a) message type = Identity assigned;

b) Reference number (Ri); and

c) the assigned TEI value in the Ai field.

If the available TEI information/resources are exhausted, a TEI check procedure should be initiated.

A user side layer management entity receiving this Identity assigned message shall compare the TEI value to its own to see if it is already allocated if an Identity request message is outstanding. Additionally, the TEI value may be compared on the receipt of all Identity assigned messages.

If there is a match, the management entity shall either:

- initiate TEI removal; or

- initiate the TEI identity verify procedures.

If there is no match, the user side layer management entity shall:

- compare the Ri value with any outstanding Identity request message and if it matches, consider the TEI value assigned to the user equipment, discard the value of Ri, inform the user side data link layer entities by means of the MDL-ASSIGN-REQUEST primitive and stop timer T202;

- compare the Ri value with any outstanding Identity request message and if there is no match, do nothing;

- if there is no outstanding Identity request message, do nothing.

When the data link layer receives the MDL-ASSIGN-REQUEST primitive from the layer management entity, the data link layer entity shall:

- enter the TEI-assigned state; and
- proceed with data link establishment procedures if a DL-ESTABLISH-REQUEST primitive is outstanding, or proceed with the transmission of a UI command frame if a DL-UNIT DATA-REQUEST primitive is outstanding.

To deny an Identity request message, the ASP shall transmit to its peer a message containing the following elements:

a) message type = Identity denied;

b) Reference number (Ri); and

c) the value of TEI which is denied in the Ai field (a value of 127 indicates that no TEI values are available).

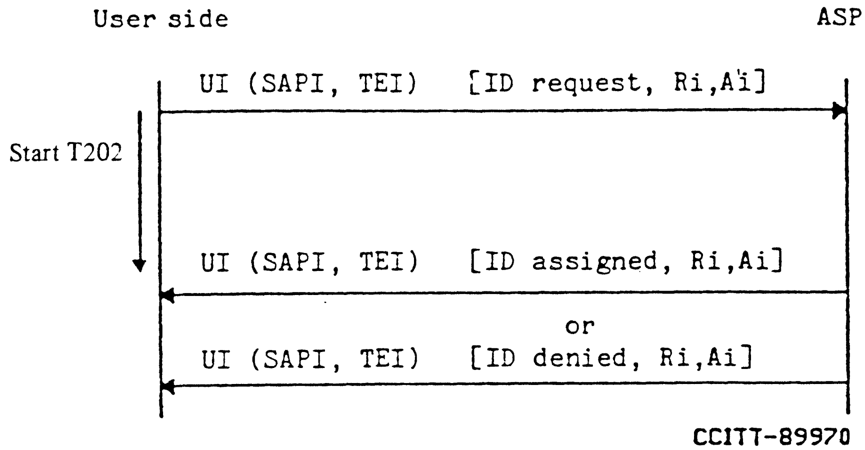
5.3.2.1 Expiry of timer T202

If the user receives either no response or an Identity denied message to its Identity request message, then on expiry of timer T202, the timer shall be restarted and the Identity request message shall be retransmitted with a new value of Ri.

After N202 unsuccessful attempts to acquire a TEI value, the layer management entity shall inform the data link layer entity using the MDL-ERROR-RESPONSE primitive. The data link layer entity receiving the MDL-ERROR-RESPONSE primitive shall respond with the DL-RELEASE-INDICATION primitive if a request for establishment had previously occurred, and shall discard all unserviced DL-UNIT DATA-REQUEST primitives.

The values of T202 and N202 are specified in § 5.9.

The TEI assignment procedure is illustrated in Figure 9/Q.921.



SAPI	: Service access point identifier = 63
TEI	: Group TEI = 127
ID request	: Identity request
ID assigned	: Identity assigned
ID denied	: Identity denied
Ai	: Action indicator, see Table 8/Q.921
Ri	: Reference number
( )	: Contents of the data link layer command address field
[ ]	: Contents of the data link layer command information field

FIGURE 9 /Q.921

TEI assignment procedure

5.3.3 TEI check procedure

5.3.3.1 Use of the TEI check procedure

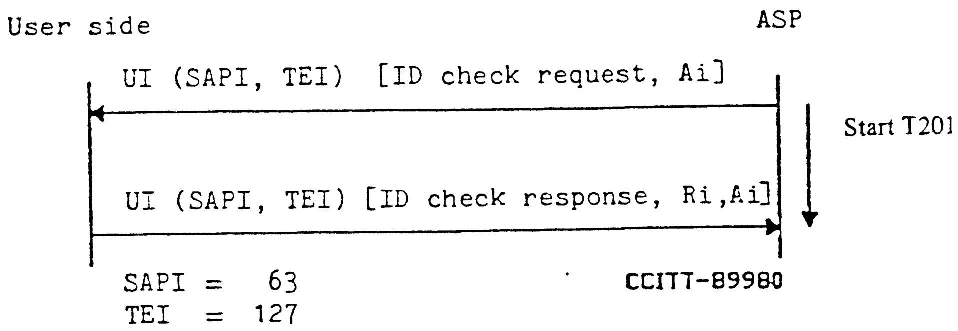
The TEI check procedure shall be used in the TEI audit and recovery procedures. The TEI check procedure allows the network side layer management entity either:

- to establish that a TEI value is in use; or
- to verify multiple TEI assignment.

The TEI check procedure for verifying multiple TEI assignment may also optionally be invoked as a response to an Identity verify request message from the user equipment.

5.3.3.2 Operation of the TEI check procedure

The TEI check procedure is illustrated in Figure 10/Q.921.



Note 1 – For explanation of legends, see Figure 9/Q.921.

FIGURE 10/Q.921

TEI Check procedure

The ASP shall transmit a message containing the following elements:

a) message type = Identity check request; and

b) Ai field which contains the TEI value to be checked or the value 127 when all TEI values are to be checked.

Timer T201 shall be started.

If any user equipment has been assigned the TEI value specified in the identity check request message, it shall respond by transmitting a message containing the following elements:

a) message type = Identity check response;

b) the TEI value in the Ai field; and

c) Reference number (Ri).

When the TEI check procedure is used to verify multiple TEI assignment:

- if more than one Identity check response is received within T201, then multiple TEI assignment shall be considered present; otherwise the request shall be repeated once and timer T201 restarted;

- if more than one Identity check response is received within the second T201 period, multiple TEI assignment shall be considered present;

- if no Identity check response is received after both T201 periods, the TEI value shall be assumed to be free and available for (re)assignment;

- if one Identity check response is received in one or both T201 periods, the TEI value shall be assumed to be in use.

When the TEI check procedure is used to test whether a TEI value is in use, it is completed upon the receipt of the first TEI Identity check response message, and the TEI value is assumed to be in use. Otherwise:

- if no Identity check response is received within T201, the identity check request shall be repeated once and timer T201 restarted;

- if no Identity check response is received after the second Identity check request, the TEI value shall be assumed to be free and available for reassignment.

If the Ai value in the Identity check request is equal to 127, it is preferred that the receiving user side layer management entity respond with a single Identity check response message that contains all of the TEI values in use within that user equipment (see § 5.3.5.5). If an Identity check request with Ai equal to 127 is transmitted and an Identity check response is received making use of the extension facility, each Ai variable in the Ai field shall be processed as if received in separate Identity check responses for parallel Identity check requests.

5.3.4 TEI removal procedure

When the network side layer management entity determines that the removal of a TEI value (see § 5.3.4.2) is necessary, the ASP shall transmit a message containing the following elements and issue an MDL-REMOVE-REQUEST primitive:

a) message type = Identity remove; and

b) TEI value which is to be removed, as indicated in the Ai field (the value 127 indicates that all user equipments should remove their TEI values; otherwise, the specific TEI value should be removed).

The Identity remove message shall be sent twice in succession, to overcome possible message loss.

When the user side layer management entity determines that the removal of a TEI value is necessary (see § 5.3.4.2), it shall instruct the data link layer entity to enter the TEI-unassigned state, using the MDL-REMOVE-REQUEST primitive. This action would also be taken for all TEI values when the Ai field contains the value of 127.

Further action to be taken shall be either initiation of automatic TEI assignment for a new TEI value or notification to the equipment user for the need for corrective action (that is, when equipment uses a non-automatic TEI value and does not support the automatic TEI assignment procedure.)

5.3.4.1 Action taken by the data link layer entity receiving the MDL-REMOVE-REQUEST primitive

A data link layer entity receiving an MDL-REMOVE-REQUEST primitive shall:

a) if no DL-RELEASE-REQUEST primitive is outstanding and the user equipment is not in the TEI-assigned state, issue a DL-RELEASE-INDICATION primitive; or

b) if a DL-RELEASE-REQUEST primitive is outstanding, issue a DL-RELEASE-CONFIRM primitive.

The data link layer entity shall then enter the TEI-unassigned state after discarding the contents of both UI and I queues.

5.3.4.2 Conditions for TEI removal

At the user equipment, automatic TEI values shall be removed, and in the case of non-automatic TEI values, an appropriate indication shall be made to the user under the following conditions:

- on request from the ASP by an Identity remove message;
- on receipt of an MPH-INFORMATION-INDICATION (disconnected) primitive;
- on receipt of an MDL-ERROR-INDICATION primitive indicating that the data link layer entity has assumed possible multiple assignment of a TEI value, rather than requesting a TEI check procedure by the transmission of an Identity verify request message; or
- optionally on receipt of an Identity assigned message containing a TEI value in the Ai field, which is already in use within the user equipment (see § 5.3.2).

At the network side, TEI values should be removed:

- following a TEI audit procedure showing that a TEI value is no longer in use or that multiple TEI assignment has occurred; or
- on receipt of an MDL-ERROR-INDICATION primitive indicating a possible multiple TEI assignment, which may be confirmed by the invocation of the TEI check procedures.

5.3.5 TEI identity verify procedure

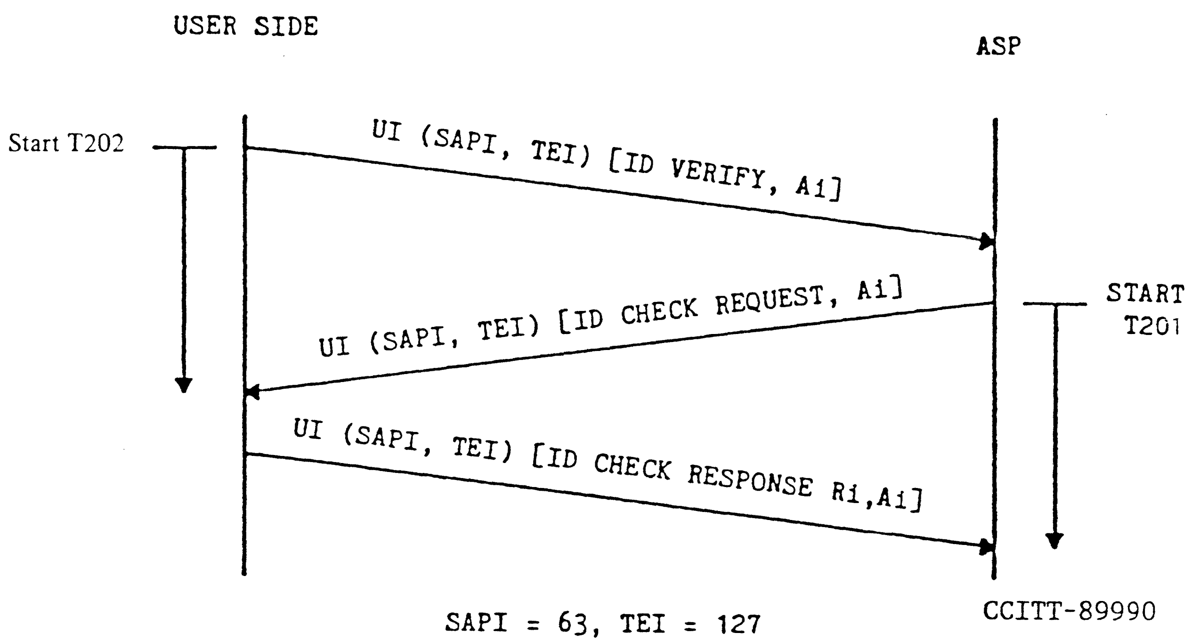
5.3.5.1 General

The TEI identity verify procedure allows the user side layer management entity to have the capability to request that the network invoke the identity check procedure for verification of multiple TEI assignment.

The TEI identity verify procedure is optional for both the network and user equipment.

5.3.5.2 Operation of the TEI identity verify procedure

The TEI identity verify procedure is illustrated in



Note 1 – For explanation of legends, see Figure 9/Q.921.

Note 2 – The Ai in the ID Verify will be in the range 0 to 126.
Ai = 127 is not allowed.

FIGURE 11/Q.921

TEI Identify verify procedure

The user equipment shall transmit an Identity verify message containing the following elements:

a) message type = Identity verify request;

b) the TEI value to be checked in the Ai field; and

c) the Ri field, which is not processed by the network and is coded 0.

Timer T202 is started.

The ASP, on receipt of the TEI Identity verify message shall, if implemented, invoke the TEI check procedure as defined in § 5.3.3. This will result in the ASP sending an Identity check request message to the user equipment.

5.3.5.3 Expiry of Timer T202

If the user equipment receives no Identity check request message with an A_i equal to its TEI or an A_i equal to 127 before the expiry of timer T202, the user side layer management entity shall restart the timer and the Identity verify message shall be retransmitted. If no Identity check request message is received from the ASP after the second Identity verify request, the TEI shall be removed.

5.3.6 Formats and codes

5.3.6.1 General

All messages used for TEI management procedures are carried in the information field of UI command frames with a SAPI value set to 63 (binary 11 1111) and TEI value set to 127 (binary 111 1111).

All messages have the structure shown in Figure 12/Q.921.

8	7	6	5	4	3	2	1	Octet
Management Entity Identifier								1
Reference Number								2
								3
Message Type								4
Action Indicator							E	5

Figure 12/Q.921

Messages used for TEI management procedures

Fields that are not used in a specific message are coded all zeros, and are not to be processed by either side.

The coding of each field for the various messages is specified in Table 8/Q.921.

E is the Action indicator field extension bit (see § 5.3.6.5).

TABLE 8/Q.921

Codes for messages concerning TEI management procedures

Message name	Management entity identifier	Reference number Ri	Message type	Action indicator Ai
Identity request (user to network)	0000 1111	0 - 65535	0000 0001	Ai = 127 , Any TEI value acceptable
Identity assigned (network to user)	0000 1111	0 - 65535	0000 0010	Ai = 64 - 126 , Assigned TEI value
Identity denied (network to user)	0000 1111	0 - 65535	0000 0011	Ai = 64-126, denied TEI value Ai = 127, No TEI value available
Identity check request (network to user)	0000 1111	Not used (coded 0)	0000 0100	Ai = 127 , Check all TEI values Ai = 0 - 126 , TEI value to be checked
Identity check response (user to network)	0000 1111	0 - 65535	0000 0101	Ai = 0 - 126 , TEI value in use
Identity remove (network to user)	0000 1111	Not used (coded 0)	0000 0110	Ai = 127 , Request for removal of all TEI values Ai = 0 - 126 , TEI value to be removed
Identity Verify (user to network)	0000 1111	Not used (coded 0)	0000 0111	Ai = 0 - 126, TEI value to be checked

5.3.6.2 Layer management entity identifier

For TEI administration procedures, the layer management entity identifier octet is 00001111. Other values are reserved for further standardization.

5.3.6.3 Reference number (Ri)

Octets 2 and 3 contain Ri. When used, it can assume any value between 0 and 65535.

5.3.6.4 Message type

Octet 4 contains the message type. The purpose of the message type is to identify the function of the message being sent.

5.3.6.5 Action indicator (Ai)

The Ai field is extended by reserving the first transmitted bit of the Ai field octets to indicate the final octet of the Ai field.

Ai variables in the Ai field are coded as follows:

a) bit 1 is the extension bit and is coded as follows:

- 0 to indicate an extension, and
- 1 to indicate the final octet;

b) bits 2 to 8 contain the Action indicator.

The purpose of the Action indicator is to identify the concerned TEI value(s).

5.4 Automatic negotiation of data link layer parameters

This procedure is defined in Appendix IV.

5.5 Procedures for establishment and release of multiple frame operation

5.5.1 Establishment of multiple frame operation

The provision of extended multiple frame operation (modulo 128 sequencing) is recommended.

5.5.1.1 General

These procedures shall be used to establish multiple frame operation between the network and a designated user entity.

Layer 3 will request establishment of the multiple frame operation by the use of the DL-ESTABLISH-REQUEST primitives. Re-establishment may be initiated as a result of the data link layer procedures defined in § 5.7. All frames other than unnumbered frame formats received during the establishment procedures shall be ignored.

5.5.1.2 Establishment procedures

A data link layer entity shall initiate a request for the multiple frame operation to be set by transmitting the SABME command. All existing exception conditions shall be cleared, the retransmission counter shall be reset, and timer T200 shall then be started (timer T200 is defined in § 5.9.1). All mode setting commands shall be transmitted with the P bit set to 1.

Layer 3 initiated establishment procedures imply the discard of all outstanding DL-DATA-REQUEST primitives and all I frames in queue.

A data link layer entity receiving an SABME command, if it is able to enter the multiple-frame-established state, shall:

- respond with a UA response with the F bit set to the same binary value as the P bit in the received SABME command;
- set V(S), V(R) and V(A) to 0;
- enter the multiple-frame-established state and inform layer 3 using the DL-ESTABLISH-INDICATION primitive;
- clear all existing exception conditions;
- clear any existing peer receiver busy condition; and
- start timer T203 (timer T203 is defined in § 5.9.8), if implemented.

If the data link layer entity is unable to enter the multiple-frame-established state, it shall respond to the SABME command with a DM response with the F bit set to the same binary value as the P bit in the received SABME command.

Upon reception of the UA response with the F bit set to 1, the originator of the SABME command shall:

- reset timer T200;
- start timer T203 if implemented;
- set V(S), V(R), and V(A) to 0; and
- enter the multiple-frame-established state and inform layer 3 using the DL-ESTABLISH-CONFIRM primitive.

Upon reception of a DM response with the F bit set to 1, the originator of the SABME command shall indicate this to layer 3 by means of the DL-RELEASE-INDICATION primitive, and reset timer T200. It shall then enter the TEI-assigned state. DM responses with the F bit set to 0 shall be ignored in this case.

A DL-RELEASE-REQUEST primitive received during data link layer initiated re-establishment shall be serviced on completion of the establishment mode-setting operation.

5.5.1.3 Procedure on expiry of timer T200

If timer T200 expires before the UA or DM response with the F bit set to 1 is received, the data link layer entity shall:

- retransmit the SABME command as above;
- restart timer T200; and
- increment the retransmission counter.

After retransmission of the SABME command N200 times, the data link layer entity shall indicate this to layer 3 and the connection management entity by means of the DL-RELEASE-INDICATION and MDL-ERROR-INDICATION primitives, respectively, and enter the TEI-assigned state, after discarding all outstanding DL-DATA-REQUEST primitives and all I frames in queue.

The value of N200 is defined in § 5.9.2.

5.5.2 Information transfer

Having either transmitted the UA response to a received SABME command or received the UA response to a transmitted SABME command, I frames and supervisory frames shall be transmitted and received according to the procedures described in § 5.6.

If an SABME command is received while in the multiple-frame-established state, the data link layer entity shall conform to the re-establishment procedure described in § 5.7.

On receipt of a UI command, the procedures defined in § 5.2 shall be followed.

5.5.3 Termination of multiple frame operation

5.5.3.1 General

These procedures shall be used to terminate the multiple frame operation between the network and a designated user entity.

Layer 3 will request termination of the multiple frame operation by use of the DL-RELEASE-REQUEST primitive.

All frames other than unnumbered frames received during the release procedures shall be ignored.

All outstanding DL-DATA-REQUEST primitives and all I frames in queue shall be discarded.

In the case of persistant layer 1 deactivation the data link layer entity shall discard all I queues and deliver to layer 3 a DL-RELEASE-CONFIRM primitive if a DL-RELEASE-REQUEST primitive is outstanding, or otherwise a DL-RELEASE-INDICATION primitive.

5.5.3.2 Release procedure

A data link layer entity shall initiate a request for release of the multiple frame operation by transmitting the Disconnect (DISC) command with the P bit set to 1. Timer T200 shall then be started and the retransmission counter reset.

A data link layer entity receiving a DISC command while in the multiple-frame-established or timer recovery state shall transmit a UA response with the F bit set to the same binary value as the P bit in the received DISC command. A DL-RELEASE-INDICATION primitive shall be passed to layer 3, and the TEI-assigned state shall be entered.

If the originator of the DISC command receives either:

- a UA response with the F bit set to 1; or
- a DM response with the F bit set to 1, indicating that the peer data link layer entity is already in the TEI-assigned state,

it shall enter the TEI-assigned state and reset timer T200.

The data link layer entity which issued the DISC command is now in the TEI-assigned state and will notify layer 3 by means of the DL-RELEASE-CONFIRM primitive. The conditions relating to this state are defined in § 5.5.4.

5.5.3.3 Procedure on expiry of timer T200

If timer T200 expires before a UA or DM response with the F bit set to 1 is received, the originator of the DISC command shall:

- retransmit the DISC command as defined in § 5.5.3.2;
- restart timer T200; and
- increment the retransmission counter.

If the data link layer entity has not received the correct response as defined in § 5.5.3.2, after N200 attempts to recover, the data link layer entity shall indicate this to the connection management entity by means of the MDL-ERROR-INDICATION primitive, enter the TEI-assigned state and notify layer 3 by means of the DL-RELEASE-CONFIRM primitive.

5.5.4 TEI-assigned state

While in the TEI-assigned state:

- the receipt of a DISC command shall result in the transmission of a DM response with F bit set to the value of the received P bit;
- on receipt of an SABME command, the procedures defined in § 5.5.1 shall be followed;

- on receipt of an unsolicited DM response with the F bit set to 0, the data link layer entity shall, if it is able to, initiate the establishment procedures by the transmission of an SABME (see § 5.5.1.2). Otherwise, the DM shall be ignored;

- on receipt of UI commands, the procedures defined in § 5.2 shall be followed; and

- on receipt of any unsolicited UA response an MDL-ERROR-INDICATION primitive indicating a possible double assignment of a TEI value shall be issued; and

- all other frame types shall be discarded.

5.5.5 Collision of unnumbered commands and responses

5.5.5.1 Identical transmitted and received commands

If the transmitted and received unnumbered commands (SABME or DISC) are the same, the data link layer entities shall send the UA response at the earliest possible opportunity. The indicated state shall be entered after receiving the UA response. The data link layer entity shall notify layer 3 by means of the appropriate confirm primitive.

5.5.5.2 Different transmitted and received commands

If the transmitted and received unnumbered commands (SABME or DISC) are different, the data link layer entities shall issue a DM response at the earliest possible opportunity. Upon receipt of a DM response with the F bit set to 1, the data link layer shall enter the TEI-assigned state and notify layer 3 by means of the appropriate primitive. The entity receiving the DISC command will issue a DL-RELEASE-INDICATION primitive, while the other entity will issue a DL-RELEASE-CONFIRM primitive.

5.5.6 Unsolicited DM response and SABME or DISC command

When a DM response with the F bit set to 0 is received by a data link layer entity, a collision between a transmitted SABME or DISC command and the unsolicited DM response may have occurred. This is typically caused by a user equipment applying a protocol procedure according to X.25 LAPB [9] to ask for a mode-setting command.

In order to avoid misinterpretation of the DM response received, a data link layer entity shall always send its SABME or DISC command with the P bit set to 1.

A DM response with the F bit set to 0 colliding with an SABME or DISC command shall be ignored.

5.6 Procedures for information transfer in multiple frame operation

The procedures which apply to the transmission of I frames are defined below.

Note — The term "transmission of an I frame" refers to the delivery of an I frame by the data link layer to the physical layer.

5.6.1 Transmitting I frames

Information received by the data link layer entity from layer 3 by means of a DL-DATA-REQUEST primitive shall be transmitted in an I frame. The control field parameters N(S) and N(R) shall be assigned the values of V(S) and V(R), respectively. V(S) shall be incremented by 1 at the end of the transmission of the I frame.

If timer T200 is not running at the time of transmission of an I frame, it shall be started. If time T200 expires, the procedures defined in § 5.6.7 shall be followed.

If V(S) is equal to V(A) plus k (where k is the maximum number of outstanding I frames — see § 5.9.5), the data link layer entity shall not transmit any new I frames, but may retransmit an I frame as a result of the error recovery procedures as described in §§ 5.6.4 and 5.6.7.

When the network side or user side is in the own receiver busy condition, it may still transmit I frames, provided that a peer receiver busy condition does not exist.

Note — Any DL-DATA-REQUEST primitives received whilst in the timer recovery condition shall be queued.

5.6.2 Receiving I frames

Independant of a timer recovery condition, when a data link layer entity is not in an own receiver busy condition and receives a valid I frame whose N(S) is equal to the current V(R), the data link layer entity shall:

- pass the information field of this frame to layer 3 using the DL-DATA-INDICATION primitive;

- increment by 1 its V(R), and act as indicated below.

5.6.2.1 P bit set to 1

If the P bit of the received I frame was set to 1, the data link layer entity shall respond to its peer in one of the following ways:

- if the data link layer entity receiving the I frame is still not in an own receiver busy condition, it shall send an RR response with the F bit set to 1;

- if the data link layer entity receiving the I frame enters the own receiver busy condition upon receipt of the I frame, it shall send an RNR response with the F bit set to 1.

5.6.2.2 P bit set to 0

If the P bit of the received I frame was set to 0 and:

a) if the data link layer entity is still not in an own receiver busy condition:

- if no I frame is available for transmission or if an I frame is available for transmission but a peer receiver busy condition exists, the data link layer entity shall transmit an RR response with the F bit set to 0; or

- if an I frame is available for transmission and no peer receiver busy condition exists, the data link layer entity shall transmit the I frame with the value of N(R) set to the current value of V(R) as defined in § 5.6.1; or

b) if, on receipt of this I frame, the data link layer entity is now in an own receiver busy condition, it shall transmit an RNR response with the F bit set to 0.

When the data link layer entity is in an own receiver busy condition, it shall process any received I frame according to § 5.6.6.

5.6.3 Sending and receiving acknowledgements

5.6.3.1 Sending acknowledgements

Whenever a data link layer entity transmits an I frame or a supervisory frame, N(R) shall be set equal to V(R).

5.6.3.2 Receiving acknowledgements

On receipt of a valid I frame or supervisory frame (RR, RNR, or REJ), even in the own receiver busy, or timer recovery conditions, the data link layer entity shall treat the N(R) contained in this frame as an acknowledgement for all the I frames it has transmitted with an N(S) up to and including the received N(R) − 1. V(A) shall be set to N(R). The data link layer entity shall reset the timer T200 on receipt of a valid I frame or supervisory frame with the N(R) higher than V(A) (actually acknowledging some I frames), or an REJ frame with an N(R) equal to V(A).

Note 1 — If a supervisory frame with the P bit set to 1 has been transmitted and not acknowledged, timer T200 shall not be reset.

Note 2 — Upon receipt of a valid I frame, timer T200 shall not be reset if the data link layer entity is in the peer receiver busy condition.

If timer T200 has been reset by the receipt of an I, RR, or RNR frame, and if there are outstanding I frames still unacknowledged, the data link layer entity shall restart timer T200. If timer T200 then expires, the data link layer entity shall follow the recovery procedure as defined in § 5.6.7 with respect to the unacknowledged I frames.

If timer T200 has been reset by the receipt of an REJ frame, the data link layer entity shall follow the retransmission procedures in § 5.6.4.

5.6.4 Receiving REJ frames

On receipt of a valid REJ frame, the data link layer entity shall act as follows:

a) if it is not in the timer recovery condition:

- clear an existing peer receiver busy condition;
- set its V(S) and its V(A) to the value of the N(R) contained in the REJ frame control field;
- stop timer T200;
- start timer T203 if implemented;
- if it was an REJ command frame with the P bit set to 1, transmit an appropriate supervisory response frame (see Note 2, § 5.6.5) with the F bit set to 1.
- transmit the corresponding I frame as soon as possible, as defined in § 5.6.1, taking into account the items 1) to 3) below and the paragraph following items 1) to 3) and
- notify a protocol violation to the connection management entity by means of the MDL-ERROR-INDICATION primitive, if it was an REJ response frame with the F bit set to 1.

b) if it is in the timer recovery condition and it was an REJ response frame with the F bit set to 1:

- clear an existing peer receiver busy condition;
- set its V(S) and its V(A) to the value N(R) contained in the REJ frame control field;
- stop timer T200;
- start timer T203 if implemented;
- enter the multiple-frame-established state; and
- transmit the corresponding I frame as soon as possible, as defined in § 5.6.1, taking into account the items 1) to 3) below and the paragraph following items 1) to 3).

c) if it is in the timer recovery condition and it was an REJ frame other than an REJ response frame with the F bit set to 1:

- clear an existing peer receiver busy condition;
- set its V(A) to the value of the N(R) contained in the REJ frame control field; and

- if it was an REJ command frame with the P bit set to 1, transmit an appropriate supervisory response frame with the F bit set to 1 (see Note 2 in § 5.6.5).

Transmission of I frames shall take account of the following:

1) if the data link layer entity is transmitting a supervisory frame when it receives the REJ frame, it shall complete that transmission before commencing transmission of the requested I frame;

2) if the data link layer entity is transmitting an SABME command, a DISC command, a UA response or a DM response when it receives the REJ frame, it shall ignore the request for retransmission; and

3) if the data link layer entity is not transmitting a frame when the REJ is received, it shall immediately commence transmission of the requested I frame.

All outstanding unacknowledged I frames, commencing with the I frame identified in the received REJ frame, shall be transmitted. Other I frames not yet transmitted may be transmitted following the retransmitted I frames.

5.6.5 Receiving RNR frames

After receiving a valid RNR command or response, if the data link layer entity is not engaged in a mode-setting operation, it shall set a peer receiver busy condition and then:

- if it was an RNR command with the P bit set to 1, it shall respond with an RR response with the F bit set to 1 if the data link layer entity is not in an own receiver busy condition, and shall respond with an RNR response with the F bit set to 1 if the data link layer entity is in an own receiver busy condition; and

- if it was an RNR response with the F bit set to 1, an existing timer recovery condition shall be cleared and the N(R) contained in this RNR response shall be used to update V(S).

The data link layer entity shall take note of the peer receiver busy condition and not transmit any I frames to the peer which has indicated the busy condition.

Note 1 – The N(R) in any RR or RNR command frame (irrespective of the setting of the P bit) will not be used to update the V(S).

The data link layer entity shall then:

- treat the N(R) contained in the received RNR frame as an acknowledgement for all the I frames that have been (re)transmitted with an N(S) up to and including N(R) minus 1, and set its V(A) to the value of the N(R) contained in the RNR frame; and

- restart timer T200 unless a supervisory response frame with the F bit set to 1 is still expected.

If timer T200 expires, the data link layer entity shall:

- if it is not yet in a timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or

- if it is already in a timer recovery condition, add one to its retransmission count variable.

The data link layer entity shall then:

a) if the value of the retransmission count variable is less than N200:

  - transmit an appropriate supervisory command (see Note 2) with a P bit set to 1;

  - restart timer T200; and

b) if the value of the retransmission count variable is equal to N200, initiate a re-establishment procedure as defined in § 5.7, and indicate this by means of the MDL-ERROR-INDICATION primitive to the connection management entity.

The data link layer entity receiving the supervisory frame with the P bit set to 1 shall respond, at the earliest opportunity, with a supervisory response frame (see Note 2) with the F bit set to 1, to indicate whether or not its own receiver busy condition still exists.

Upon receipt of the supervisory response with the F bit set to 1, the data link layer entity shall reset timer T200, and:

- if the response is an RR or REJ response, the peer receiver busy condition is cleared and the data link layer entity may transmit new I frames or retransmit I frames as defined in §§ 5.6.1 or 5.6.4, respectively; or

- if the response is an RNR response, the data link layer entity receiving the response shall proceed according to this § 5.6.5, first paragraph.

If a supervisory command (RR, RNR, or REJ) with the P bit set to 0 or 1, or a supervisory response frame (RR, RNR, or REJ) with the F bit set to 0 is received during the enquiry process, the data link layer entity shall:

- if the supervisory frame is an RR or REJ command frame or an RR or REJ response frame with the F bit set to 0, clear the peer receiver busy condition and if the supervisory frame received was a command with the P bit set to 1, transmit the appropriate supervisory response frame (see Note 2) with the F bit set to 1. However, the transmission or retransmission of I frames shall not be undertaken until the appropriate supervisory response frame with the F bit set to 1 is received or until expiry of timer T200; or

- if the supervisory frame is an RNR command frame or an RNR response frame with the F bit set to 0, retain the peer receiver busy condition and if the supervisory frame received was an RNR command with P bit set to 1, transmit the appropriate supervisory response frame (see Note 2) with the F bit set to 1.

Upon receipt of an SABME command, the data link layer entity shall clear the peer receiver busy condition.

Note 2 – If the data link layer entity is not in an own receiver busy condition and is in a Reject exception condition [that is, an N(S) sequence error has been received, and an REJ frame has been transmitted, but the requested I frame has not been received], the appropriate supervisory frame is the RR frame.

If the data link layer entity is not in an own receiver busy condition but is in an N(S) sequence error exception condition [that is, an N(S) sequence error has been received but an REJ frame has not been transmitted], the appropriate supervisory frame is the REJ frame.

If the data link layer entity is in its own receiver busy condition, the appropriate supervisory frame is the RNR frame.

Otherwise, the appropriate supervisory frame is the RR frame.

5.6.6 Data link layer own receiver busy condition

When the data link layer entity enters an own receiver busy condition, it shall transmit an RNR frame at the earliest opportunity.

The RNR frame may be either:

- an RNR response with the F bit set to 0; or

- if this condition is entered on receiving a command frame with the P bit set to 1, an RNR response with the F bit set to 1; or

- if this condition is entered on expiry of timer T200, an RNR command with the P bit set to 1.

All received I frames with the P bit set to 0 shall be discarded, after updating V(A).

All received supervisory frames with the P/F bit set to 0 shall be processed, including updating V(A).

All received I frames with the P bit set to 1 shall be discarded, after updating V(A). However, an RNR response frame with the F bit set to 1 shall be transmitted.

All received supervisory frames with the P bit set to 1 shall be processed including updating V(A). An RNR response with the F bit set to 1 shall be transmitted.

To indicate to the peer data link layer entity the clearance of the own receiver busy condition, the data link layer entity shall transmit an RR frame or, if a previously detected N(S) sequence error has not yet been reported, an REJ frame with the N(R) set to the current value of V(R).

The transmission of an SABME command or a UA response (in reply to an SABME command) also indicates to the peer data link layer entity the clearance of the own receiver busy condition.

5.6.7 Waiting acknowledgement

The data link layer entity shall maintain an internal retransmission count variable.

If timer T200 expires, the data link layer entity shall:

- if it is not yet in the timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or

- if it is already in the timer recovery condition, add one to its retransmission count variable.

The data link layer entity shall then:

a) if the value of the retransmission count variable is less than N200:

   - restart timer T200; and either

   - transmit an appropriate supervisory command (see Note 2 in § 5.6.5) with the P bit set to 1; or

   - retransmit the last transmitted I frame [V(S) − 1] with the P bit set to 1; or

b) if the value of the retransmission count variable is equal to N200, initiate a re-establishment procedure as defined in § 5.7 and indicate this by means of the MDL-ERROR-INDICATION primitive to the connection management entity.

The timer recovery condition is cleared when the data link layer entity receives a valid supervisory frame response with the F bit set to 1. If the received supervisory frame N(R) is within the range from its current V(A) to its current V(S) inclusive, it shall set its V(S) to the value of the received N(R). Timer T200 shall be reset if the received supervisory frame response is an RR or REJ response, and then the data link layer entity shall resume with I frame transmission or retransmission, as appropriate. Timer T200 shall be reset and restarted if the received supervisory response is an RNR response, to proceed with the enquiry process according to § 5.6.5.

5.7 Re-establishment of multiple frame operation

5.7.1 Criteria for re-establishment

The criteria for re-establishing the multiple frame mode of operation are defined in this section by the following conditions:

- the receipt, while in the multiple-frame mode of operation, of an SABME;
- the receipt of a DL-ESTABLISH-REQUEST primitive from layer 3 (see § 5.5.1.1);
- the occurrence of N200 retransmission failures while in the timer recovery condition (see § 5.6.7);
- the occurrence of a frame rejection condition as identified in § 5.8.5;
- the receipt, while in the multiple-frame mode of operation, of an FRMR response frame (see § 5.8.6);
- the receipt, while in the multiple-frame mode of operation, of an unsolicited DM response with the F bit set to 0 (see § 5.8.7);
- the receipt, while in the timer-recovery condition, of a DM response with the F bit set to 1.

5.7.2 Procedures

In all re-establishment situations, the data link layer entity shall follow the procedures defined in § 5.5.1. All locally generated conditions for re-establishment will cause the transmission of the SABME.

In the case of data link layer and peer initiated re-establishment, the data link layer entity shall also:

- issue an MDL-ERROR-INDICATION primitive to the connection management entity; and
- if V(S) > V(A) prior to re-establishment, issue a DL-ESTABLISH-INDICATION primitive to layer 3, and discard all I queues.

In case of layer 3 initiated re-establishment or if a DL-ESTABLISH-REQUEST primitive occurs pending re-establishment, the DL-ESTABLISH-CONFIRM primitive shall be used.

5.8 Exception condition reporting and recovery

Exception conditions may occur as the result of physical layer errors or data link layer procedural errors.

The error recovery procedures which are available to effect recovery following the detection of an exception condition at the data link layer are defined in this section.

The actions to be taken by the connection management entity on receipt of an MDL-ERROR-INDICATION primitive are defined in Appendix II.

5.8.1 N(S) sequence error

An N(S) sequence error exception condition occurs in the receiver when a valid I frame is received which contains an N(S) value which is not equal to the V(R) at the receiver. The information field of all I frames whose N(S) does not equal V(R) shall be discarded.

The receiver shall not acknowledge [nor increment its V(R)] the I frame causing the sequence error, nor any I frames which may follow, until an I frame with the correct N(S) is received.

A data link layer entity which receives one or more I frames having sequence errors but otherwise error-free, or subsequent supervisory frames (RR, RNR, and REJ), shall use the control field information contained in the N(R) field and the P or F bit to perform data link control functions; for example, to receive acknowledgement of previously transmitted I frames and to cause the data link layer entity to respond if the P bit is set to 1. Therefore, the retransmitted I frame may contain an N(R) field value and P bit that are updated from, and therefore different from, the ones contained in the originally transmitted I frame.

The REJ frame is used by a receiving data link layer entity to initiate an exception condition recovery (retransmission) following the detection of an N(S) sequence error.

Only one REJ exception condition for a given direction of information transfer shall be established at a time.

A data link layer entity receiving an REJ command or response shall initiate sequential transmission (retransmission) of I frames starting with the I frame indicated by the N(R) contained in the REJ frame.

An REJ exception condition is cleared when the requested I frame is received or when an SABME or DISC command is received.

An optional procedure for the retransmission of an REJ response frame is described in Appendix I.

5.8.2 N(R) sequence error

An N(R) sequence error exception condition occurs in the transmitter when a valid supervisory frame or I frame is received which contains an invalid N(R) value.

A valid N(R) is one that is in the range $V(A) \leq N(R) \leq V(S)$.

The information field contained in an I frame which is correct in sequence and format may be delivered to layer 3 by means of the DL-DATA-INDICATION primitive.

The data link layer entity shall inform the connection management entity of this exception condition by means of the MDL-ERROR-INDICATION primitive, and initiate re-establishment according to § 5.7.2.

5.8.3 Timer recovery condition

If a data link layer entity, due to a transmission error, does not receive a single I frame or the last I frame(s) in a sequence of I frames, it will not detect an out-of-sequence exception condition and therefore will not transmit an REJ frame.

The data link layer entity which transmitted the unacknowledged I frame(s) shall, on the expiry of timer T200, take appropriate recovery action as defined in § 5.6.7 to determine at which I frame retransmission must begin.

5.8.4 Invalid frame condition

Any frame received which is invalid (as defined in § 2.9) shall be discarded, and no action shall be taken as a result of that frame.

5.8.5 Frame rejection condition

A frame rejection condition results from one of the conditions described in § 3.6.1 (third paragraph) or § 3.6.11, items b, c and d.

Upon occurrence of a frame rejection condition, the data link layer entity shall:

- issue an MDL-ERROR-INDICATION primitive; and

- initiate re-establishment (see § 5.7.2).

Note — For satisfactory operation it is essential that a receiver is able to discriminate between invalid frames, as defined in § 2.9, and I frames with an I-field which exceeds the maximum established length [see d) of § 3.6.11]. An unbounded frame may be assumed, and thus discarded, if two times the longest permissible frame plus two octets are received without a flag detection.

5.8.6 Receipt of an FRMR response frame

Upon receipt of an FRMR response frame in the multiple-frame mode of operation, the data link layer entity shall:

- issue an MDL-ERROR-INDICATION primitive; and
- initiate re-establishment (see § 5.7.2).

5.8.7 Unsolicited response frames

The action to be taken on the receipt of an unsolicited response frame is defined in Table 9/Q.921.

The data link layer entity shall assume possible multiple-TEI assignment on the receipt of an unsolicited UA response and shall inform layer management.

TABLE 9/Q.921

Actions taken on receipt of unsolicited response frames

Unsolicited response frame	*TEI-assigned*	*Awaiting Establishment*	*Awaiting Release*	*Multiple frame modes of operation*	
				Established mode	*Time recovery condition*
UA response F = 1	MDL-Error Indication	Solicited	Solicited	MDL-Error Indication	MDL-Error Indication
UA response F = 0	MDL-Error Indication	MDL-Error Indication	MDL-Error Indication	MDL-Error Indication	MDL-Error Indication
DM response F = 1	Ignore	Solicited	Solicited	MDL-Error Indication	Solicited
DM response F = 0	Establish	Ignore	Ignore	Re-establish MDL-Error Indication	Re-establish MDL-Error Indication
Supervisory Response F = 1	Ignore	Ignore	Ignore	MDL-Error Indication	Solicited
Supervisory Response F = 0	Ignore	Ignore	Ignore	Solicited	Solicited

5.8.8 Multiple assignment of a TEI value

A data link layer entity shall assume multiple assignment of a TEI value and initiate recovery as specified below by:

a) the receipt of a UA response frame whilst in the multiple-frame-established state;

b) the receipt of a UA response frame whilst in the timer recovery state;

c) the receipt of a UA response frame whilst in the TEI-assigned state.

A data link layer entity, after assuming multiple assignment of a TEI value shall inform the connection management entity by means of the MDL-ERROR-INDICATION primitive.

5.9 List of system parameters

The system parameters listed below are associated with each individual SAP.

A method of assigning these parameters is defined in § 5.4.

The term default implies that the value defined should be used in the absence of any assignment or negotiation of alternative values.

5.9.1 Timer T200

The default value for timer T200 at the end of which transmission of a frame may be initiated according to the procedures described in § 5.6 shall be one second.

Note 1 — The proper operation of the procedure requires that timer T200 be greater than the maximum time between transmission of command frames and the reception of their corresponding response or acknowledgement frames.

Note 2 — When an implementation includes multiple terminals on the user side together with a satellite connection in the transmission path, a value of T200 greater than 1 second may be necessary. A value of 2.5 seconds is suggested.

5.9.2 Maximum number of retransmissions (N200)

The maximum number of retransmissions of a frame (N200) is a system parameter. The default value of N200 shall be 3.

5.9.3 Maximum number of octets in an information field (N201)

The maximum number of octets in an information field (N201) is a system parameter. (See also § 2.5.)

- For an SAP supporting signalling, the default value shall be 260 octets.

- For SAPs supporting packet information, the default value shall be 260 octets.

5.9.4 Maximum number of transmissions of the TEI Identity request message (N202)

The maximum number of transmissions of a TEI Identity request message (when the user requests a TEI) is a system parameter. The default value of N202 shall be 3.

5.9.5 Maximum number of outstanding I frames (k)

The maximum number (k) of sequentially numbered I frames that may be outstanding (that is, unacknowledged) at any given time is a system parameter which shall not exceed 127, for extended (modulo 128) operation.

- For an SAP supporting basic access (16 kbit/s) signalling, the default value shall be 1.

- For an SAP supporting primary rate (64 kbit/s) signalling, the default value shall be 7.

- For an SAP supporting basic access (16 kbit/s) packet information, the default value shall be 3.

- For an SAP supporting primary rate (64 kbit/s) packet information, the default value shall be 7.

5.9.6 Timer T201

The minimum time between retransmission of the TEI Identity check messages (T201) is a system parameter which shall be set to T200 seconds.

5.9.7 Timer T202

The minimum time between the transmission of TEI Identity request messages is a system parameter (T202) which shall be set to 2 seconds.

5.9.8 Timer T203

Timer T203 represents the maximum time allowed without frames being exchanged. The default value of timer T203 shall be 10 seconds.

5.10 Data link layer monitor function

5.10.1 General

The procedural elements defined in § 5 allow for the supervision of the data link layer resource. This section describes procedures which may be used to provide this supervision function. The use of this function is optional.

5.10.2 Data link layer supervision in the multiple-frame-established state

The procedures specified herein propose a solution which is already identified in the HDLC classes of procedures. The connection verification is a service provided by data link layer to layer 3. This implies that layer 3 is informed in case of a failure only. Furthermore, the procedure may be incorporated in the "normal" exchange of information and may become more efficient than a procedure based on the involvement of layer 3.

The procedure is based on supervisory command frames (RR command, RNR command) and timer T203, and operates in the multiple-frame-established state as follows.

If there are no frames being exchanged on the data link connection (neither new nor outstanding I frames, nor supervisory frames with a P bit set to 1), there is no means to detect a faulty data link connection condition, or a user equipment having been unplugged. Timer T203 represents the maximum time allowed without frames being exchanged.

If timer T203 expires, a supervisory command with a P bit set to 1 is transmitted. Such a procedure is protected against transmission errors by making use of the normal timer T200 procedure including retransmission count and N200 attempts.

5.10.3 Connection verification procedures

5.10.3.1 Start timer T203

The timer T203 is started:

- when the multiple-frame-established state is entered; and

- in the multiple-frame-established state whenever T200 is stopped. (See Note in § 5.10.3.2.)

Upon receiving an I or supervisory frame, timer T203 will be restarted if timer T200 is not to be started.

5.10.3.2 Stop timer T203

The timer T203 is stopped:

- when, in the multiple-frame-established state, the timer T200 is started (see note); and

- upon leaving the multiple-frame-established state.

Note — These two conditions mean that timer T203 is only started whenever T200 is stopped and not restarted.

5.10.3.3 Expiry of timer T203

If timer T203 expires, the data link layer entity will act as follows (it should be noted that timer T200 is neither running nor expired):

a) set the retransmission count variable to 0;

b) enter timer recovery state;

c) transmit a supervisory command with the P bit set to 1 as follows:

   - if there is not a receiver busy condition (own receiver not busy), transmit an RR command; or

   - if there is a receiver busy condition (own receiver busy), transmit an RNR command; and

d) start timer T200; and

e) send MDL-ERROR-INDICATION primitive to connection management after N200 retransmissions.

ANNEX A

(to Recommendation Q.921)

Provision of point-to-point signalling connections

In certain applications it may be advantageous to have a single point-to-point signalling connection at layer 3; the allocation of the value 0 as a preferred TEI for that purpose is a network option. Use of the value 0 in such applications does not preclude using that value in other applications or networks.

ANNEX B

(to Recommendation Q.921)

SDL for point-to-point procedures

B.1 General

The purpose of this annex is to provide one example of an SDL representation of the point-to-point procedures of the data link layer, to assist in the understanding of this Recommendation. This representation does not describe all of the possible actions of the data link layer entity, as a non-partitioned representation was selected in order to minimize its complexity. The SDL representation does not therefore constrain implementations from exploiting the full scope of the procedures as presented within the text of this Recommendation. The text description of the procedures is definitive.

The representation is a peer-to-peer model of the point-to-point procedures of the data link layer and is applicable to the data link layer entities at both the user and network sides for all ranges of TEI values. See Figure B-1/Q.921.

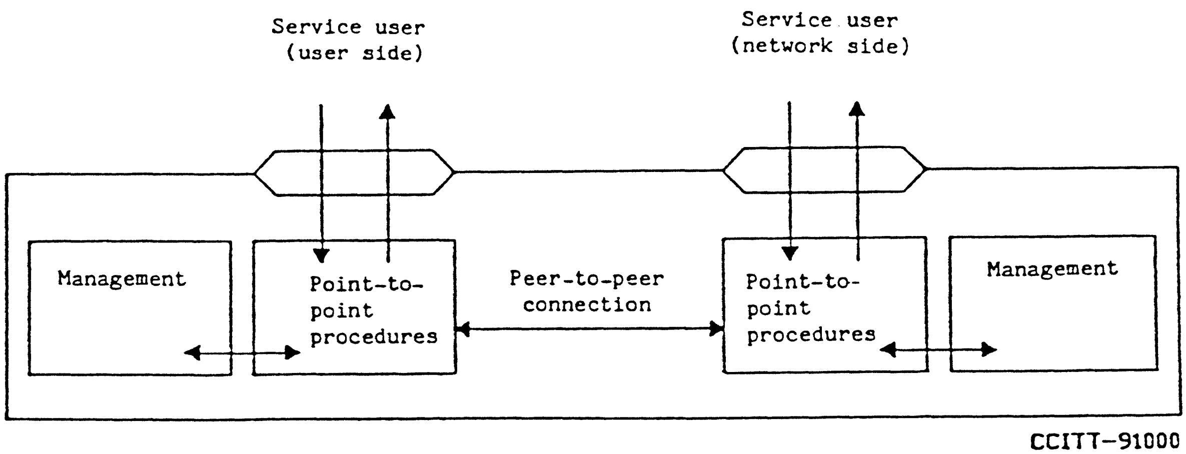


FIGURE B-1/Q.921

Peer-to-peer model of the point-to-point procedures

B.2 An overview of the states of the point-to-point data link layer entity

The SDL representation of the point-to-point procedures are based on an expansion of the three basic states identified in § 3.4.2/Q.920 to the following 8 states:

State 1 TEI unassigned

State 2 Assign awaiting TEI

State 3 Establish awaiting TEI

State 4 TEI assigned

State 5 Awaiting establishment

State 6 Awaiting release

State 7 Multiple frame established

State 8 Timer recovery

An overview of the inter-relationship of these states is provided in Figure B-2/Q.921. This overview is incomplete, and serves only as an introduction to the SDL representation. All data link layer entities are conceptually initiated in the TEI unassigned state (state 1), and will interact with the layer management in order to request a TEI value. TEI assignment initiated by a Unit data request will cause the data link layer entity to move to the TEI assigned state (state 4) via the assign awaiting TEI state (state 2). Initiation by an Establishment request will cause a transition to the awaiting establishment state (state 5) via the establish awaiting TEI state (state 3). Direct TEI assignment will cause an immediate transition to the TEI assigned state (state 4). In states 4-8, Unit data requests can be directly serviced by the data link layer entity. The receipt of an Establish request in the TEI assigned state (state 4) will cause the initiation of the establishment procedures and the transition to the awaiting establishment state (state 5). Completion of the LAP establishment procedures takes the data link layer entity into the multiple frame established state (state 7). Peer initiated establishment causes a direct transition from the TEI assigned state (state 4) to the multiple frame established state (state 7). In the multiple frame established state (state 7), Acknowledged data transfer requests can be serviced directly subject to the restrictions of the procedures. Expiry of timer T200, which is used in both the flow control and data transfer aspects of the data link layer entity's procedures initiates the transition to the timer recovery state (state 8). Completion of the timer recovery procedures will return the data link layer entity to the multiple frame established state (state 7). In states 7 and 8, of the SDL representation the following conditions which are identified within the Recommendation are observed:

a) peer receiver busy

b) reject exception

c) own receiver busy.

In addition other conditions are used in order to avoid identification of additional states. The complete combination of both of these categories of conditions with the 8 states of the SDL representation is the basis for the state transition table description of the data link layer entity. A peer initiated LAP release will take the data link layer entity directly into the TEI assigned state (state 4), whilst a Release request will be via the awaiting release state (state 6). TEI removal will cause a transition to the TEI unassigned state (state 1).

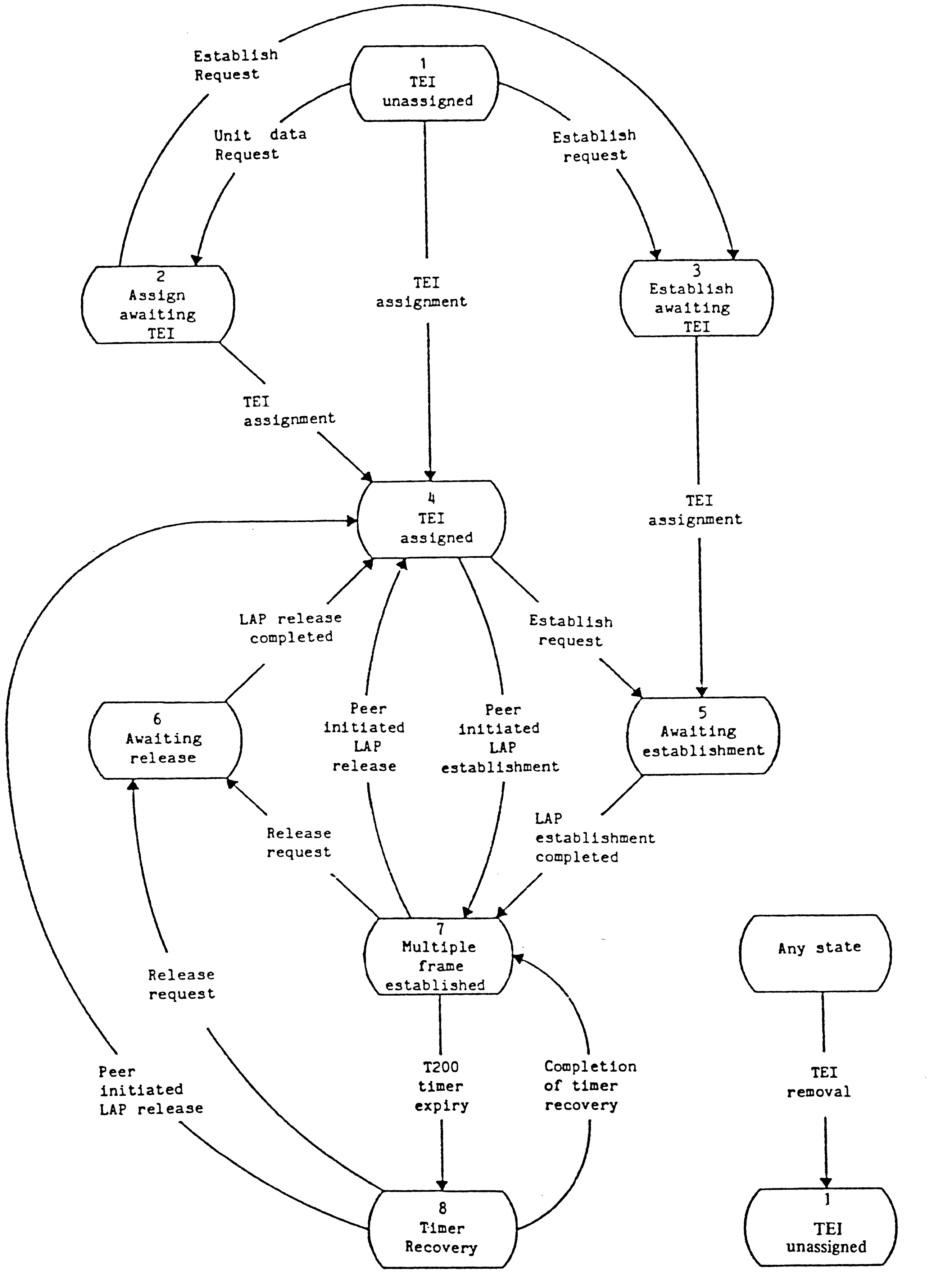
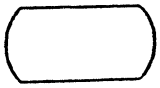


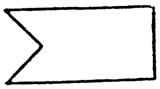
FIGURE B-2/Q.921

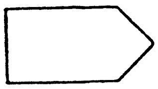
An overview of the states of the point-to-point procedures

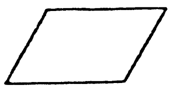
B.3 Cover notes

The following symbols and abbreviations are used within this description. A full description of the symbols and their meaning and application can be found in the Series Z Recommendations (Fascicles VI.10 and VI.11).

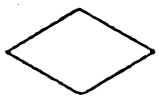
a)  State

b)  Signal reception

c)  Signal generation

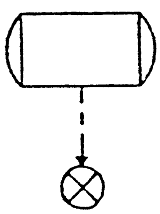
d)  Save a signal (until completion of a transition to a new state)

e)  Process description

f)  Test

g)  Procedure call

h)  Implementation option

i)  Procedure definition

j) *** To mark an event or signal required as a result of the representation approach adopted, which is local to the data link layer entity

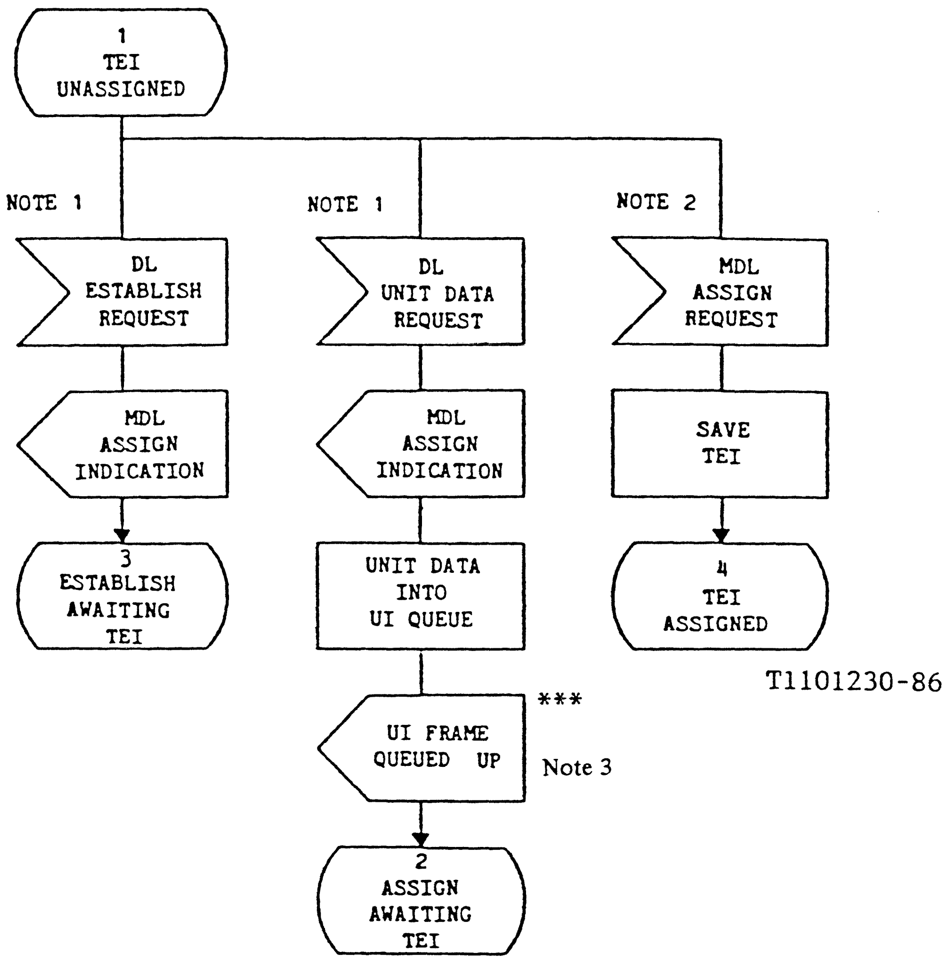
k) RC Retransmission counter

l) (A-O) The codes used in the MDL-ERROR-INDICATION signals are defined in TABLE II-1/Q.921 in Appendix II. When multiple codes are shown, only one applies.

B.4 The use of queues

To enable a satisfactory representation of the data link layer entity, conceptual queues for the UI frame and I frame transmission have been explicitly brought out. These conceptual queues are finite but unbounded and should in no way restrict the implementation of the point-to-point procedures. Two additional signals have been provided in order to cause the servicing of these queues to be initiated – UI frame queued up and I frame queued up.

B.5 SDL representation



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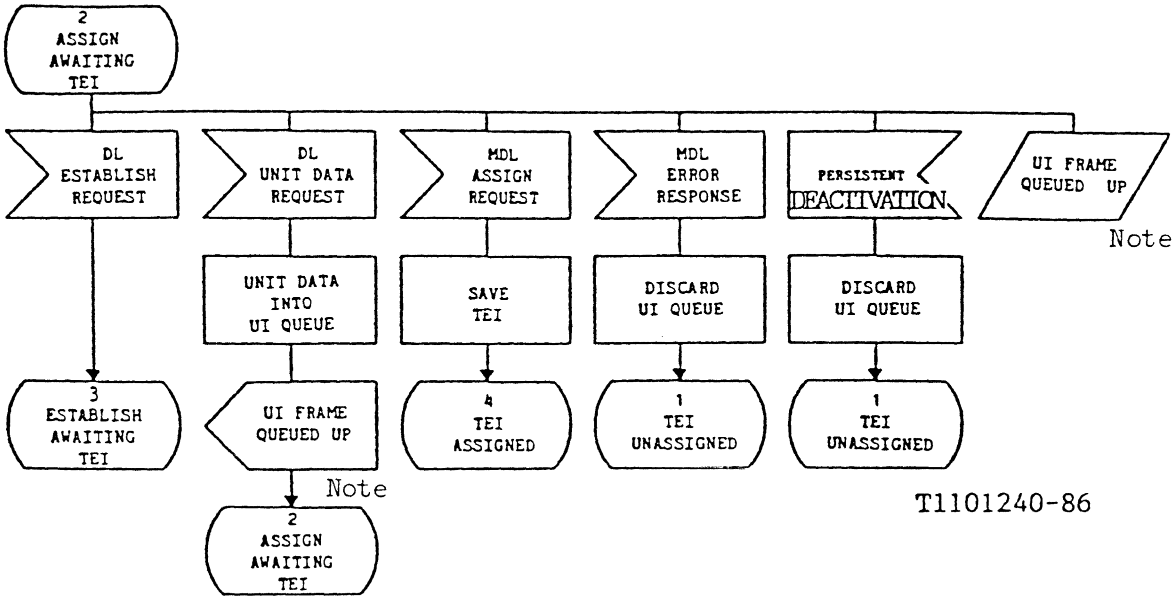
Note 1: The use of these events on the network side is for further study.

Note 2: - This function may be implemented over a geographically distributed architecture.

- This primitive may occur on initialization for fixed TEIs at the network side, or as appropriate in order to correctly process a frame carrying a fixed TEI.

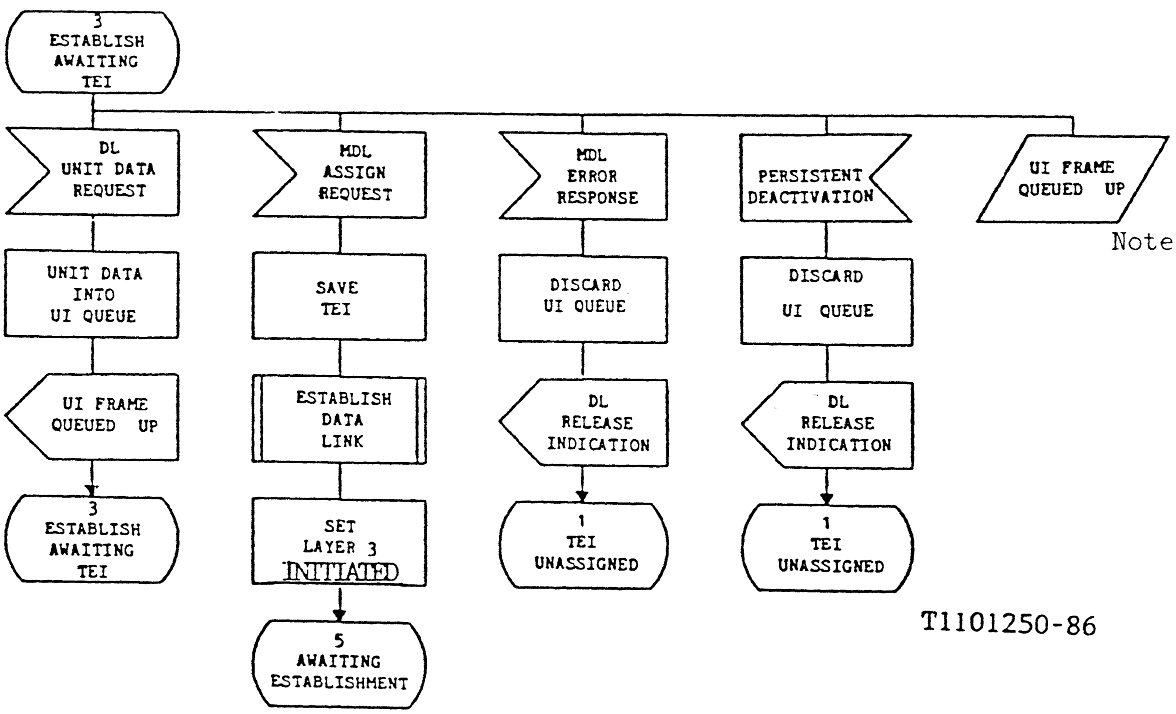
Note 3: Processing of UI frame queued up is described in Figure B-9/Q.921

FIGURE B-3/Q.921 (1 of 3)



Note: Processing of UI frame queued up is described in Figure B-9/Q.921

FIGURE B-3/Q.921 (2 of 3)



Note: Processing of UI frame queued up is described in Figure B-9/Q.921

FIGURE B-3/Q.921 (3 of 3)

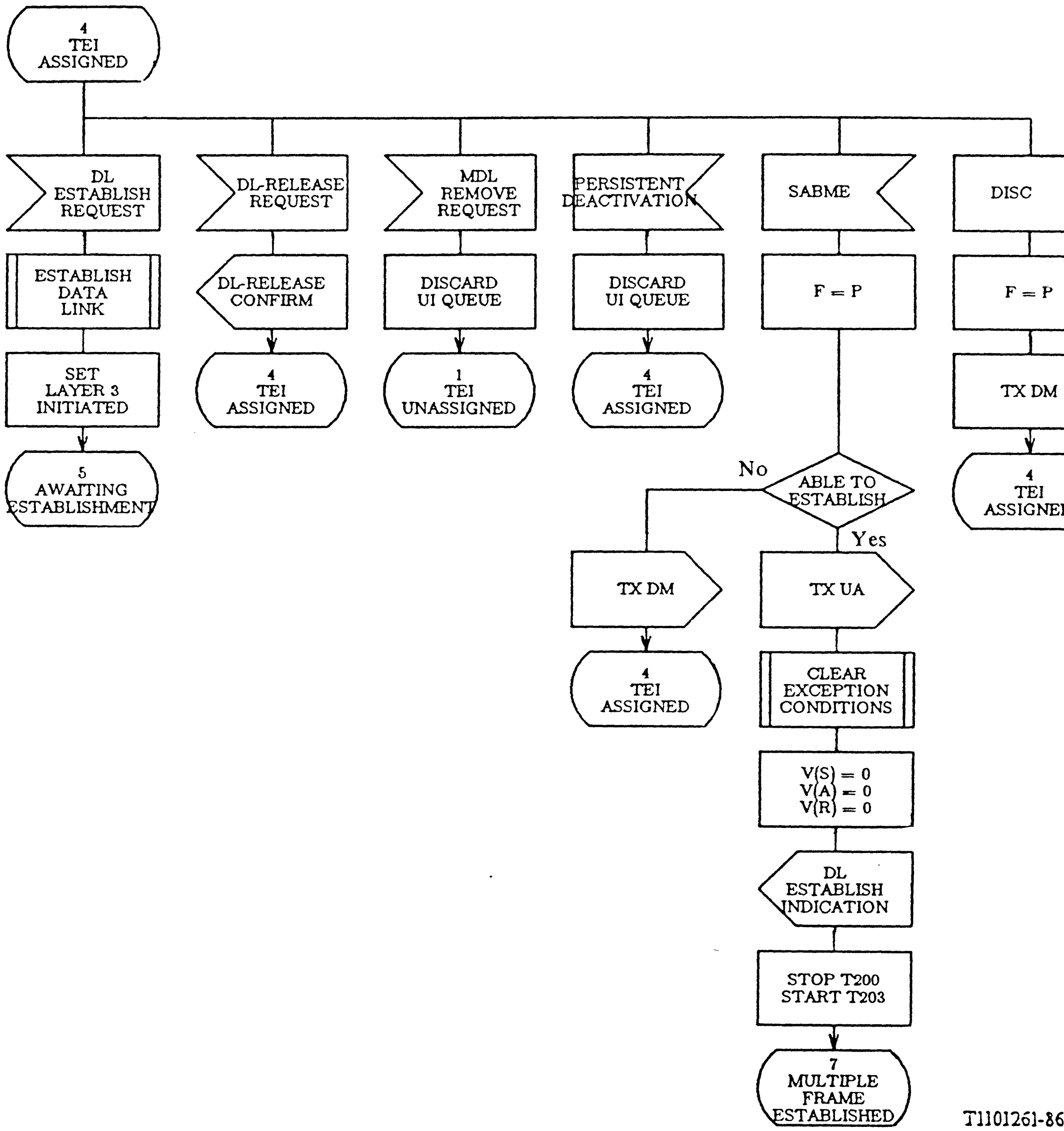


FIGURE B-4/Q.921 (1 of 2)

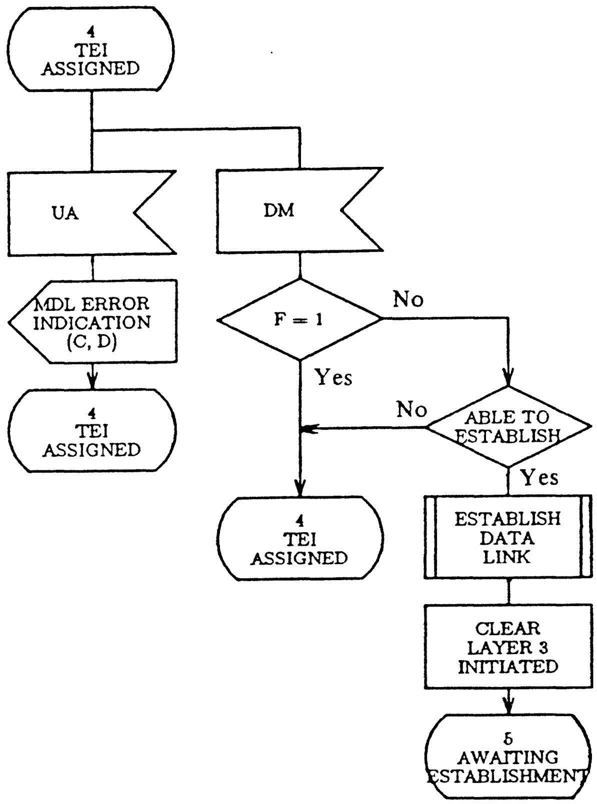


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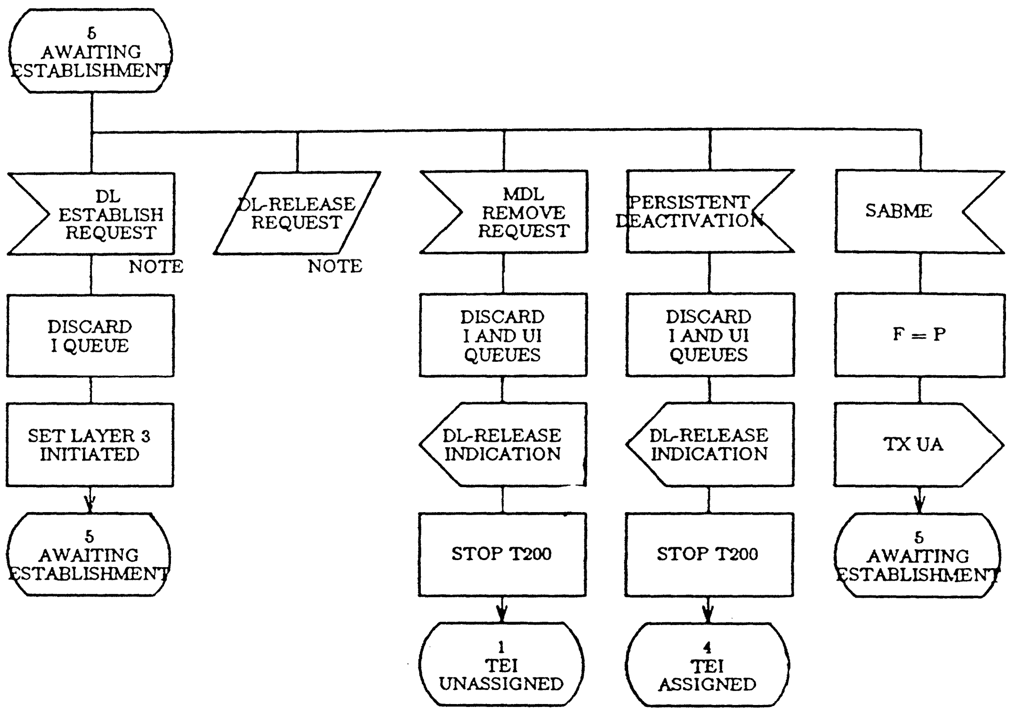
FIGURE B-4/Q.921 (2 of 2)



NOTE - Only possible in cases of Layer 2 initiated re-establishment.

FIGURE B-5/Q.921 (1 of 3)

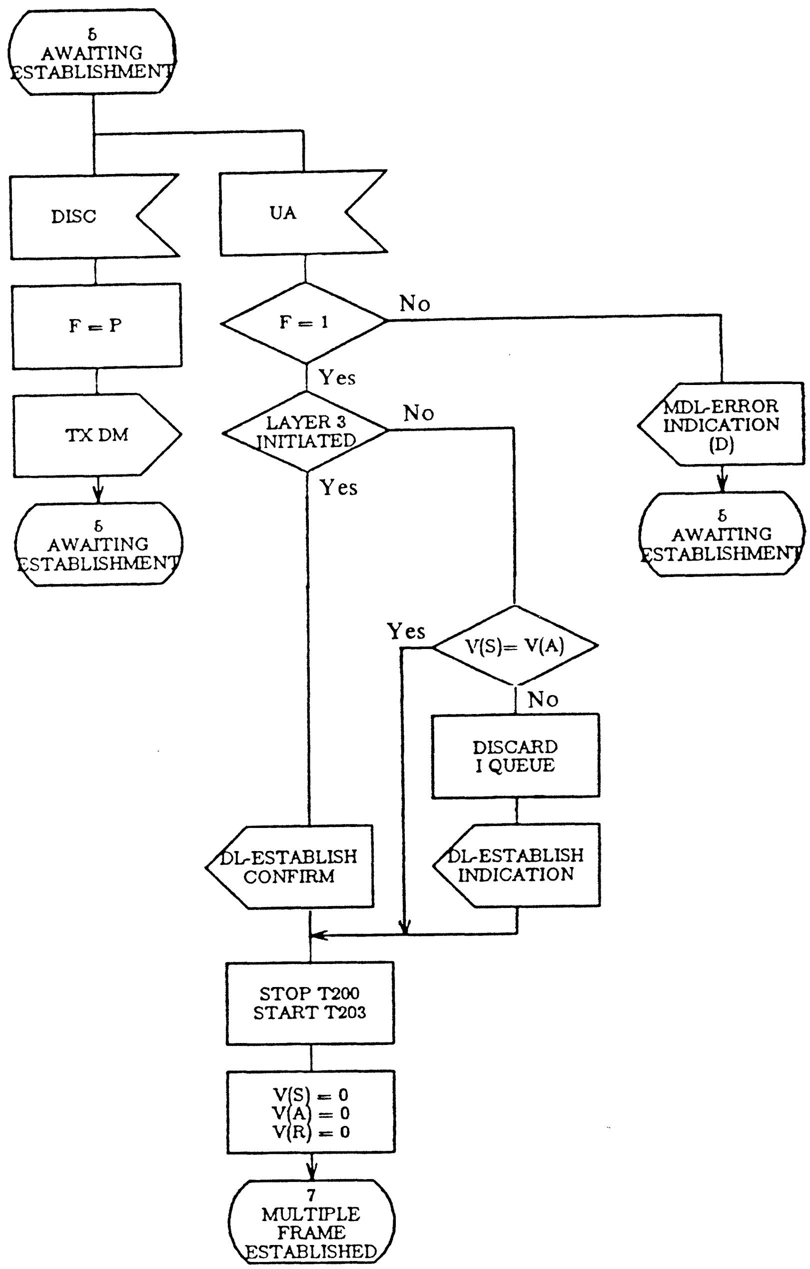


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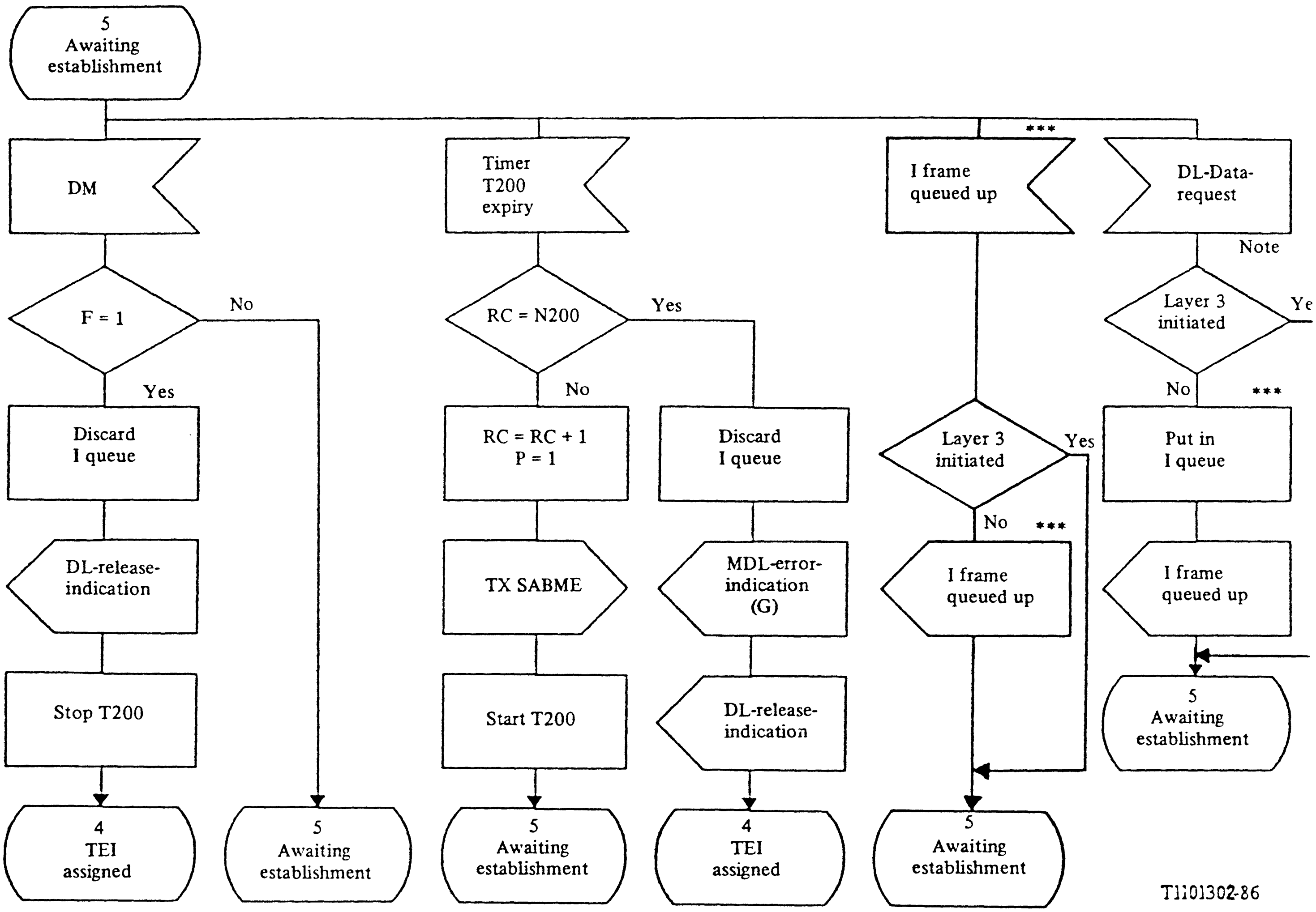
FIGURE B-5/Q.921 (2 of 3)



NOTE: Only possible in cases of layer 2 initiated re-establishment.

FIGURE B-5/Q.921 (3 of 3)

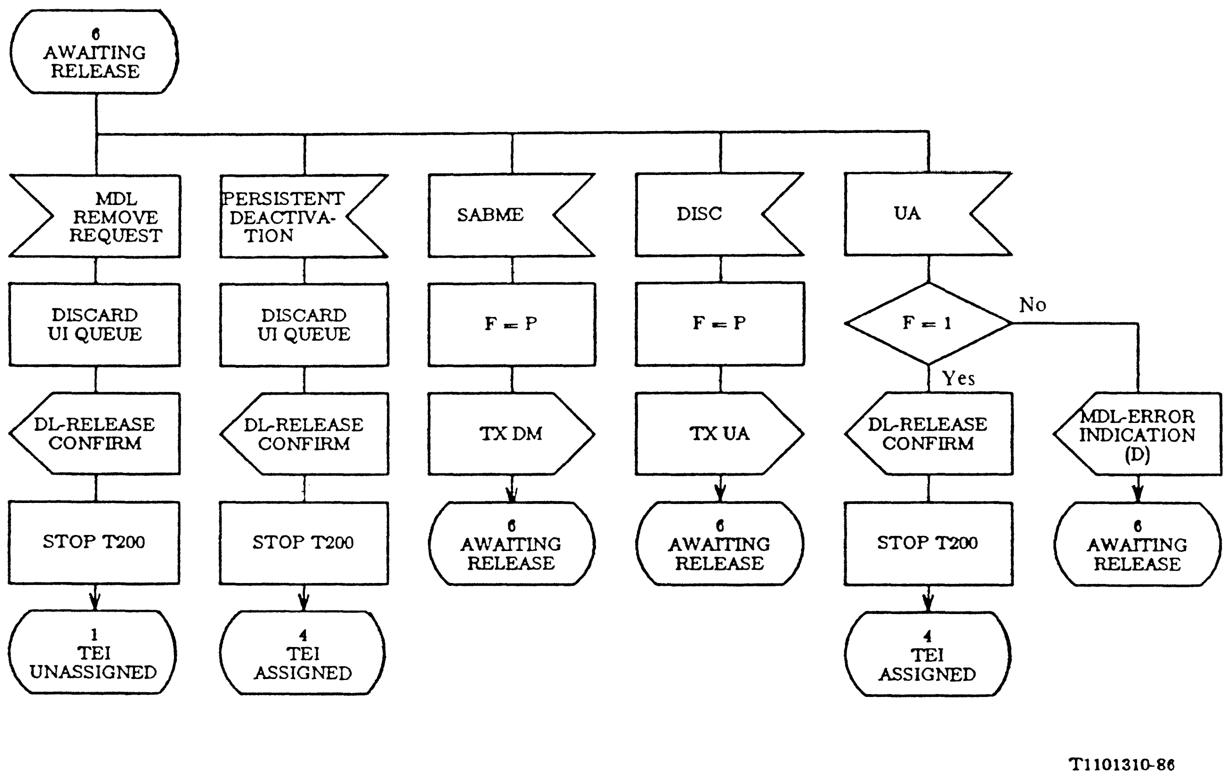


FIGURE B-6/Q.921 (1 of 2)

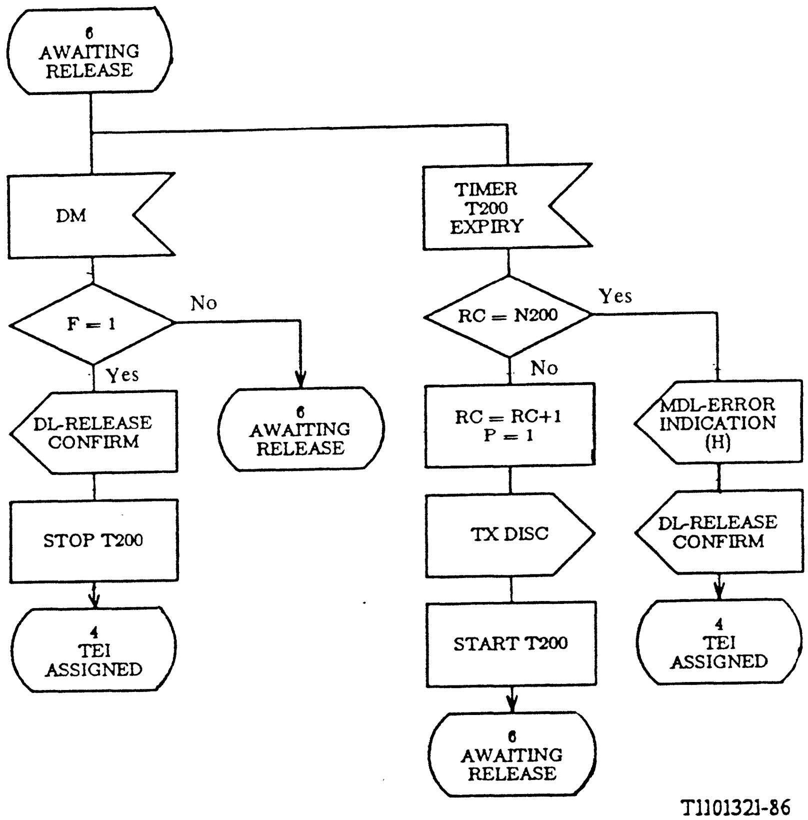


FIGURE B-6/Q.921 (2 of 2)

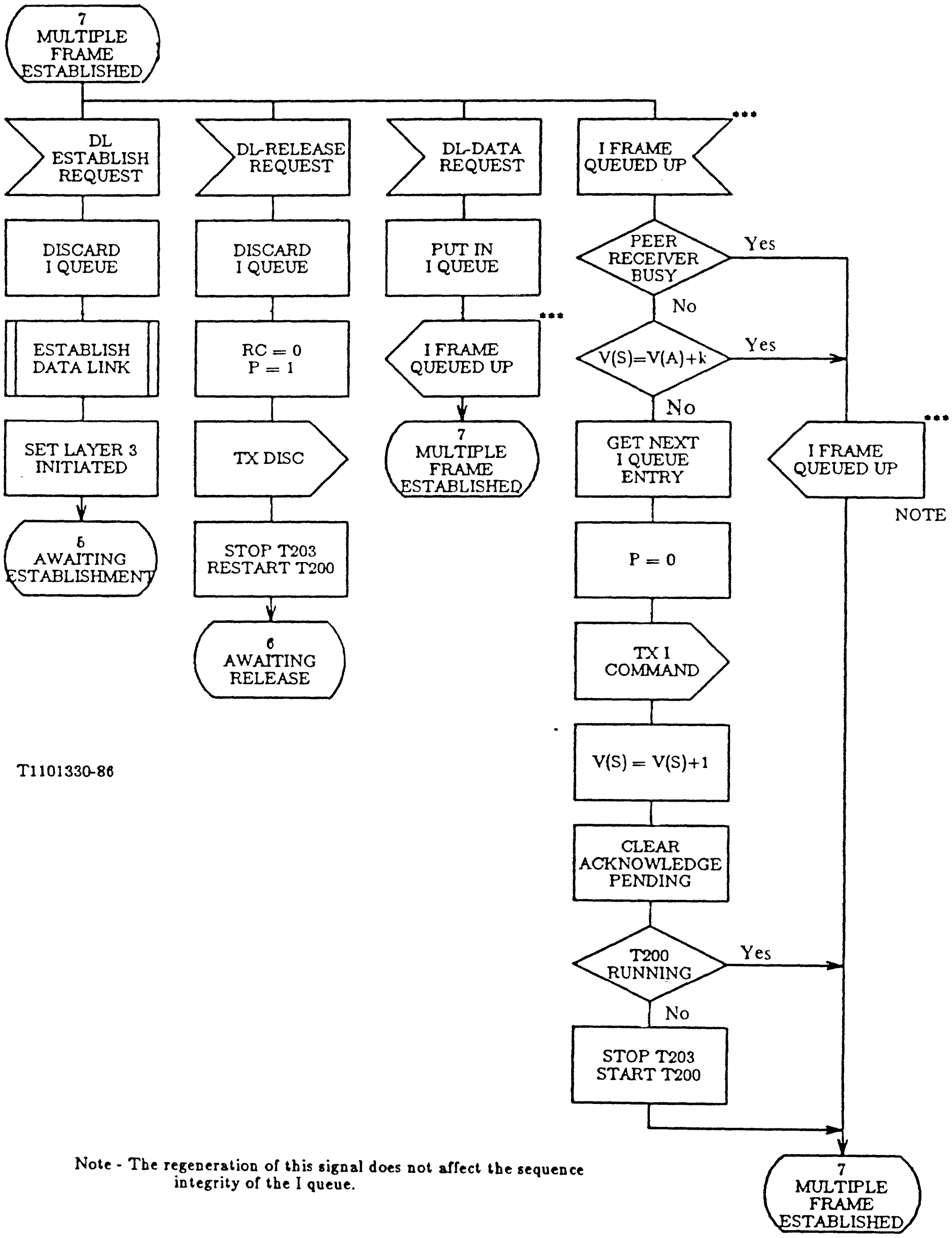


FIGURE B-7/Q.921 (1 of 10)

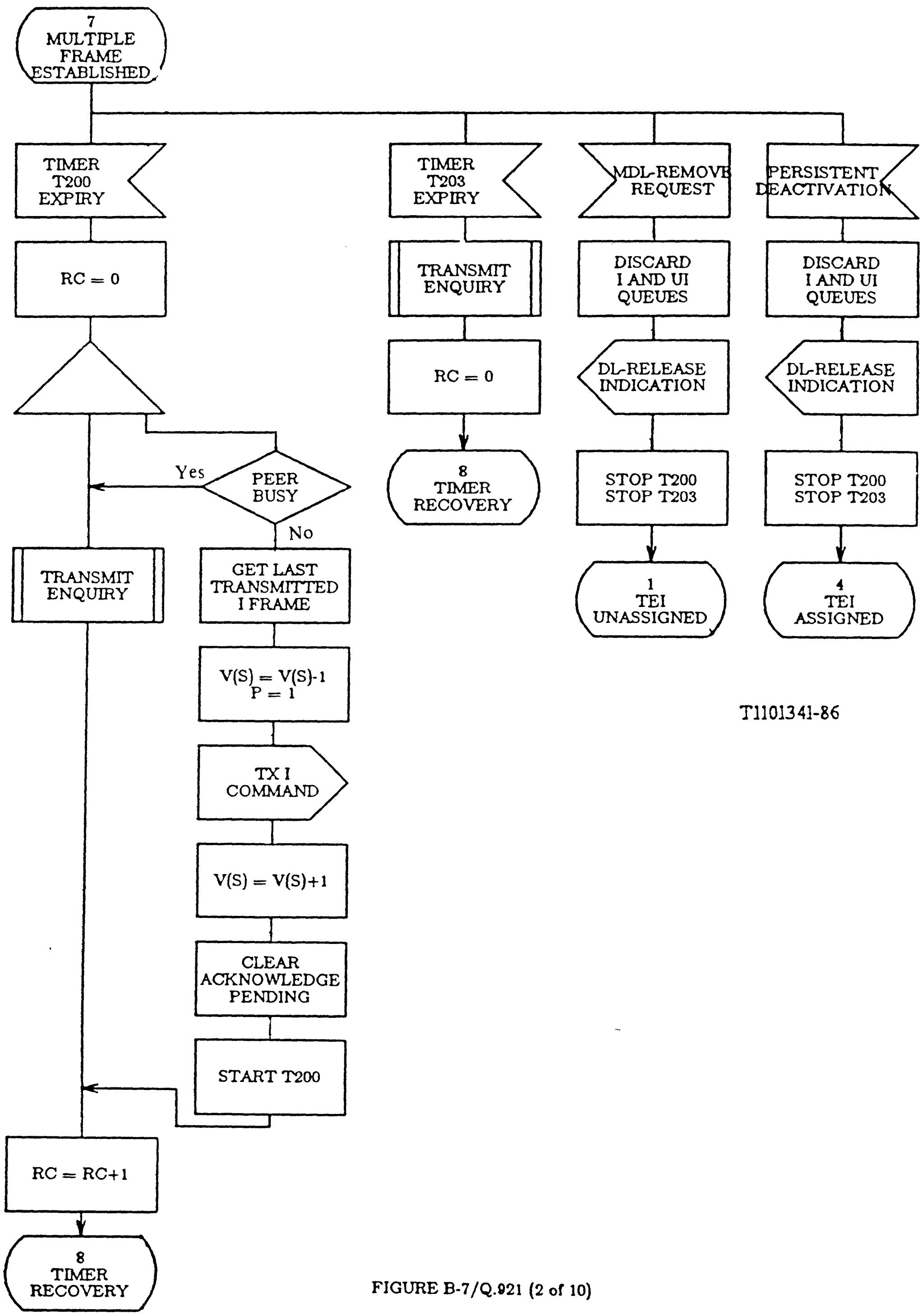


FIGURE B-7/Q.921 (2 of 10)

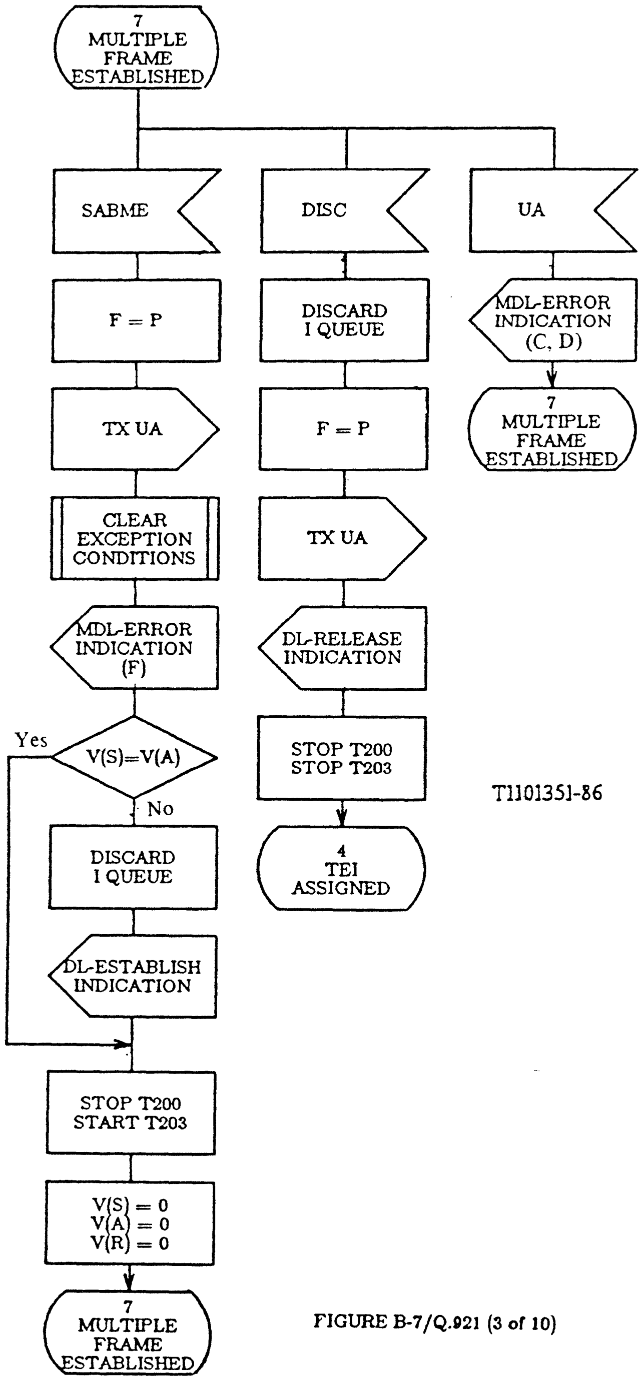
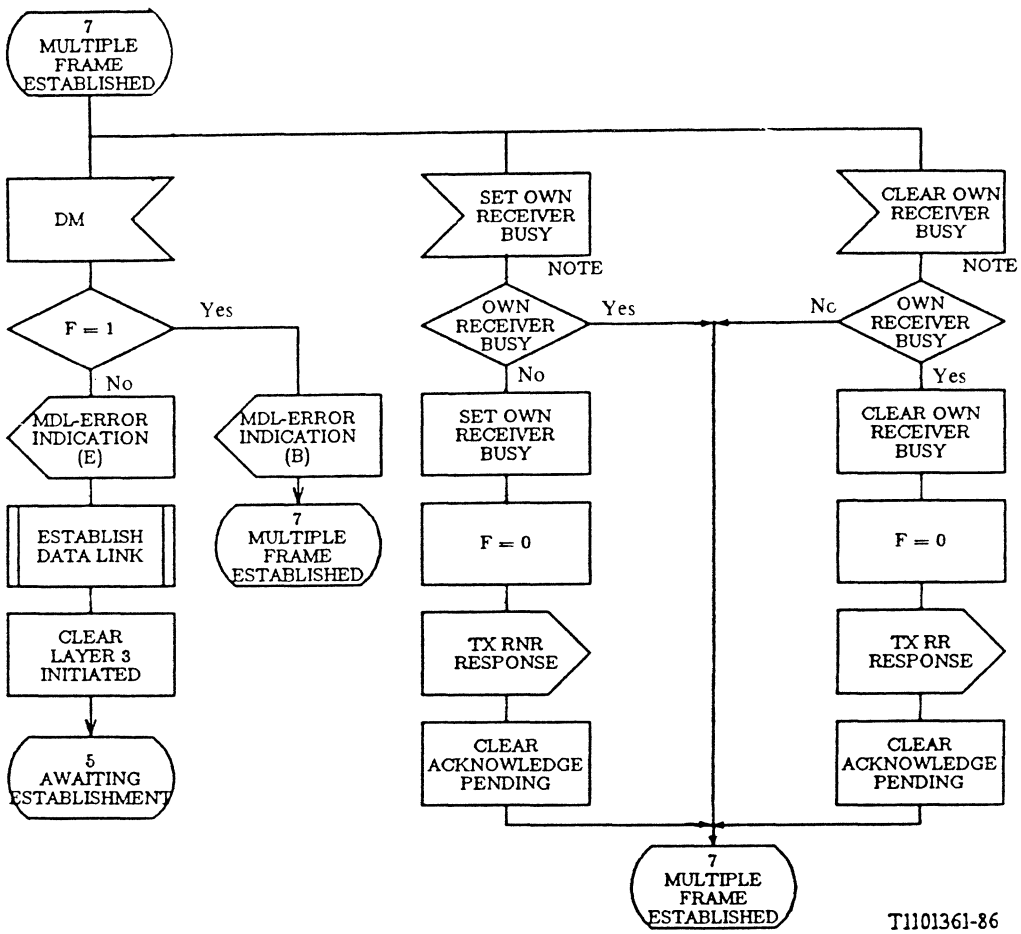


FIGURE B-7/Q.921 (3 of 10)



Note - These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

FIGURE B-7/Q.921 (4 of 10)

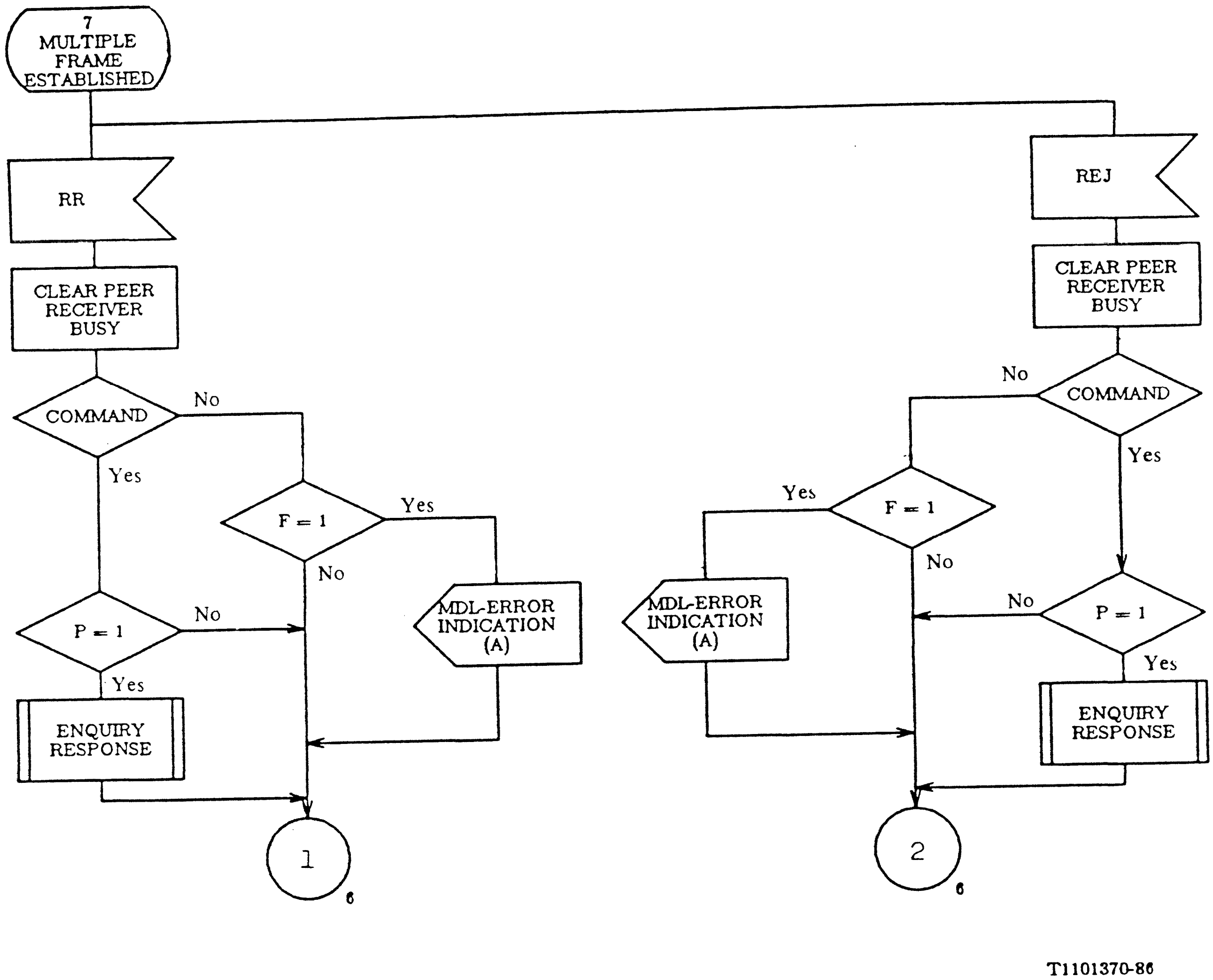


FIGURE B-7/Q.921 (5 of 10)

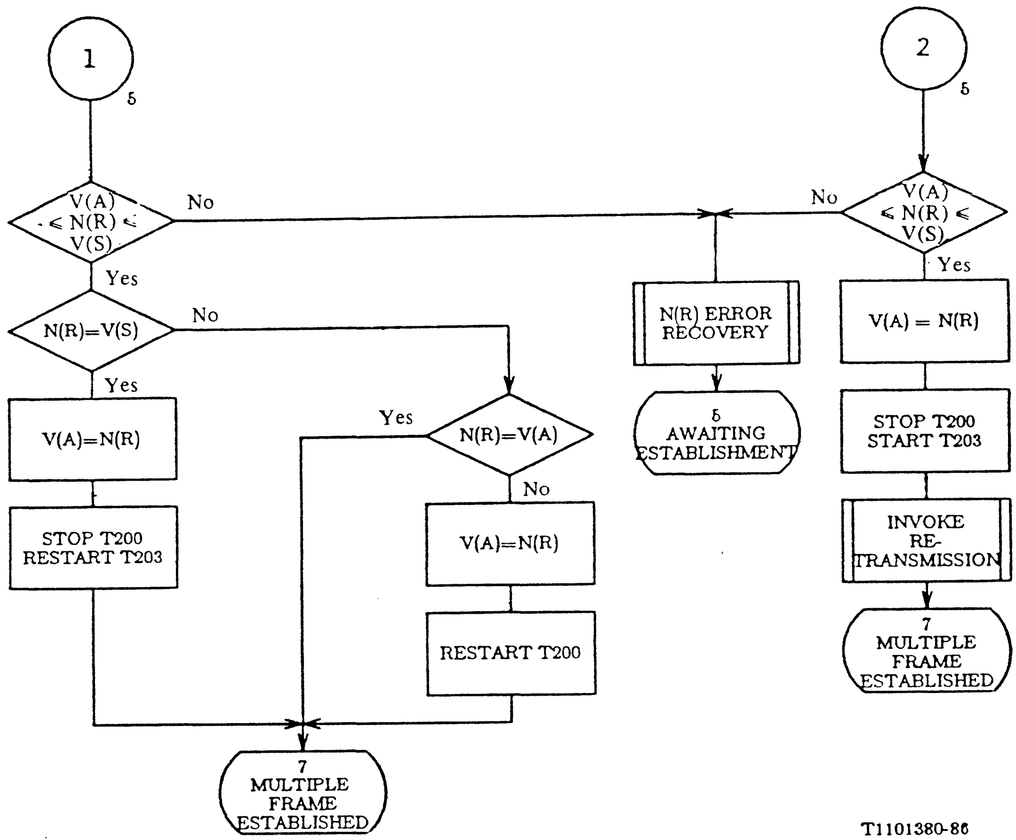


FIGURE B-7/Q.921 (6 of 10)

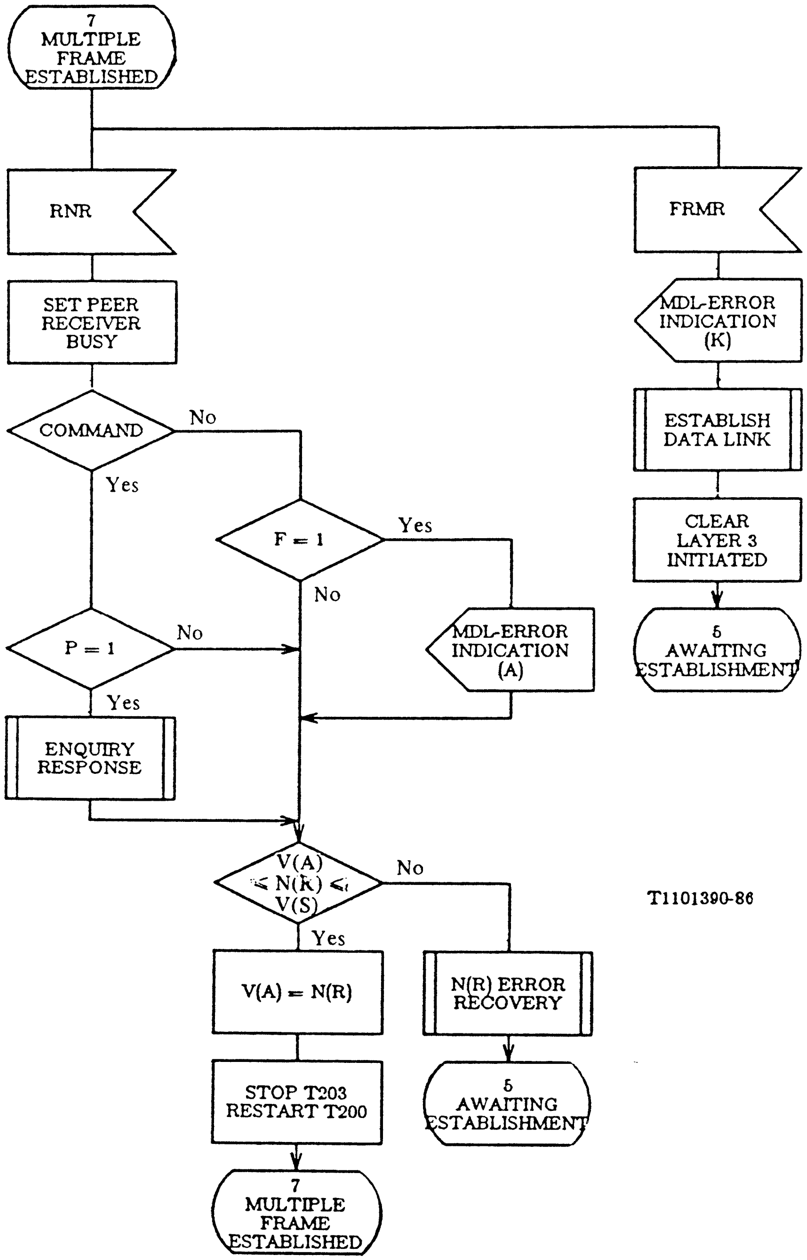
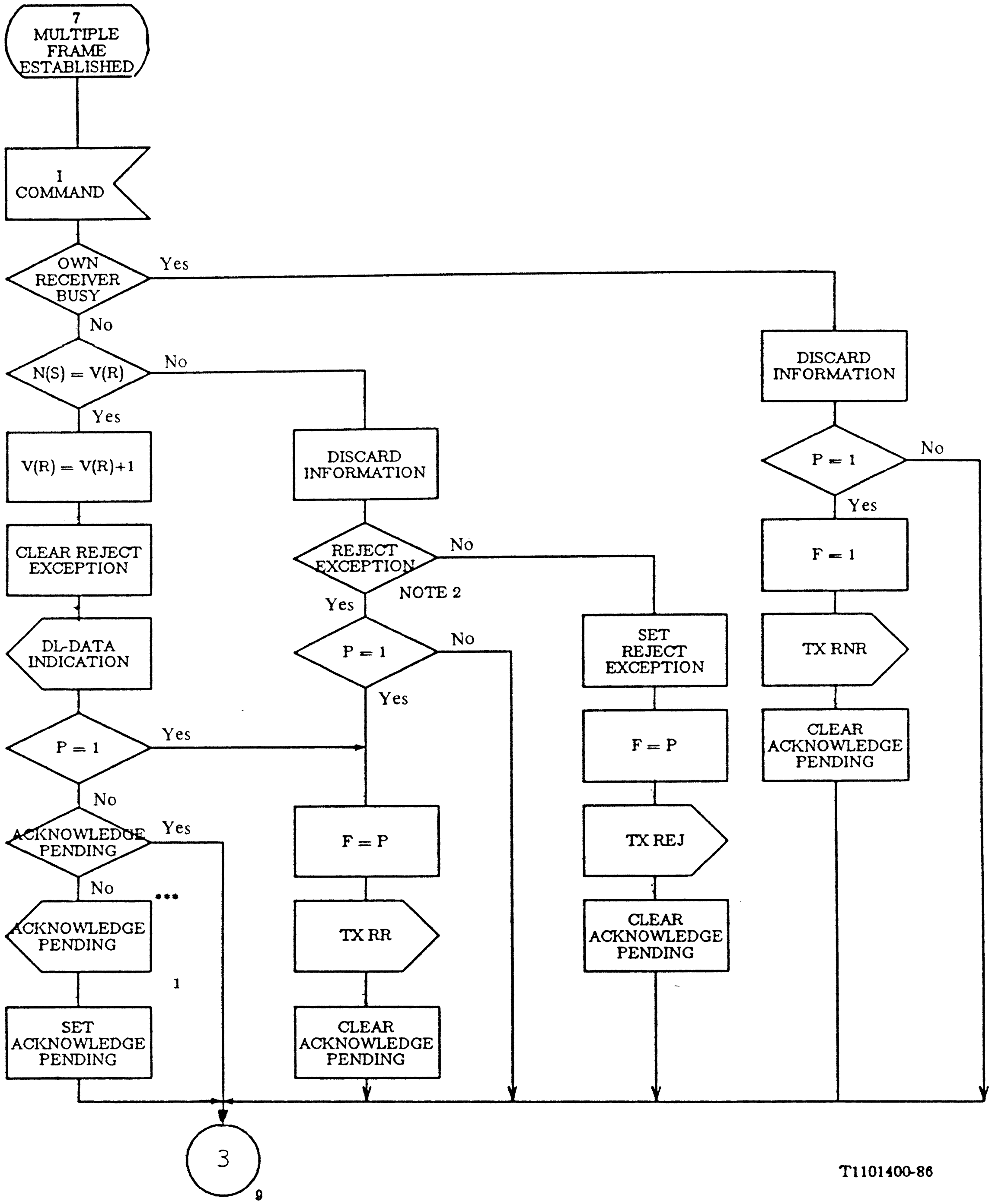


FIGURE B-7/Q.921 (7 of 10)



NOTE 1 – Processing of acknowledge pending is described on sheet 10 of this Figure B-7/Q.921.

NOTE 2 – This SDL representation does not include the optional procedure in Appendix I.

FIGURE B-7/Q.921 (8 of 10)

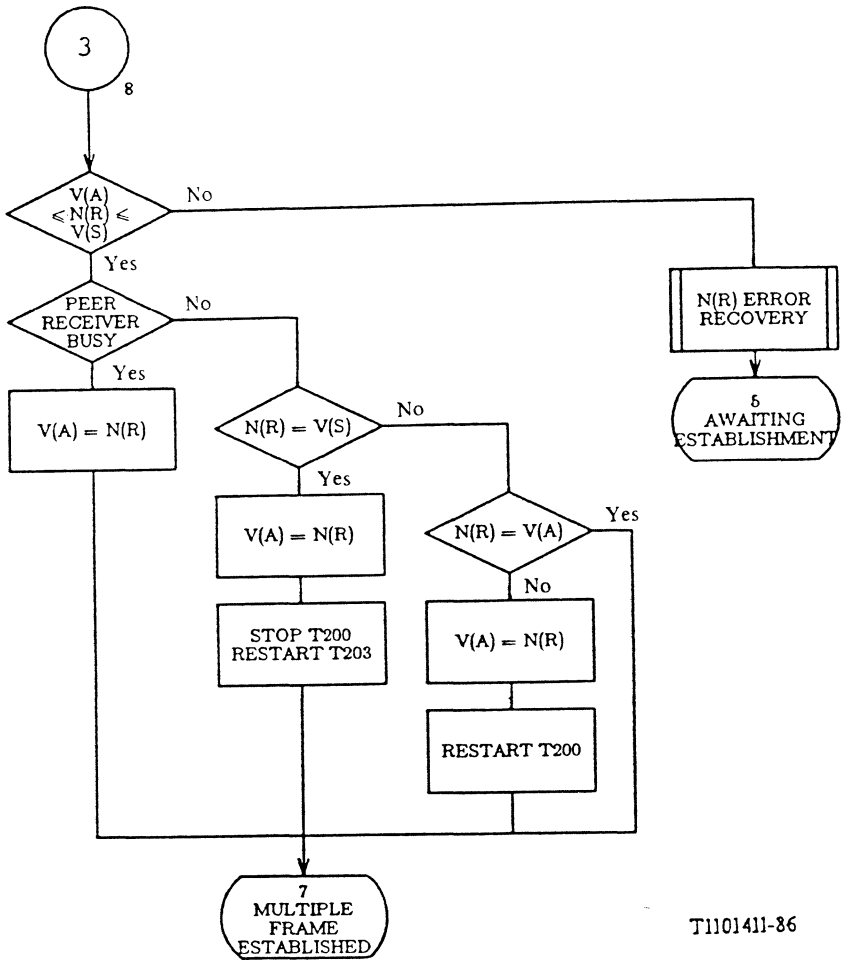


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FIGURE B-7/Q.921 (9 of 10)

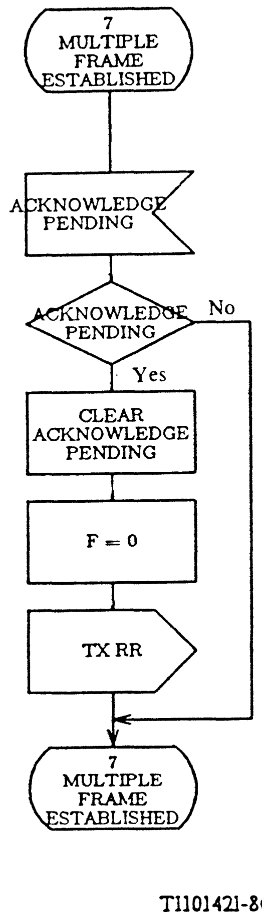


FIGURE B-7/Q.921 (10 of 10)

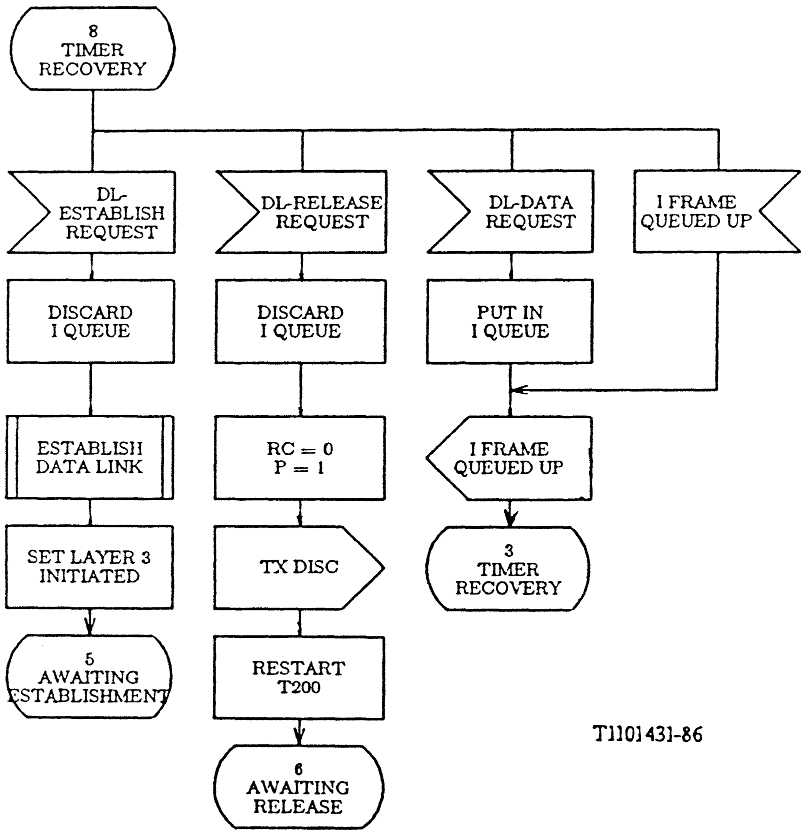


FIGURE B-8/Q.921 (1 of 9)

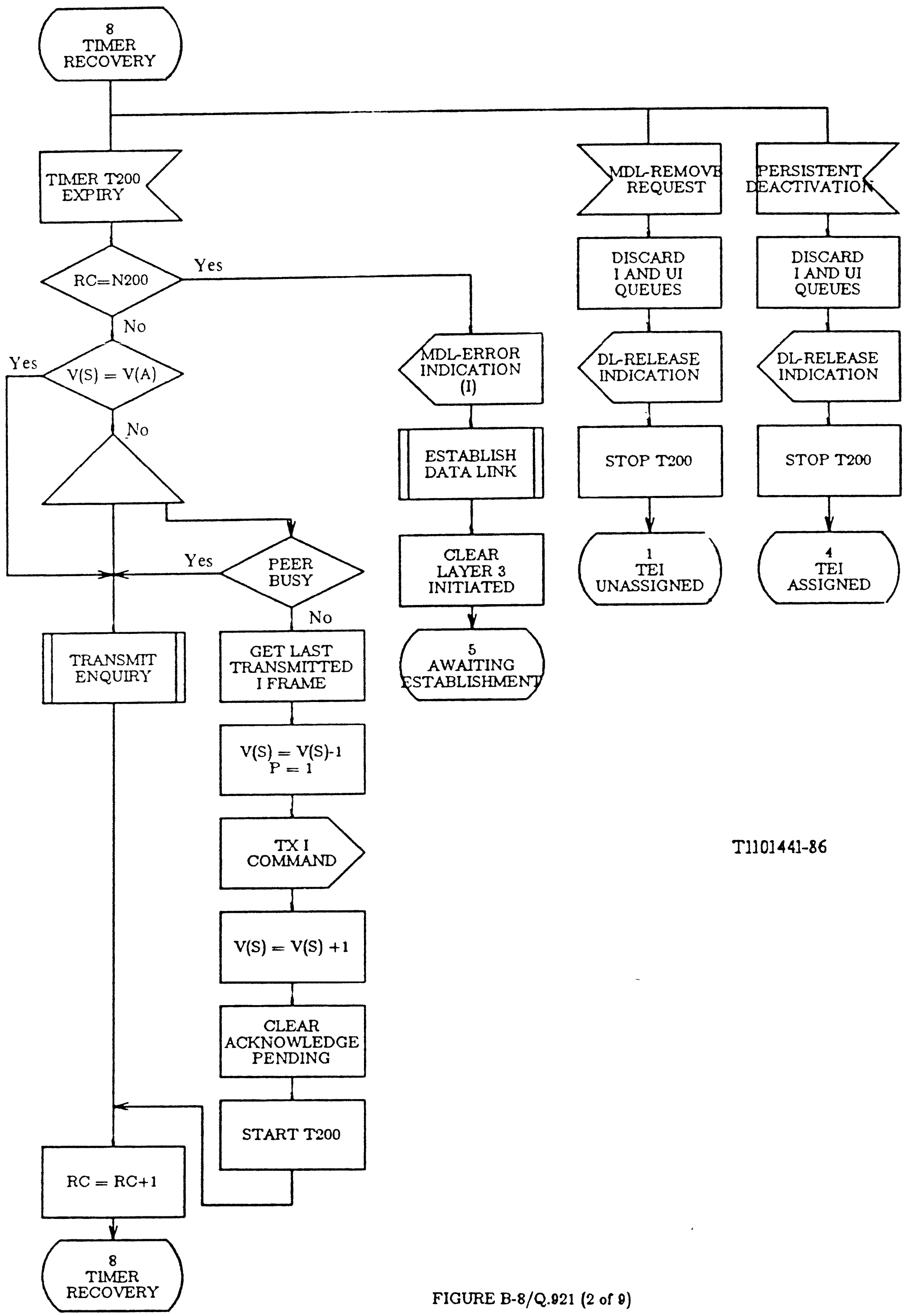


FIGURE B-8/Q.921 (2 of 9)

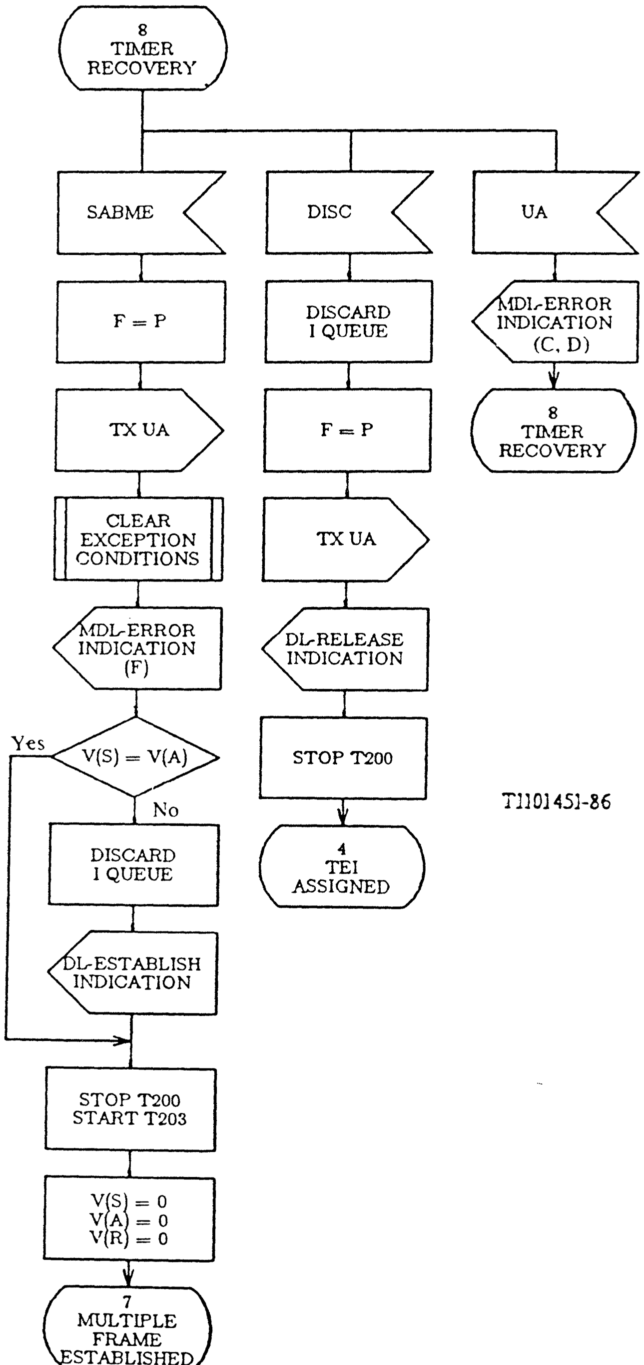
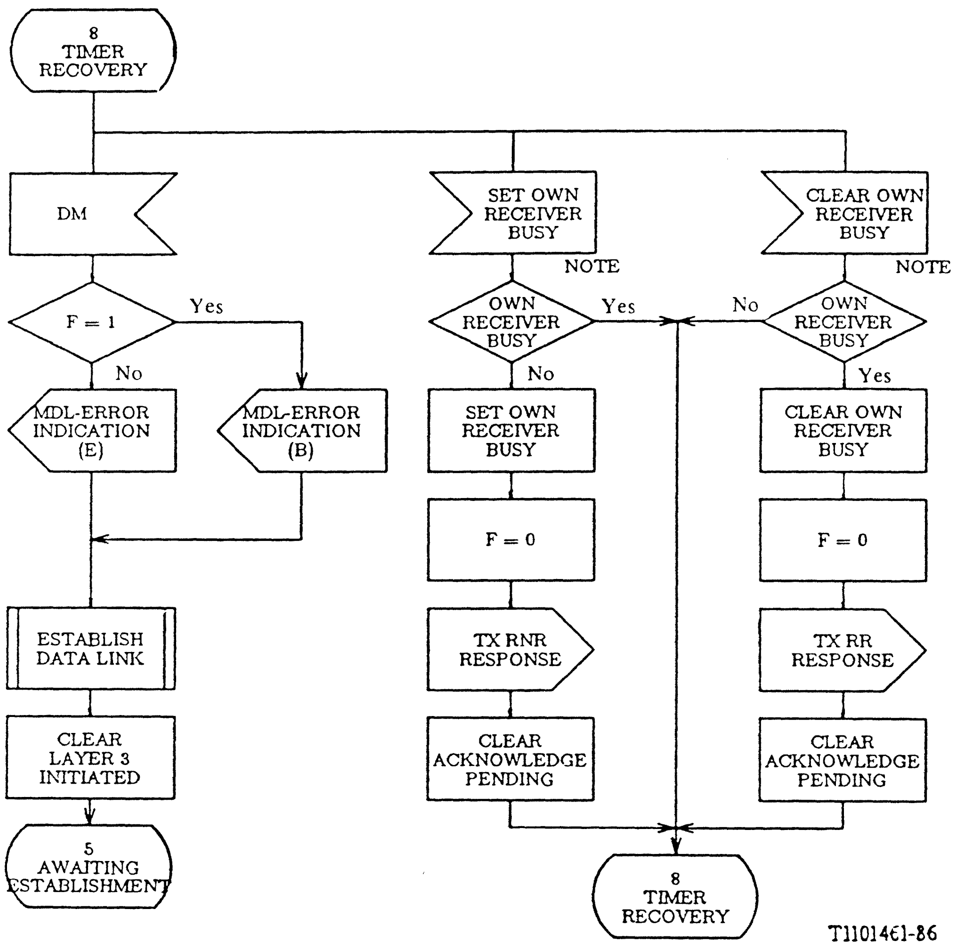


FIGURE B-8/Q.921 (3 of 9)



NOTE - These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

FIGURE B-8/Q.921 (4 of 9)

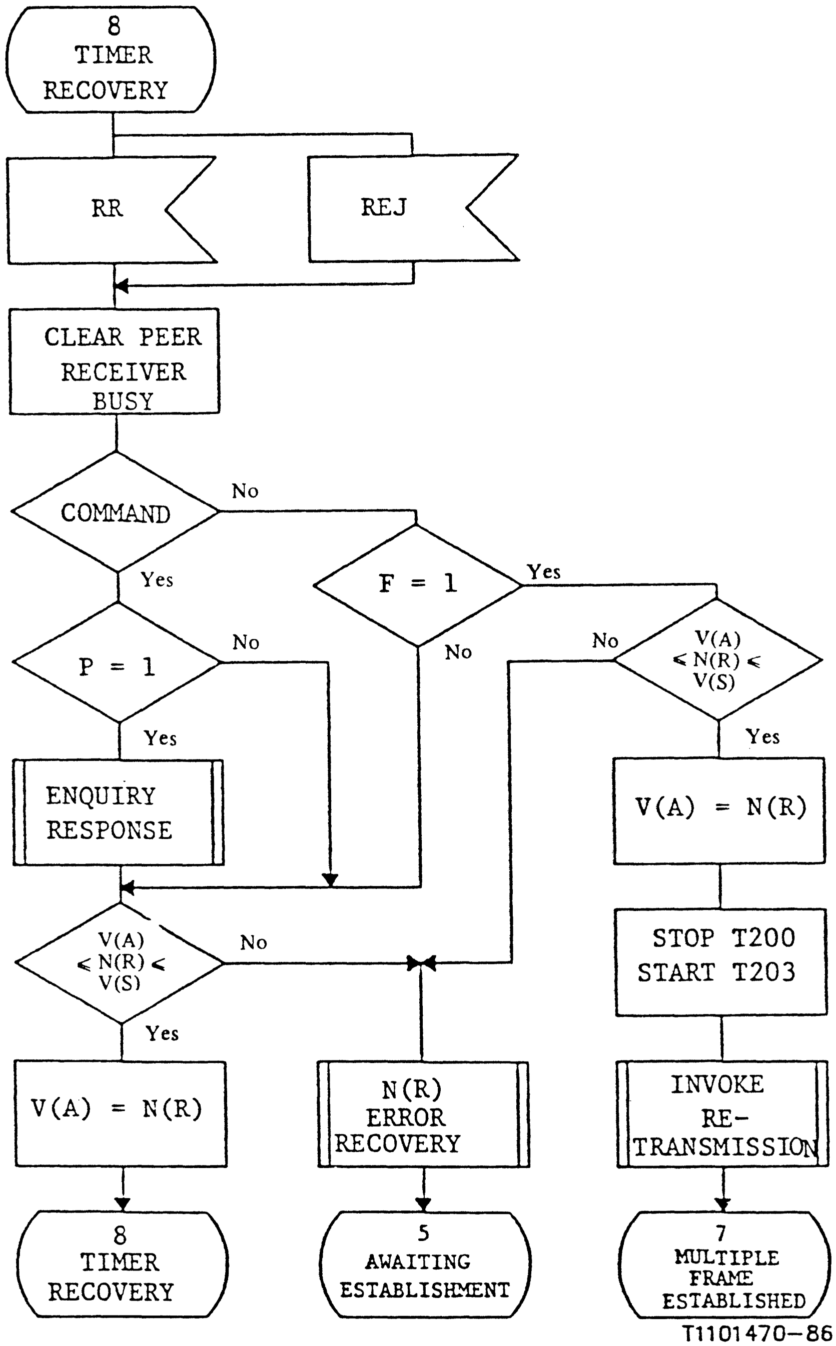


FIGURE B-8/Q.921 (5 of 9)

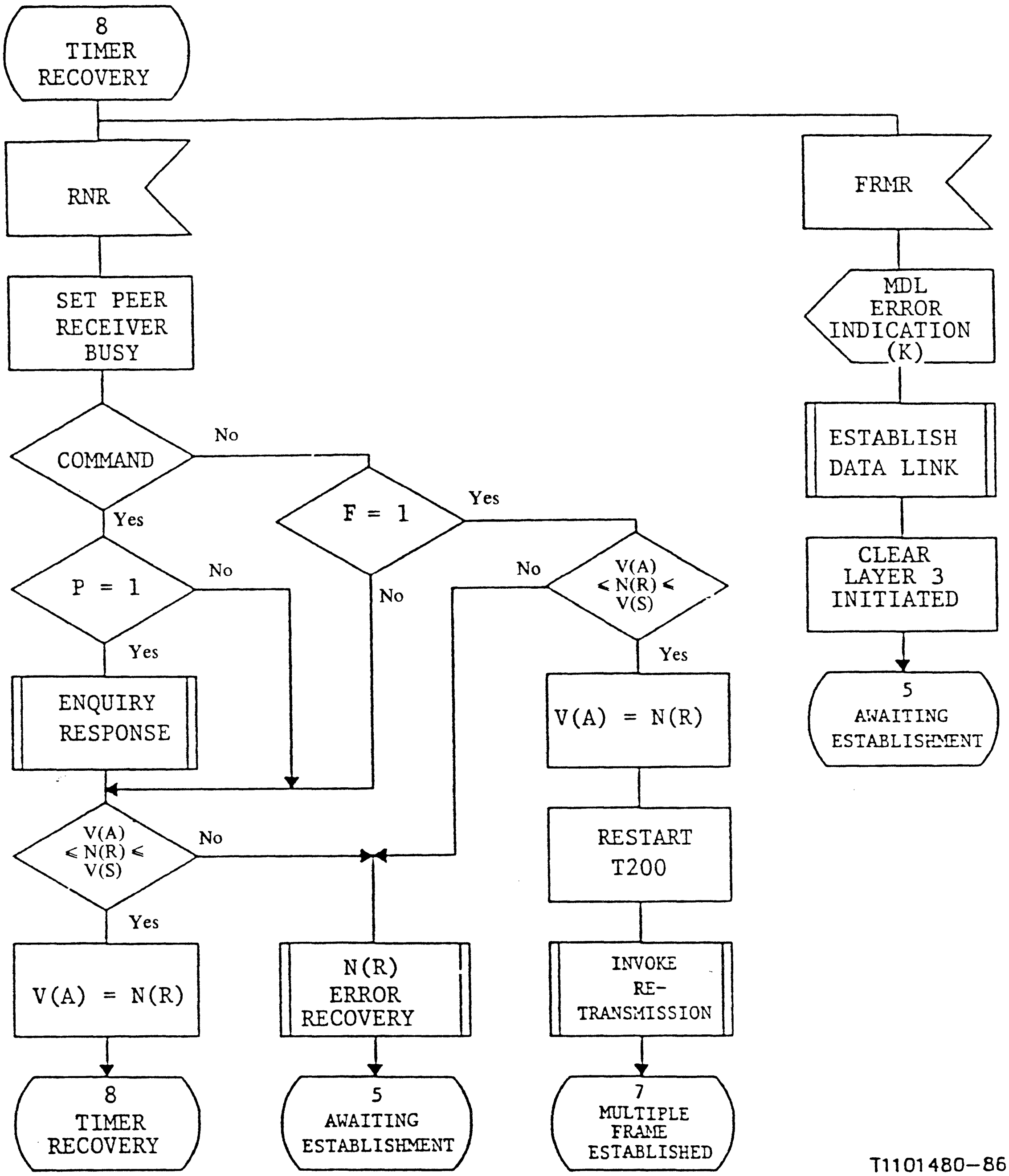
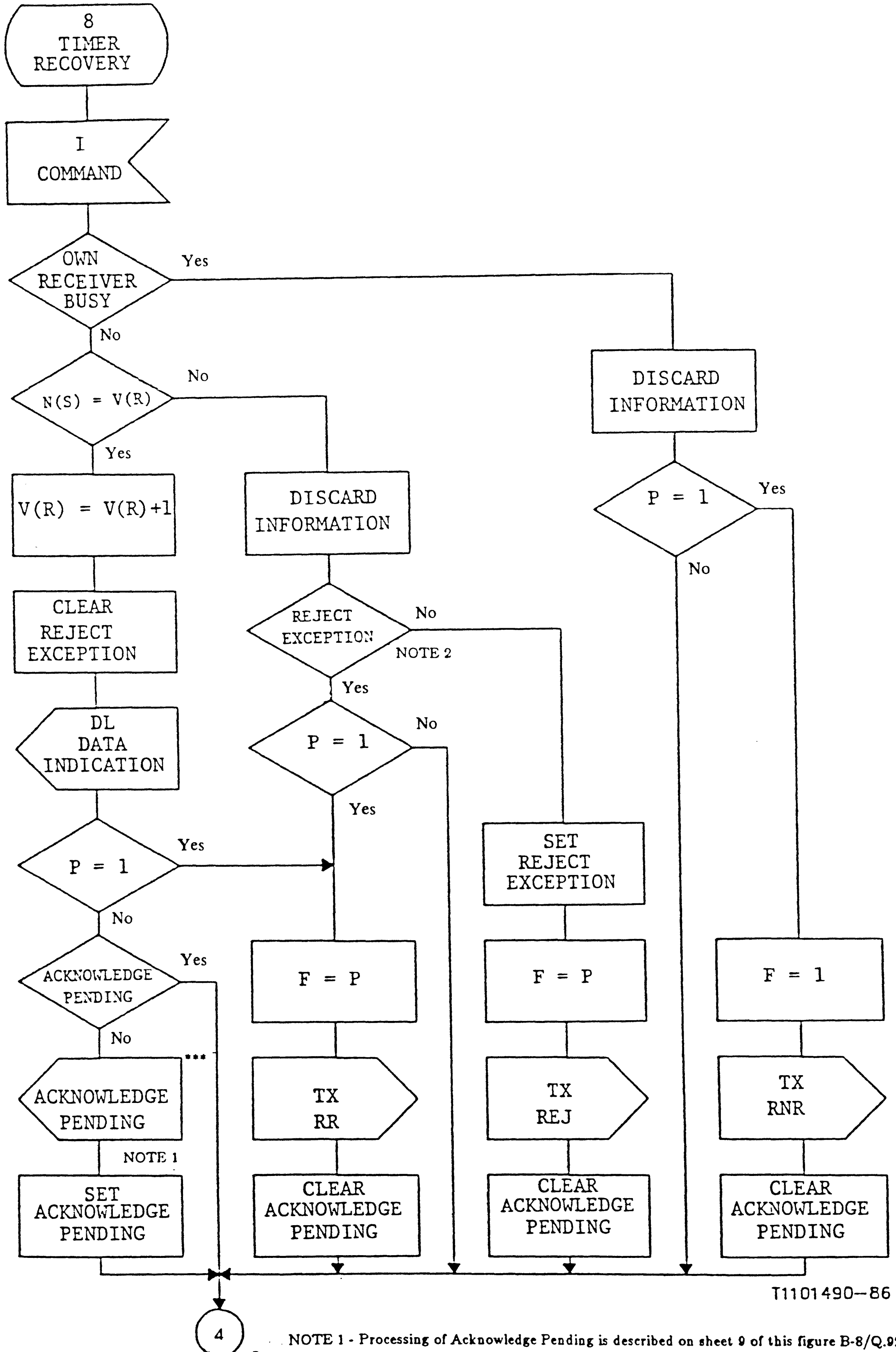


FIGURE B-8/Q.921 (6 of 9)



8 NOTE 1 - Processing of Acknowledge Pending is described on sheet 9 of this figure B-8/Q.921.

NOTE 2 - This SDL representation does not include the optional procedure in Appendix I

FIGURE B-8/Q.921 (7 of 9)

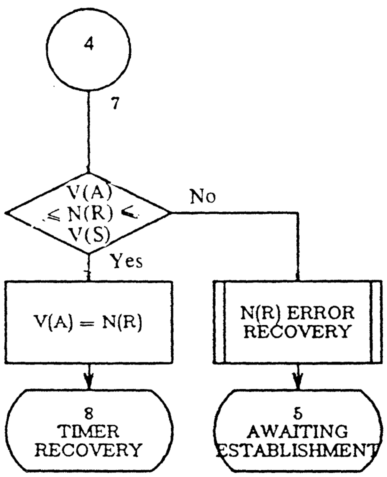


FIGURE B-8/Q.921 (8 of 9)

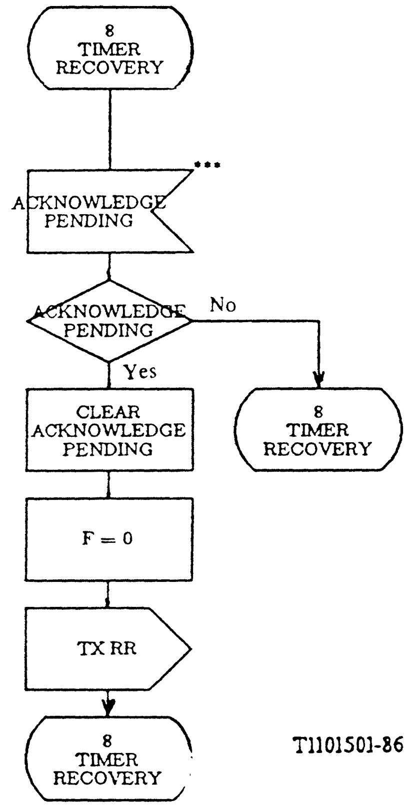


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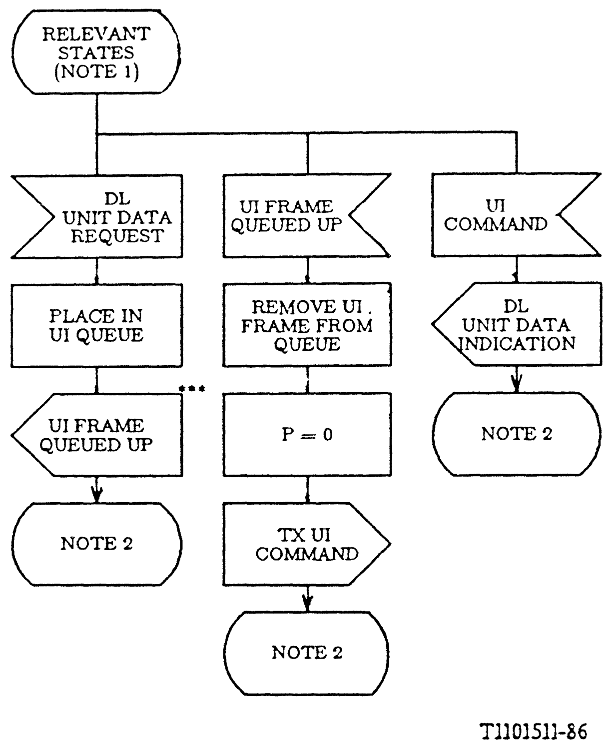
FIGURE B-8/Q.921 (9 of 9)

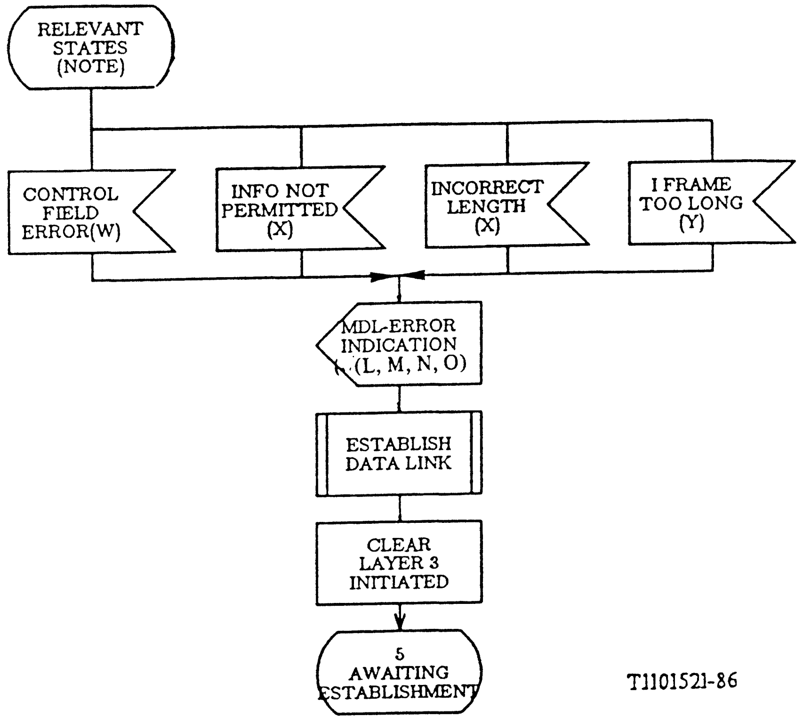


NOTE 1 - The relevant states are as follows:

4 TEI-assigned
5 Awaiting-establishment
6 Awaiting-release
7 Multiple-frame-established
8 Timer-recovery

NOTE 2 - The data link layer returns to the state it was in prior to the events shown.

FIGURE B-9/Q.921 (1 of 5)



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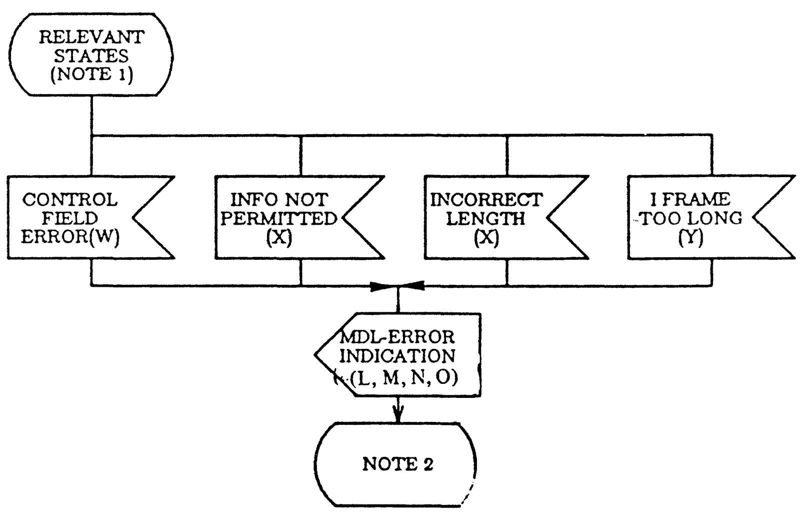
NOTE - The relevant states are as follows:

7 Multiple-frame-established
8 Timer-recovery

FIGURE B-9/Q.921 (2 of 5)



NOTE 1 - The relevant states are as follows:

4 TEI-assigned
5 Awaiting-establishment
6 Awaiting-release

NOTE 2 - The data link layer returns to the state it was in prior to the events shown.

FIGURE B-9/Q.921 (3 of 5)

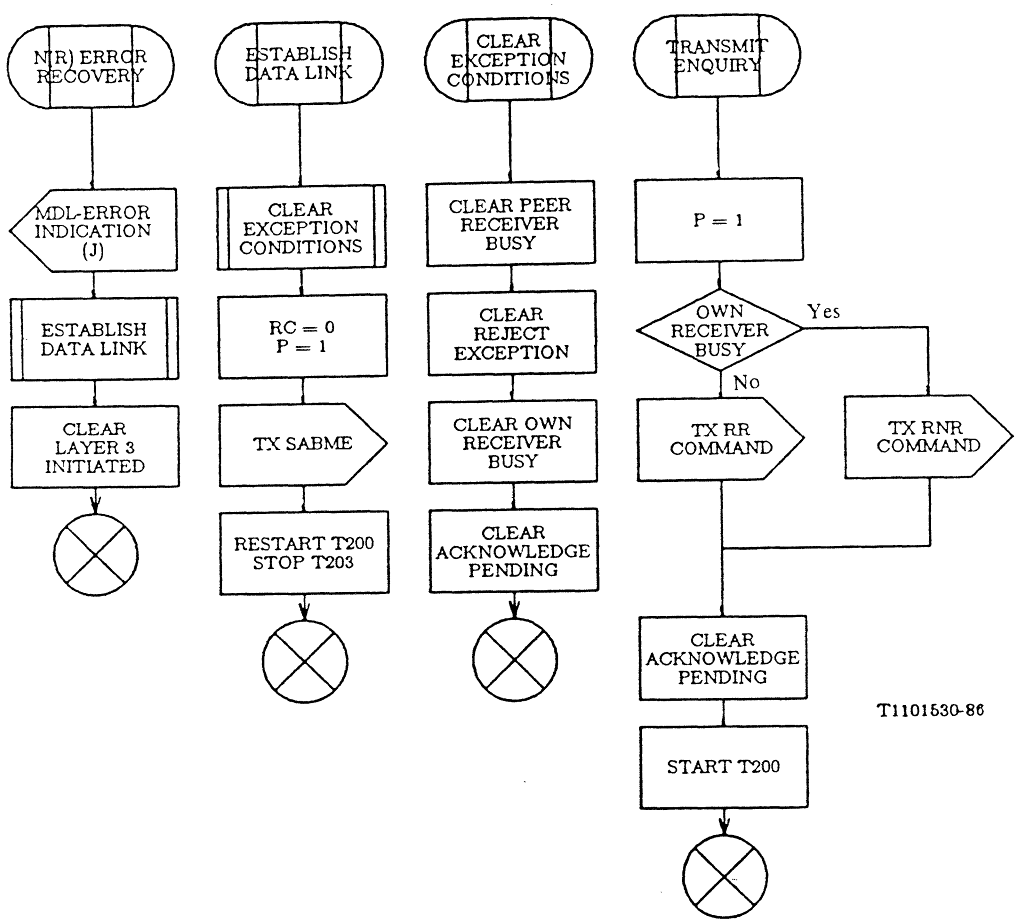
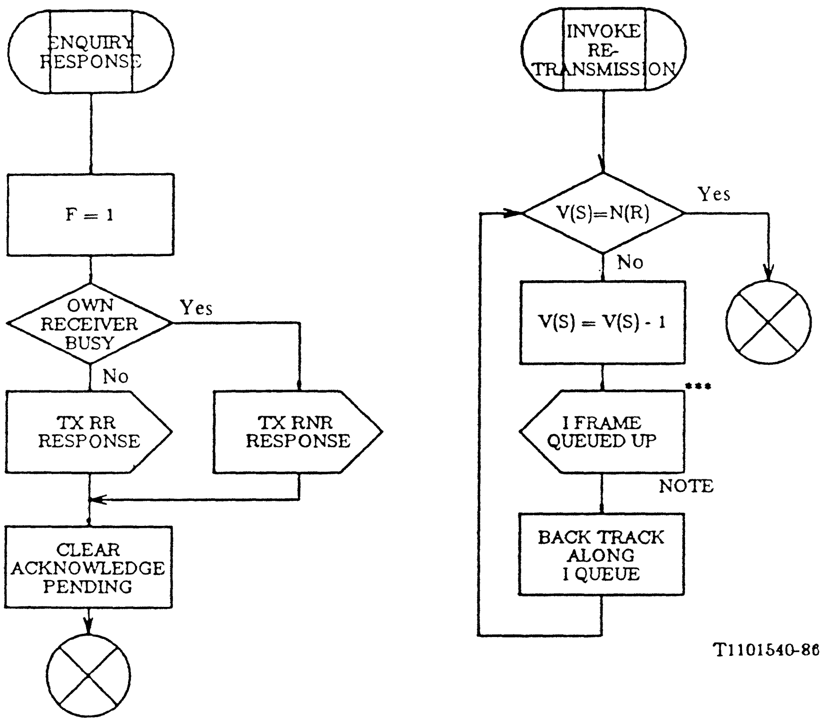


FIGURE B-9/Q.921 (4 of 5)



NOTE - The generation of the correct number of signals in order to cause the required retransmission of I frames does not alter their sequence integrity.

FIGURE B-9/Q.921 (5 of 5)

ANNEX C

(to Recommendation Q.921)

SDL representation of the broadcast procedures

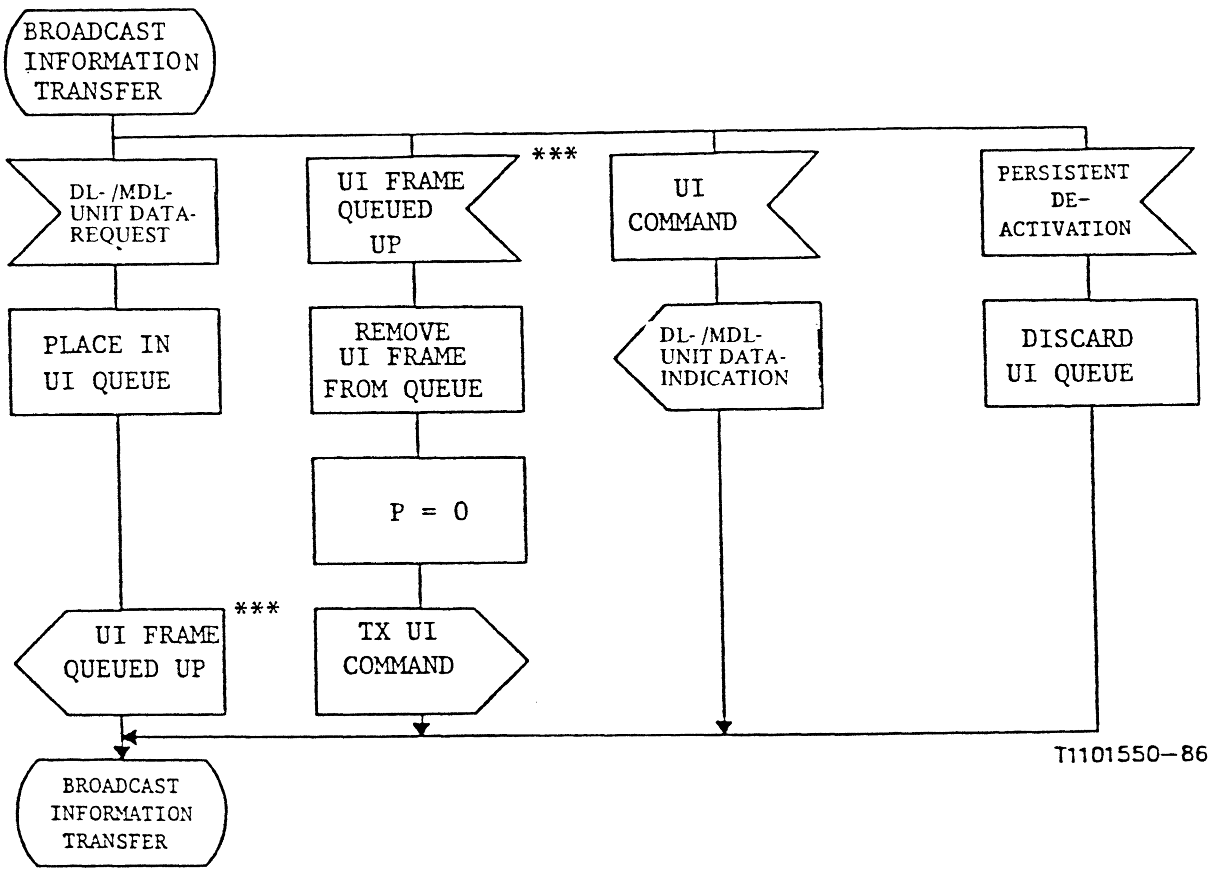


FIGURE C-1/Q.921

ANNEX D

(to Recommendation Q.921)

State transition table of the point-to-point procedures of the data link layer

D.1 The state transition table presented in Tables D-1/Q.921 to D-3/Q.921 is based on the eight basic states (see § B.2) recognized in the SDL representation and the related transmitter and receiver conditions.

The state transition table relinquishes to any partitioning of the procedures. It is conceptual and does not prevent a designer from partitioning in his implementation. Moreover, all the processes related to primitive procedures, the management of queues and the exchange of information between adjacent layers are conceptual, not visible from outside of the system and would not impose any constraints on the implementation.

The eight basic states apply to both the transmitter and the receiver within one data link layer entity. However, some of the conditions are confined to the transmitter (e.g. "peer receiver busy"), whilst some are confined to the receiver (e.g. "REJ recovery"). This implies, if the concept of non-partitioning is adopted, that each transmitter condition has to be combined with each receiver condition resulting in composite states. This state transition table comprises 24 composite states representing the 8 basic states and the related combinations of transmitter and receiver conditions.

Events are defined as follows:

a) primitives;

b) repertoire of frames to be received;

- unnumbered frames (SABME, DISC, UA, DM, UI, FRMR)
- supervisory frames (RR, REJ, RNR)
- information frame (I);

c) internal events (servicing of queues, expiry of timers, receiver busy condition).

The actions to be taken when an event occurs whilst in a specific state comprise:

i) transition to another state

ii) peer-to-peer frame to be transmitted

iii) primitives to be issued

iv) timer actions

v) retry counters

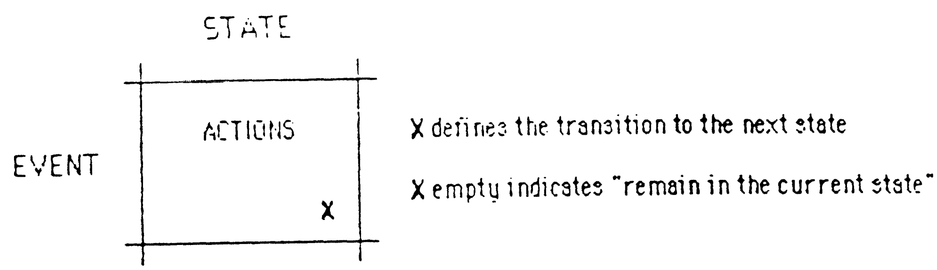
vi) state variables

vii) P/F bit setting

viii) discarding contents of queues.

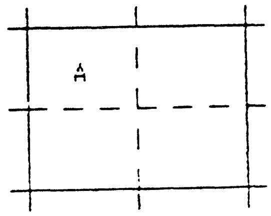
D.2 Key to the state transition table

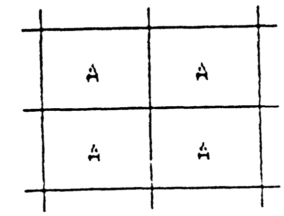
D.2.1 Definition of a cell of the state transition table



D.2.2 Key to the contents of a cell

|	Impossible by the definition of the data link layer service.
/	Impossible by the definition of the peer-to-peer data link procedures.
—	No action, no state change.
V(S)=V(A)=N(R)	Collective term for the two actions V(S)=N(R) and V(A)=N(R).
Timer T200	Start timer T200 if not already running.
TX ACK	The acknowledgement of the received I frame may be conveyed by an I frame associated with the information flow in the opposite direction or a supervisory response frame, as appropriate.
"DISCARD"	Indicates the discarding of the information contained in the information field of the I frame.
(A-O)	The codes used in MDL-ERROR-INDICATION signals are defined in Table II-1/Q.921 in Appendix II. When multiple codes are shown, only one applies.

The action 

indicates 

Note — In general, this state transition table does not prevent an implementation from using N(R) to acknowledge more than one I frame.

TABLE D-1/Q.921 (1 of 10)

State transition table: receiving primitive

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION							See Note	
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
DL-ESTABLISH-REQUEST	MDL-ASS-IDN 3	3	I	RC=0 TX SABME P=1 START T200 5.0	I	DISC. I QUEUE 5.0	I	I
DL-RELEASE-REQUEST	I	I	I	DL-REL-CONF	I	5.2	I	I
DL-DATA-REQUEST	I	I	I	I	I	DATA INTO I QUEUE	I	I
I FRAME IN QUEUE V(S)<V(A)+k	I	I	I	I	I	LEAVE I FRAME IN QUEUE		I
I FRAME IN QUEUE V(S)=V(A)+k	I	I	I	I	I			I
DL-UNIT DATA-REQUEST	MDL-ASS-IND UNIT DATA INTO UI QUEUE 2	UNIT DATA INTO UI QUEUE						
UI FRAME IN QUEUE	I	LEAVE UI FRAME IN QUEUE		TX UI P=0				
MDL-ASSIGN-REQUEST	STORE TEI VALUE 4		STORE TEI VALUE RC=0 TX SABME P=1 START T200 5.0	I	I	I	I	I
MDL-REMOVE-REQUEST	I	I	I	DISC. UI QUEUE 1	DL-REL-IND DISC. UI QUEUE STOP T200 1	DL-REL-IND DISC. I and UI QUEUES STOP T200	DL-REL-CONF DISC. I and UI QUEUES STOP T200 1	DL-REL-CONF DISC. UI QUEUE STOP T200 1
MDL-ERROR-RESPONSE	I	DISC. UI QUEUE 1	DL-REL-IND DISC. UI QUEUE 1	I	I	I	I	I
PERSISTENT DEACTIVATION	-	DISC. UI QUEUE 1	DL-REL-IND DISC. UI QUEUE 1	DISC. UI QUEUE	DL-REL-IND DISC. UI QUEUE STOP T200 4	DL-REL-IND DISC. I and UI QUEUES STOP T200 4	DL-REL-CONF DISC. I and UI QUEUES STOP T200 4	DL-REL-CONF DISC. UI QUEUE STOP T200 4

Note – The transmitter condition "pending release" may occur only in cases of layer 2 initiated re-establishment.

TABLE D-1/Q.921 (2 of 10)

State transition table: receiving unnumbered frame with correct format

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
SABME P=1 ABLE TO ENTER STATE 7.0	/	/	/	DL-EST-IND V(S,R,A)=0 TX UA F=1 START T203 7.0	TX UA F=1			TX DM F=1
SABME P=1 UNABLE TO ENTER STATE 7.0	/	/	/	TX DM F=1	/	/	/	/
SABME P=0 ABLE TO ENTER STATE 7.0	/	/	/	DL-EST-IND V(S,R,A)=0 TX UA F=0 START T203 7.0	TX UA F=0			TX DM F=0
SABME P=0 UNABLE TO ENTER STATE 7.0	/	/	/	TX DM F=0	/	/	/	/
DISC P=1	/	/	/	TX DM F=1	TX DM F=1			TX UA F=1
DISC P=0	/	/	/	TX DM F=0	TX DM F=0			TX UA F=0
UA F=1 V(S) = V(A)	/	/	/	MDL-ERR-IND(C)	V(S,R,A)=0 DL-EST-CONF STOP T200 START T203 7.0	V (S,R,A)=0 STOP T200 START T203 7.0	DISC I QUEUE RC=0 TX DISC P=1 RESTART T200 6	DL-REL-CONF STOP T200 4
UA F=1 V(S) ≠ V(A)	/	/	/			DISC I QUEUE V(S,R,A)=0 DL-EST-IND STOP T200 START T203 7.0		
UA F=0	/	/	/	MDL-ERR-IND(D)				
DM F=1	/	/	/	-	DL-REL-IND STOP T200 4	DL-REL-IND DISC I QUEUE STOP T200 4	DL-REL-CONF DISC I QUEUE STOP T200 4	DL-REL-CONF STOP T200 4
DM F=0 ABLE TO ENTER STATE 7.0	/	/	/	RC=0 TX SABME P=1 START T200 5.1	-	-	-	-
DM F=0 UNABLE TO ENTER STATE 7.0	/	/	/	-	/	/	/	/
UI command	/	/	/	DL-UNIT DATA-IND				

TABLE D-1/Q.921 (3 of 10)

State transition table: receiving FRMR unnumbered frame with correct format

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
FRMR response rejecting SABME	/	/	/	/	-	-	-	/
FRMR response rejecting DISC	/	/	/	/	/	/	/	-
FRMR response rejecting UA	/	/	/	-	-	-	-	-
FRMR response rejecting DM	/	/	/	-	-	-	-	-
FRMR response rejecting I command	/	/	/	/	-	-	-	-
FRMR response rejecting S frame	/	/	/	/	-	-	-	-
FRMR response rejecting FRMR	/	/	/	/	/	/	/	/

TABLE D-1/Q.921 (4 of 10)

State transition table: receiving RR supervisory frame with correct format

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
RR command P=1	/	/	/	-	-	-	-	-
RR command P=0	/	/	/	-	-	-	-	-
RR response F=0	/	/	/	-	-	-	-	-
RR response F=1	/	/	/	-	-	-	-	-

TABLE D-1/Q.921 (5 of 10)

State transition table: receiving REJ supervisory frame with correct format

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
REJ command P=1	/	/	/	-	-	-	-	-
REJ command P=0	/	/	/	-	-	-	-	-
REJ response F=0	/	/	/	-	-	-	-	-
REJ response F=1	/	/	/	-	-	-	-	-

TABLE D-1/Q.921 (6 of 10)

State transition table: Receiving RNR supervisory frame with correct format

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
RNR command P=1	/	/	/	-	-	-	-	-
RNR command P=0	/	/	/	-	-	-	-	-
RNR response F=0	/	/	/	-	-	-	-	-
RNR response F=1	/	/	/	-	-	-	-	-

TABLE D-1/Q.921 (7 of 10)

State transition table: receiving I command frame with correct format acknowledging all outstanding I frames or containing an N(R) which satisfies V(A) ≤ N(R) ≤ V(S)

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
I command P=1 N(S) = V(R) N(R) = V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) = V(R) N(R) = V(S)	/	/	/	-	-	-	-	-
I command P=1 N(S) ≠ V(R) N(R) = V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) ≠ V(R) N(R) = V(S)	/	/	/	-	-	-	-	-
I command P=1 N(S) = V(R) V(A)<N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) = V(R) V(A)<N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=1 N(S) ≠ V(R) V(A)<N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) ≠ V(R) V(A)<N(R)<V(S)	/	/	/	-	-	-	-	-

TABLE D-1/Q.921 (8 of 10)

State transition table: receiving I command frame with correct format containing an N(R) which satisfies V(A) = N(R) < V(S), or an N(R) error

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
I command P=1 N(S) = V(R) V(A)=N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) = V(R) V(A)=N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=1 N(S) ≠ V(R) V(A)=N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=0 N(S) ≠ V(R) V(A)=N(R)<V(S)	/	/	/	-	-	-	-	-
I command P=1 N(S) = V(R) N(R) error	/	/	/	-	-	-	-	-
I command P=0 N(S) = V(R) N(R) error	/	/	/	-	-	-	-	-
I command P=1 N(S) ≠ V(R) N(R) error	/	/	/	-	-	-	-	-
I command P=0 N(S) ≠ V(R) N(R) error	/	/	/	-	-	-	-	-

TABLE D-1/Q.921 (9 of 10)

State transition table: Internal events (expiry of timers, receiver busy condition)

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
T200 TIME-OUT RC < N200	/	/	/	/	RC=RC+1 TX SABME P=1 START T200			RC=RC+1 TX DISC P=1 START T200
T200 TIME-OUT RC = N200	/	/	/	/	DL-REL-IND MDL-ERR-IND(G) 4	DISC I QUEUE DL-REL-IND MDL-ERR-IND(G) 4	DISC I QUEUE DL-REL-CONF MDL-ERR-IND(G) 4	DL-REL-CONF MDL-ERR-IND(H) 4
T203 TIME-OUT	/	/	/	/	/	/	/	/
SET OWN RECEIVER BUSY (Note)	/	/	/	/	/	/	/	/
CLEAR OWN RECEIVER BUSY (Note)	/	/	/	/	/	/	/	/

Note – These signals are generated outside the procedures specified in this state transition table, and may be generated by the connection management entity.

TABLE D-1/Q.921 (10 of 10)

State transition table: Receiving frame with incorrect format or frame not implemented

BASIC STATE	TEI UNASSIGNED	ASSIGN AWAITING TEI	ESTABLISH AWAITING TEI	TEI ASSIGNED	AWAITING ESTABLISHMENT			AWAITING RELEASE
TRANSMITTER CONDITION					Establish	Re-establish	Pending release	
RECEIVER CONDITION								
STATE NUMBER	1	2	3	4	5.0	5.1	5.2	6
SABME incorrect length	/	/	/	MDL-ERR-IND(N)				
DISC incorrect length	/	/	/					
UA incorrect length	/	/	/					
DM incorrect length	/	/	/					
FRMR incorrect length	/	/	/					
Supervisory frame RR, REJ, RNR incorrect length	/	/	/					
N201 error	/	/	/	MDL-ERR-IND(O)				
Undefined command and response frames	/	/	/	MDL-ERR-IND(L)				
I field not permitted	/	/	/	MDL-ERR-IND(M)				

TABLE D-2/Q.921 (1 of 10)

State transition table: receiving primitive

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
DL-ESTABLISH-REQUEST	DISC I QUEUE RC=0 TX SABME P=1 STOP T203 RESTART T200 5.0							
DL-RELEASE-REQUEST	DISC I QUEUE RC=0 TX DISC P=1 STOP T203 RESTART T200 6							
DL-DATA-REQUEST	DATA INTO I QUEUE							
I FRAME IN QUEUE V(S)<V(A)+k	TX I P=0 V(S)=V(S)+1 STOP T203 TIMER T200				LEAVE I FRAME IN QUEUE			
I FRAME IN QUEUE V(S)=V(A)+k	LEAVE I FRAME IN QUEUE							
DL-UNIT DATA-REQUEST	UNIT DATA INTO UI QUEUE							
UI FRAME IN QUEUE	TX UI P=0							
MDL-ASSIGN-REQUEST	I							
MDL-REMOVE-REQUEST	DL-REL-IND DISC I and UI QUEUES STOP T200 STOP T203 1							
MDL-ERROR-RESPONSE	I							
PERSISTENT DEACTIVATION	DL-REL-IND DISC I and UI QUEUES STOP T200 STOP T203 4							

TABLE D-2/Q.921 (2 of 10)

State transition table: receiving unnumbered frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
SABME P=1 V(S) = V(A)	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=1 STOP T200 START T203	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=1 STOP T200 START T203 7.0						
SABME P=1 V(S) ≠ V(A)	DL-EST-IND MDL-ERR-IND(F) DISC I QUEUE V(S,R,A)=0 TX UA F=1 STOP T200 START T203	DL-EST-IND MDL-ERR-IND(F) DISC I QUEUE V(S,R,A)=0 TX UA F=1 STOP T200 START T203 7.0						
SABME P=0 V(S) = V(A)	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=0 STOP T200 START T203	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=0 STOP T200 START T203 7.0						
SABME P=0 V(S) ≠ V(A)	DL-EST-IND MDL-ERR-IND(F) DISC I QUEUE V(S,R,A)=0 TX UA F=0 STOP T200 START T203	DL-EST-IND MDL-ERR-IND(F) DISC I QUEUE V(S,R,A)=0 TX UA F=0 STOP T200 START T203 7.0						
DISC P=1	DL-REL-IND DISC I QUEUE TX UA F=1 STOP T200, T203 4							
DISC P=0	DL-REL-IND DISC I QUEUE TX UA F=0 STOP T200, T203 4							

TABLE D-2/Q.921 (2 of 10 *cont'd*)

State transition table: receiving unnumbered frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
UA F=1	MDL-ERR-IND(C)							
UA F=0	MDL-ERR-IND(D)							
DM F=1	MDL-ERR-IND(B)							
DM F=0	MDL-ERR-IND(E) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(E) RC = 0 TX SABME P=1 RESTART T200 5.1			
UI command	DL-UNIT DATA-IND							

TABLE D-2/Q.921 (3 of 10)

State transition table: receiving FRMR unnumbered frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC BUSY	PEER REC BUSY	PEER REC BUSY	PEER REC BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
FRMR response rejecting SABME	/	/	/	/	/	/	/	/
FRMR response rejecting DISC	/	/	/	/	/	/	/	/
FRMR response rejecting UA	MDL-ERR-IND(K) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(K) RC = 0 TX SABME P=1 RESTART T200 5.1			
FRMR response rejecting DM	/	/	/	/	/	/	/	/
FRMR response rejecting I command	MDL-ERR-IND(K) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(K) RC = 0 TX SABME P=1 RESTART T200 5.1			
FRMR response rejecting S frame								
FRMR response rejecting FRMR	/	/	/	/	/	/	/	/

TABLE D-2/Q.921 (4 of 10)

State transition table: receiving RR supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC BUSY	PEER REC BUSY	PEER REC BUSY	PEER REC BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
RR command P=1 N(R)=V(S)	TX RR F=1 STOP T200 RESTART T203 V(A)=N(R)		TX RNR F=1 STOP T200 RESTART T203 V(A)=N(R)		TX RR F=1 STOP T200 START T203 V(A)=N(R) 7.0	TX RR F=1 STOP T200 START T203 V(A)=N(R) 7.1	TX RNR F=1 STOP T200 START T203 V(A)=N(R) 7.2	TX RNR F=1 STOP T200 START T203 V(A)=N(R) 7.3
RR command P=0 N(R)=V(S)	STOP T200 RESTART T203 V(A)=N(R)				STOP T200 START T203 V(A)=N(R) 7.0	STOP T200 START T203 V(A)=N(R) 7.1	STOP T200 START T203 V(A)=N(R) 7.2	STOP T200 START T203 V(A)=N(R) 7.3
RR response F=0 N(R)=V(S)								
RR response F=1 N(R)=V(S)	MDL-ERR-IND(A) STOP T200 RESTART T203 V(A)=N(R)				MDL-ERR-IND(A) STOP T200 START T203 V(A)=N(R) 7.0	MDL-ERR-IND(A) STOP T200 START T203 V(A)=N(R) 7.1	MDL-ERR-IND(A) STOP T200 START T203 V(A)=N(R) 7.2	MDL-ERR-IND(A) STOP T200 START T203 V(A)=N(R) 7.3
RR command P=1 V(A) < N(R) < V(S)	TX RR F=1 RESTART T200 V(A)=N(R)		TX RNR F=1 RESTART T200 V(A)=N(R)		TX RR F=1 RESTART T200 V(A)=N(R) 7.0	TX RR F=1 RESTART T200 V(A)=N(R) 7.1	TX RNR F=1 RESTART T200 V(A)=N(R) 7.2	TX RNR F=1 RESTART T200 V(A)=N(R) 7.3
RR command P=0 V(A) < N(R) < V(S)	RESTART T200 V(A)=N(R)				RESTART T200 V(A)=N(R) 7.0	RESTART T200 V(A)=N(R) 7.1	RESTART T200 V(A)=N(R) 7.2	RESTART T200 V(A)=N(R) 7.3
RR response F=0 V(A) < N(R) < V(S)								
RR response F=1 V(A) < N(R) < V(S)	MDL-ERR-IND(A) RESTART T200 V(A)=N(R)				MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.0	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.1	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.2	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.3

TABLE D-2/Q.921 (4 of 10 *cont'd*)

State transition table: receiving RR supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC BUSY	PEER REC. BUSY	PEER REC BUSY	PEER REC BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
RR command P=1 V (A) = N(R) < V(S)	TX RR F=1		TX RNR F=1		TX RR F=1 7.0	TX RR F=1 7.1	TX RNR F=1 7.2	TX RNR F=1 7.3
RR command P=0 V (A) = N(R) < V(S)	-	-	-	-	7.0	7.1	7.2	7.3
RR response F=0 V (A) = N(R) < V(S)	-	-	-	-				
RR response F=1 V (A) = N(R) < V(S)	MDL-ERR-IND(A)				MDL-ERR-IND(A) 7.0	MDL-ERR-IND(A) 7.1	MDL-ERR-IND(A) 7.2	MDL-ERR-IND(A) 7.3
RR command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
RR command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			
RR response F=0 N(R) error								
RR response F=1 N(R) error	MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			

TABLE D-2/Q.921 (5 of 10)

State transition table: receiving REJ supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC BUSY	PEER REC. BUSY	PEER REC BUSY	PEER REC BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
REJ command P=1 N(R)=V(S) (Note)	TX RR F=1 V(A)=N(R) STOP T200 RESTART T203		TX RNR F=1 V(A)=N(R) STOP T200 RESTART T203		TX RR F=1 V(A)=N(R) STOP T200 START T203 7.0	TX RR F=1 V(A)=N(R) STOP T200 START T203 7.1	TX RNR F=1 V(A)=N(R) STOP T200 START T203 7.2	TX RNR F=1 V(A)=N(R) STOP T200 START T203 7.3
REJ command P=0 N(R)=V(S) (Note)	V(A)=N(R) STOP T200 RESTART T203				V(A)=N(R) STOP T200 START T203 7.0	V(A)=N(R) STOP T200 START T203 7.1	V(A)=N(R) STOP T200 START T203 7.2	V(A)=N(R) STOP T200 START T203 7.3
REJ response F=0 N(R)=V(S) (Note)								
REJ response F=1 N(R)=V(S) (Note)	MDL-ERR-IND(A) V(A)=N(R) STOP T200 RESTART T203				MDL-ERR-IND(A) V(A)=N(R) STOP T200 START T203 7.0	MDL-ERR-IND(A) V(A)=N(R) STOP T200 START T203 7.1	MDL-ERR-IND(A) V(A)=N(R) STOP T200 START T203 7.2	MDL-ERR-IND(A) V(A)=N(R) STOP T200 START T203 7.3
REJ command P=1 V(A) ≤ N(R) < V(S)	TX RR F=1 V(S)=V(A)=N(R) STOP T200 START T203		TX RNR F=1 V(S)=V(A)=N(R) STOP T200 START T203		TX RR F=1 V(S)=V(A)=N(R) STOP T200 START T203 7.0	TX RR F=1 V(S)=V(A)=N(R) STOP T200 START T203 7.1	TX RNR F=1 V(S)=V(A)=N(R) STOP T200 START T203 7.2	TX RNR F=1 V(S)=V(A)=N(R) STOP T200 START T203 7.3
REJ command P=0 V(A) ≤ N(R) < V(S)	V(S)=V(A)=N(R) STOP T200 START T203				V(S)=V(A)=N(R) STOP T200 START T203 7.0	V(S)=V(A)=N(R) STOP T200 START T203 7.1	V(S)=V(A)=N(R) STOP T200 START T203 7.2	V(S)=V(A)=N(R) STOP T200 START T203 7.3
REJ response F=0 V(A) ≤ N(R) < V(S)								
REJ response F=1 V(A) ≤ N(R) < V(S)	MDL-ERR-IND(A) V(S)=V(A)=N(R) STOP T200 START T203				MDL-ERR-IND(A) V(S)=V(A)=N(R) STOP T200 START T203 7.0	MDL-ERR-IND(A) V(S)=V(A)=N(R) STOP T200 START T203 7.1	MDL-ERR-IND(A) V(S)=V(A)=N(R) STOP T200 START T203 7.2	MDL-ERR-IND(A) V(S)=V(A)=N(R) STOP T200 START T203 7.3

Note – This event is impossible by the definition of the peer-to-peer data link procedures. However, it would not harm the information transfer, if actions according to this table are taken.

TABLE D-2/Q.921 (5 of 10 *cont'd*)

State transition table: receiving REJ supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
REJ command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
REJ command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			
REJ response F=0 N(R) error								
REJ response F=1 N(R) error	MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			

TABLE D-2/Q.921 (6 of 10)

State transition table: receiving RNR supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
RNR command P=1 N(R)=V(S)	TX RR F=1 STOP T203 RESTART T200 V(A)=N(R) 7.4	TX RR F=1 STOP T203 RESTART T200 V(A)=N(R) 7.5	TX RNR F=1 STOP T203 RESTART T200 V(A)=N(R) 7.6	TX RNR F=1 STOP T203 RESTART T200 V(A)=N(R) 7.7	TX RR F=1 RESTART T200 V(A)=N(R)		TX RNR F=1 RESTART T200 V(A)=N(R)	
RNR command P=0 N(R)=V(S)	STOP T203 RESTART T200 V(A)=N(R) 7.4	STOP T203 RESTART T200 V(A)=N(R) 7.5	STOP T203 RESTART T200 V(A)=N(R) 7.6	STOP T203 RESTART T200 V(A)=N(R) 7.7	RESTART T200 V(A)=N(R)			
RNR response F=0 N(R)=V(S)								
RNR response F=1 N(R)=V(S)	MDL-ERR-IND(A) STOP T203 RESTART T200 V(A)=N(R) 7.4	MDL-ERR-IND(A) STOP T203 RESTART T200 V(A)=N(R) 7.5	MDL-ERR-IND(A) STOP T203 RESTART T200 V(A)=N(R) 7.6	MDL-ERR-IND(A) STOP T203 RESTART T200 V(A)=N(R) 7.7	MDL-ERR-IND(A) RESTART T200 V(A)=N(R)			
RNR command P=1 V(A) ≤ N(R) < V(S)	TX RR F=1 RESTART T200 V(A)=N(R) 7.4	TX RR F=1 RESTART T200 V(A)=N(R) 7.5	TX RNR F=1 RESTART T200 V(A)=N(R) 7.6	TX RNR F=1 RESTART T200 V(A)=N(R) 7.7	TX RR F=1 RESTART T200 V(A)=N(R)		TX RNR F=1 RESTART T200 V(A)=N(R)	
RNR command P=0 V(A) ≤ N(R) < V(S)	RESTART T200 V(A)=N(R) 7.4	RESTART T200 V(A)=N(R) 7.5	RESTART T200 V(A)=N(R) 7.6	RESTART T200 V(A)=N(R) 7.7	RESTART T200 V(A)=N(R)			
RNR response F=0 V(A) ≤ N(R) < V(S)								
RNR response F=1 V(A) ≤ N(R) < V(S)	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.4	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.5	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.6	MDL-ERR-IND(A) RESTART T200 V(A)=N(R) 7.7	MDL-ERR-IND(A) RESTART T200 V(A)=N(R)			

TABLE D-2/Q.921 (6 of 10 *cont'd*)

State transition table: receiving RNR supervisory frame with correct format

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
RNR command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
RNR command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			
RNR response F=0 N(R) error								
RNR response F=1 N(R) error	MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1				MDL-ERR-IND(A) MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			

TABLE D-2/Q.921 (7 of 10)

State transition table: receiving I command frame with correct format acknowledging all outstanding I frames or containing an N(R) which satisfies $V(A) < N(R) < V(S)$

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
I command P=1 N(S) = V(R) N(R) = V(S)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 STOP T200 RESTART T203 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 STOP T200 RESTART T203 V(A)=N(R) 7.0	"DISCARD" TX RNR F=1 STOP T200 RESTART T203 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 7.4	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) = V(R) N(R) = V(S)	V(R)=V(R)+1 DL-DATA-IND TX ACK STOP T200 RESTART T203 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX ACK STOP T200 RESTART T203 V(A)=N(R) 7.0	"DISCARD" STOP T200 RESTART T203 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R) 7.4	"DISCARD" V(A)=N(R)	
I command P=1 N(S) ≠ V(R) N(R) = V(S)	"DISCARD" TX REJ F=1 STOP T200 RESTART T203 V(A)=N(R) 7.1	"DISCARD" TX RR F=1 STOP T200 RESTART T203 V(A)=N(R)	"DISCARD" TX RNR F=1 STOP T200 RESTART T203 V(A)=N(R)		"DISCARD" TX REJ F=1 V(A)=N(R) 7.5	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) ≠ V(R) N(R) = V(S)	"DISCARD" TX REJ F=0 STOP T200 RESTART T203 V(A)=N(R) 7.1	"DISCARD" STOP T200 RESTART T203 V(A)=N(R)			"DISCARD" TX REJ F=0 V(A)=N(R) 7.5	"DISCARD" V(A)=N(R)		
I command P=1 N(S) = V(R) $V(A)<N(R)<V(S)$	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 RESTART T200 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 RESTART T200 V(A)=N(R) 7.0	"DISCARD" TX RNR F=1 RESTART T200 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 7.4	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) = V(R) $V(A)<N(R)<V(S)$	V(R)=V(R)+1 DL-DATA-IND TX ACK RESTART T200 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX ACK RESTART T200 V(A)=N(R) 7.0	"DISCARD" RESTART T200 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R) 7.4	"DISCARD" V(A)=N(R)	
I command P=1 N(S) ≠ V(R) $V(A)<N(R)<V(S)$	"DISCARD" TX REJ F=1 RESTART T200 V(A)=N(R) 7.1	"DISCARD" TX RR F=1 RESTART T200 V(A)=N(R)	"DISCARD" TX RNR F=1 RESTART T200 V(A)=N(R)		"DISCARD" TX REJ F=1 V(A)=N(R) 7.5	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) ≠ V(R) $V(A)<N(R)<V(S)$	"DISCARD" TX REJ F=0 RESTART T200 V(A)=N(R) 7.1	"DISCARD" RESTART T200 V(A)=N(R)			"DISCARD" TX REJ F=0 V(A)=N(R) 7.5	"DISCARD" V(A)=N(R)		

TABLE D-2/Q.921 (8 of 10)

State transition table: receiving I command frame with correct format containing an N(R) which satisfies V(A) = N(R) < V(S), or an N(R) error

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
I command P=1 N(S) = V(R) V(A)=N(R)<V(S)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 7.0	"DISCARD" TX RNR F=1		V(R)=V(R)+1 DL-DATA-IND TX RR F=1	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 7.4	"DISCARD" TX RNR F=1	
I command P=0 N(S) = V(R) V(A)=N(R)<V(S)	V(R)=V(R)+1 DL-DATA-IND TX ACK	V(R)=V(R)+1 DL-DATA-IND TX ACK 7.0	"DISCARD"		V(R)=V(R)+1 DL-DATA-IND TX RR F=0	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 7.4	"DISCARD"	
I command P=1 N(S) ≠ V(R) V(A)=N(R)<V(S)	"DISCARD" TX REJ F=1 7.1	"DISCARD" TX RR F=1	"DISCARD" TX RNR F=1		"DISCARD" TX REJ F=1 7.5	"DISCARD" TX RR F=1	"DISCARD" TX RNR F=1	
I command P=0 N(S) ≠ V(R) V(A)=N(R)<V(S)	"DISCARD" TX REJ F=0 7.1	"DISCARD"			"DISCARD" TX REJ F=0 7.5	"DISCARD"		
I command P=1 N(S) = V(R) N(R) error	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=0 N(S) = V(R) N(R) error	V(R)=V(R)+1 DL-DATA-IND MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		V(R)=V(R)+1 DL-DATA-IND MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=1 N(S) ≠ V(R) N(R) error	"DISCARD" TX REJ F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1	"DISCARD" TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1	"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1		"DISCARD" TX REJ F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=0 N(S) ≠ V(R) N(R) error	"DISCARD" TX REJ F=0 MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1	"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1			"DISCARD" TX REJ F=0 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		

TABLE D-2/Q.921 (9 of 10)

State transition table: internal events (expiry of timers, receiver busy condition)

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
T200 TIME-OUT RC < N200	RC=0 either V(S)=V(S)-1 TX I P=1 V(S)=V(S)+1 or TX RR P=1 then RC=RC+1 START T200 8.0	RC=0 either V(S)=V(S)-1 TX I P=1 V(S)=V(S)+1 or TX RR P=1 then RC=RC+1 START T200 8.1	RC=0 either V(S)=V(S)-1 TX I P=1 V(S)=V(S)+1 or TX RNR P=1 then RC=RC+1 START T200 8.2	RC=0 either V(S)=V(6)-1 TX I P=1 V(S)=V(S)+1 or TX RNR P=1 then RC=RC+1 START T200 8.3	RC=0 TX RR P=1 RC=RC+1 START T200 8.4	RC=0 TX RR P=1 RC=RC+1 START T200 8.5	RC=0 TX RNR P=1 RC=RC+1 START T200 8.6	RC=0 TX RNR P=1 RC=RC+1 START T200 8.7
T200 TIME-OUT RC = N200	/	/	/	/	/	/	/	/
T203 TIME-OUT	RC=0 TX RR P=1 START T200 8.0	RC=0 TX RR P=1 START T200 8.1	RC=0 TX RNR P=1 START T200 8.2	RC=0 TX RR P=1 START T200 8.3	/	/	/	/
SET OWN RECEIVER BUSY (Note)	TX RNR F=0 7.2	TX RNR F=0 7.3	-	-	TX RNR F=0 7.6	TX RNR F=0 7.7	-	-
CLEAR OWN RECEIVER BUSY (Note)	-	-	TX RR F=0 7.0	TX RR F=0 7.1	-	-	TX RR F=0 7.4	TX RR F=0 7.5

Note – These signals are generated outside the procedures specified in this state transition table, and may be generated by the connection management entity.

TABLE D-2/Q.921 (10 of 10)

State transition table: receiving frame with incorrect format or frame not implemented

BASIC STATE	MULTIPLE FRAME ESTABLISHED							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
SABME incorrect length	MDL-ERR-IND(N) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1							
DISC incorrect length								
UA incorrect length								
DM incorrect length								
FRMR incorrect length								
Supervisory frame RR, REJ, RNR incorrect length								
N201 error	MDL-ERR-IND(O) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1							
Undefined command and response frames	MDL-ERR-IND(L) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1							
I field not permitted	MDL-ERR-IND(M) RC = 0 TX SABME P=1 STOP T203 RESTART T200 5.1							

TABLE D-3/Q.921 (1 of 10)

State transition table: receiving primitive

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
DL-ESTABLISH-REQUEST	DISC. I QUEUE RC=0 TX SABME P=1 RESTART T200 5.0							
DL-RELEASE-REQUEST	DISC. I QUEUE RC=0 TX DISC P=1 RESTART T200 6							
DL-DATA-REQUEST	DATA INTO I QUEUE							
I FRAME IN QUEUE V(S)<V(A)+k	LEAVE I FRAME IN QUEUE							
I FRAME IN QUEUE V(S)=V(A)+k								
DL-UNIT DATA-REQUEST	UNIT DATA INTO UI QUEUE							
UI FRAME IN QUEUE	TX UI P=0							
MDL-ASSIGN-REQUEST	I							
MDL-REMOVE-REQUEST	DL-REL-IND DISC. I and UI QUEUES STOP T200 1							
MDL-ERROR-RESPONSE	I							
PERSISTENT DEACTIVATION	DL-REL-IND DISC. I and UI QUEUES STOP T200 4							

TABLE D-3/Q.921 (2 of 10)

State transition table: receiving unnumbered frame with correct format

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
SABME P=1 V(S) = V(A)	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=1 STOP T200 START T203 7.0							
SABME P=1 V(S) ≠ V(A)	DL-EST-IND MDL-ERR-IND(F) DISC. I QUEUE V(S,R,A)=0 TX UA F=1 STOP T200 START T203 7.0							
SABME P=0 V(S) = V(A)	MDL-ERR-IND(F) V(S,R,A)=0 TX UA F=0 STOP T200 START T203 7.0							
SABME P=0 V(S) ≠ V(A)	DL-EST-IND MDL-ERR-IND(F) DISC. I QUEUE V(S,R,A)=0 TX UA F=0 STOP T200 START T203 7.0							
DISC P=1	DL-REL-IND DISC. I QUEUE TX UA F=1 STOP T200 4							
DISC P=0	DL-REL-IND DISC. I QUEUE TX UA F=0 STOP T200 4							

TABLE D-3/Q.921 (2 of 10 *cont'd*)

State transition table: receiving unnumbered frame with correct format

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
UA F=1	MDL-ERR-IND(C)							
UA F=0	MDL-ERR-IND(D)							
DM F=1	MDL-ERR-IND(B) RC = 0 TX SABME P=1 RESTART T200 5.1							
DM F=0	MDL-ERR-IND(E) RC=0 TX SABME P=1 RESTART T200 5.1							
UI command	DL-UNIT DATA-IND							

TABLE D-3/Q.921 (3 of 10)

State transition table: receiving FRMR unnumbered frame with correct format

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
FRMR response rejecting SABME	/	/	/	/	/	/	/	/
FRMR response rejecting DISC	/	/	/	/	/	/	/	/
FRMR response rejecting UA	/	/	/	/	/	/	/	/
FRMR response rejecting DM	/	/	/	/	/	/	/	/
FRMR response rejecting I command	MDL-ERR-IND(K) RC = 0 TX SABME P=1 RESTART T200 5.1							
FRMR response rejecting S frame								
FRMR response rejecting FRMR	/	/	/	/	/	/	/	/

TABLE D-3/Q.921 (4 of 10)

State transition table: receiving RR supervisory frame with correct format, clearance of timer recovery if there is F = 1 only

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
RR command P=1 V(A) $\le$ N(R) $\le$ V(S)	TX RR F=1 V(A)=N(R)		TX RNR F=1 V(A)=N(R)		TX RR F=1 V(A)=N(R) 8.0	TX RR F=1 V(A)=N(R) 8.1	TX RNR F=1 V(A)=N(R) 8.2	TX RNR F=1 V(A)=N(R) 8.3
RR command P=0 V(A) $\le$ N(R) $\le$ V(S)	V(A)=N(R)				V(A)=N(R) 8.0	V(A)=N(R) 8.1	V(A)=N(R) 8.2	V(A)=N(R) 8.3
RR response F=0 V(A) $\le$ N(R) $\le$ V(S)								
RR response F=1 V(A) $\le$ N(R) $\le$ V(S)	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.0	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.1	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.2	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.3	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.0	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.1	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.2	V(S)=N(R) STOP T200 START T203 V(A)=N(R) 7.3
RR command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
RR command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1							
RR response F=0 N(R) error								
RR response F=1 N(R) error								

TABLE D-3/Q.921 (5 of 10)

State transition table: receiving REJ supervisory frame with correct format, clearance of timer recovery if there is F = 1 only

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
REJ command P=1 $V(A) \le N(R) \le V(S)$	TX RR F=1 V(A)=N(R)		TX RNR F=1 V(A)=N(R)		TX RR F=1 V(A)=N(R) 8.0	TX RR F=1 V(A)=N(R) 8.1	TX RNR F=1 V(A)=N(R) 8.2	TX RNR F=1 V(A)=N(R) 8.3
REJ command P=0 $V(A) \le N(R) \le V(S)$	V(A)=N(R)				V(A)=N(R) 8.0	V(A)=N(R) 8.1	V(A)=N(R) 8.2	V(A)=N(R) 8.3
REJ response F=0 $V(A) \le N(R) \le V(S)$								
REJ response F=1 $V(A) \le N(R) \le V(S)$	V(S)=V(A)=N(R) STOP T200 START T203 7.0	V(S)=V(A)=N(R) STOP T200 START T203 7.1	V(S)=V(A)=N(R) STOP T200 START T203 7.2	V(S)=V(A)=N(R) STOP T200 START T203 7.3	V(S)=V(A)=N(R) STOP T200 START T203 7.0	V(S)=V(A)=N(R) STOP T200 START T203 7.1	V(S)=V(A)=N(R) STOP T200 START T203 7.2	V(S)=V(A)=N(R) STOP T200 START T203 7.3
REJ command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
REJ command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1							
REJ response F=0 N(R) error								
REJ response F=1 N(R) error								

TABLE D-3/Q.921 (6 of 10)

State transition table: receiving RNR supervisory frame with correct format, clearance of timer recovery if there is F = 1 only

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
RNR command P=1 $V(A) \leq N(R) \leq V(S)$	TX RR F=1 V(A)=N(R) 8.4	TX RR F=1 V(A)=N(R) 8.5	TX RNR F=1 V(A)=N(R) 8.6	TX RNR F=1 V(A)=N(R) 8.7	TX RR F=1 V(A)=N(R)		TX RNR F=1 V(A)=N(R)	
RNR command P=0 $V(A) \leq N(R) \leq V(S)$	V(A)=N(R) 8.4	V(A)=N(R) 8.5	V(A)=N(R) 8.6	V(A)=N(R) 8.7	V(A)=N(R)			
RNR response F=0 $V(A) \leq N(R) \leq V(S)$								
RNR response F=1 $V(A) \leq N(R) \leq V(S)$	V(S)=N(R) RESTART T200 V(A)=N(R) 7.4	V(S)=N(R) RESTART T200 V(A)=N(R) 7.5	V(S)=N(R) RESTART T200 V(A)=N(R) 7.6	V(S)=N(R) RESTART T200 V(A)=N(R) 7.7	V(S)=N(R) RESTART T200 V(A)=N(R) 7.4	V(S)=N(R) RESTART T200 V(A)=N(R) 7.5	V(S)=N(R) RESTART T200 V(A)=N(R) 7.6	V(S)=N(R) RESTART T200 V(A)=N(R) 7.7
RNR command P=1 N(R) error	TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
RNR command P=0 N(R) error	MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1							
RNR response F=0 N(R) error								
RNR response F=1 N(R) error								

TABLE D-3/Q.921 (7 of 10)

State transition table: receiving I command frame with correct format acknowledging all outstanding I frames or containing an N(R) which satisfies V(A) < N(R) < V(S); no clearance of timer recovery

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
I command P=1 N(S) = V(R) N(R) = V(S)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 8.0	"DISCARD" TX RNR F=1 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 8.4	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) = V(R) N(R) = V(S)	V(R)=V(R)+1 DL-DATA-IND TX ACK V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX ACK V(A)=N(R) 8.0	"DISCARD" V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R) 8.4	"DISCARD" V(A)=N(R)	
I command P=1 N(S) ≠ V(R) N(R) = V(S)	"DISCARD" TX REJ F=1 V(A)=N(R) 8.1	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)		"DISCARD" TX REJ F=1 V(A)=N(R) 8.5	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) ≠ V(R) N(R) = V(S)	"DISCARD" TX REJ F=0 V(A)=N(R) 8.1	"DISCARD" V(A)=N(R)			"DISCARD" TX REJ F=0 V(A)=N(R) 8.5	"DISCARD" V(A)=N(R)		
I command P=1 N(S) = V(R) V(A)<N(R)<V(S)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 8.0	"DISCARD" TX RNR F=1 V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 V(A)=N(R) 8.4	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) = V(R) V(A)<N(R)<V(S)	V(R)=V(R)+1 DL-DATA-IND TX ACK V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX ACK V(A)=N(R) 8.0	"DISCARD" V(A)=N(R)		V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R)	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 V(A)=N(R) 8.4	"DISCARD" V(A)=N(R)	
I command P=1 N(S) ≠ V(R) V(A)<N(R)<V(S)	"DISCARD" TX REJ F=1 V(A)=N(R) 8.1	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)		"DISCARD" TX REJ F=1 V(A)=N(R) 8.5	"DISCARD" TX RR F=1 V(A)=N(R)	"DISCARD" TX RNR F=1 V(A)=N(R)	
I command P=0 N(S) ≠ V(R) V(A)<N(R)<V(S)	"DISCARD" TX REJ F=0 V(A)=N(R) 8.1	"DISCARD" V(A)=N(R)			"DISCARD" TX REJ F=0 V(A)=N(R) 8.5	"DISCARD" V(A)=N(R)		

TABLE D-3/Q.921 (8 of 10)

State transition table: receiving I command frame with correct format containing an N(R) which satisfies $V(A) = N(R) < V(S)$, or an N(R) error

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
I command P=1 N(S) = V(R) $V(A)=N(R)<V(S)$	V(R)=V(R)+1 DL-DATA-IND TX RR F=1	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 8.0	"DISCARD" TX RNR F=1		V(R)=V(R)+1 DL-DATA-IND TX RR F=1	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 8.4	"DISCARD" TX RNR F=1	
I command P=0 N(S) = V(R) $V(A)=N(R)<V(S)$	V(R)=V(R)+1 DL-DATA-IND TX ACK	V(R)=V(R)+1 DL-DATA-IND TX ACK 8.0	"DISCARD"		V(R)=V(R)+1 DL-DATA-IND TX RR F=0	V(R)=V(R)+1 DL-DATA-IND TX RR F=0 8.4	"DISCARD"	
I command P=1 N(S) ≠ V(R) $V(A)=N(R)<V(S)$	"DISCARD" TX REJ F=1 8.1	"DISCARD" TX RR F=1	"DISCARD" TX RNR F=1		"DISCARD" TX REJ F=1 8.5	"DISCARD" TX RR F=1	"DISCARD" TX RNR F=1	
I command P=0 N(S) ≠ V(R) $V(A)=N(R)<V(S)$	"DISCARD" TX REJ F=0 8.1	"DISCARD"			"DISCARD" TX REJ F=0 8.5	"DISCARD"		
I command P=1 N(S) = V(R) N(R) error	V(R)=V(R)+1 DL-DATA-IND TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		V(R)=V(R)+1 DL-DATA-IND TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=0 N(S) = V(R) N(R) error	V(R)=V(R)+1 DL-DATA-IND MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		V(R)=V(R)+1 DL-DATA-IND MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=1 N(S) ≠ V(R) N(R) error	"DISCARD" TX REJ F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		"DISCARD" TX REJ F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" TX RNR F=1 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	
I command P=0 N(S) ≠ V(R) N(R) error	"DISCARD" TX REJ F=0 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1			"DISCARD" TX REJ F=0 MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1	"DISCARD" MDL-ERR-IND(J) RC = 0 TX SABME P=1 RESTART T200 5.1		

TABLE D-3/Q.921 (9 of 10)

State transition table: internal events (expiry of timers, receiver busy condition); initiation of a re-establishment procedure if the value of the retransmission count variable is equal to N200

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
T200 TIME-OUT RC < N200 V(A) < V(S)	either V(S)=V(S)-1 TX I P=1 V(S)=V(S)+1 or TX RR P=1 then RC=RC+1 START T200		either V(S)=V(S)-1 TX I P=1 V(S)=V(S)+1 or TX RNR P=1 then RC=RC+1 START T200		TX RR P=1 RC=RC+1 START T200		TX RNR P=1 RC=RC+1 START T200	
T200 TIME-OUT RC < N200 V(A) = V(S)	TX RR P=1 RC = RC+1 START T200		TX RNR P=1 RC = RC+1 START T200					
T200 TIME-OUT RC = N200	MDL-ERR-IND(I) RC=0 TX SABME P=1 START T200 5.1							
T203 TIME-OUT	/	/	/	/	/	/	/	/
SET OWN RECEIVER BUSY (Note)	TX RNR F=0 8.2	TX RNR F=0 8.3	-	-	TX RNR F=0 8.6	TX RNR F=0 8.7	-	-
CLEAR OWN RECEIVER BUSY (Note)	-	-	TX RR F=0 8.0	TX RR F=0 8.1	-	-	TX RR F=0 8.4	TX RR F=0 8.5

Note – These signals are generated outside the procedures specified in this state transition table, and may be generated by the conneciton management entity.

TABLE D-3/Q.921 (10 of 10)

State transition table: receiving frame with incorrect format or frame not implemented

BASIC STATE	TIMER RECOVERY							
TRANSMITTER CONDITION	NORMAL	NORMAL	NORMAL	NORMAL	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY	PEER REC. BUSY
RECEIVER CONDITION	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy	NORMAL	REJ RECOVERY	OWN REC. BUSY	REJ and own REC busy
STATE NUMBER	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
SABME incorrect length	MDL-ERR-IND(N) RC = 0 TX SABME P=1 RESTART T200 5.1							
DISC incorrect length								
UA incorrect length								
DM incorrect length								
FRMR incorrect length								
Supervisory frame RR, REJ, RNR incorrect length								
N201 error	MDL-ERR-IND(O) RC = 0 TX SABME P=1 RESTART T200 5.1							
Undefined command and response frames	MDL-ERR-IND(L) RC = 0 TX SABME P=1 RESTART T200 5.1							
I field not permitted	MDL-ERR-IND(M) RC = 0 TX SABME P=1 RESTART T200 5.1							

APPENDIX I

(to Recommendation Q.921)

Retransmission of REJ response frames

I.1 Introduction

This appendix describes an optional procedure which may be used to provide a reject retransmission procedure.

I.2 Procedure

This optional reject retransmission procedure can supplement the Q.921 LAPD protocol by defining a new variable for multiple frame operation (§ 3.5.2), and by modifying the N(S) sequence error exception condition reporting and recovery (§ 5.8.1).

I.2.1 Recovery state variable V(M)

Each point-to-point data link entity may have an associated V(M) when using I frame commands and supervisory frame commands/responses. V(M) denotes the sequence number of the last frame received which caused an N(S) sequence error condition. V(M) can take on the value 0 to 127 and may be used to determine if another REJ response frame should be sent on receipt of an N(S) sequence error while in the REJ exception condition.

I.2.2 N(S) sequence error supplementary procedure

The first three paragraphs of § 5.8.1, N(S) sequence error, apply. The remainder of the section if as follows:

The REJ frame is used by a receiving data link layer entity to initiate an exception recovery (retransmission) following the detection of an N(S) sequence error. The receiving data link entity shall set V(M) to the N(S) sequence number which caused the N(S) sequence error condition.

Only one REJ exception condition for a given direction of information transfer shall be established at a time [that is, all REJ frames must have the same N(R) value until the REJ reception is cleared].

A data link layer entity receiving an REJ command or response shall initiate sequential transmission (retransmission) of I frames starting with the I frame indicated by the N(R) contained in the REJ frame.

A REJ exception is cleared when the requested I frame is received or when SABME, or DISC is received.

If an N(S) sequence error exception occurs when the receiving data link layer entity is in the REJ exception condition, then check the N(S) of the received frame to see if the data link layer entity which received the REJ frame has retransmitted in response to the REJ frame {i.e. is N(S) within the range [$V(R)+1 \leq N(S) \leq V(M)$]}. If the N(S) of the received frame is within the above range, then send another REJ response frame, issue an MDL-ERROR-INDICATION primitive to the connection management entity, and set V(M) equal to N(S). The transmitting side will not need to wait for timer T200 to expire before it can retransmit the lost frame.

If an N(S) sequence error occurs when the receiving data link layer entity is in the REJ exception condition, and it cannot be determined if the data link layer entity which received the REJ frame has retransmitted in response to that frame [i.e. if N(S) > V(M)], then set V(M) equal to the N(S) of the received frame.

APPENDIX II

(to Recommendation Q.921)

Occurrence of MDL-ERROR-INDICATION within the basic states and actions to be taken by the management entity

II.1 Introduction

Table II-1/Q.921 gives the error situations in which the MDL-ERROR-INDICATION primitive will be generated. This primitive notifies the data link layer's connection management entity of the occurred error situation. The associated error parameter contains the error code that describes the unique error conditions. Table II-1/Q.921 also identifies the associated connection management actions to be taken from the network and the user side, based on the types of error conditions reported.

This appendix does not incorporate the retransmission of REJ response frames described in Appendix I.

II.2 Layout of Table II-1/Q.921

The "Error code" column gives the identification value of each error situation to be included as a parameter with the MDL-ERROR-INDICATION primitive.

The column entitled "Error condition" together with the "Affected states" describes unique protocol error events and the basic state of the data link layer entity at the point that the MDL-ERROR-INDICATION primitive is generated.

For a given error condition, the column entitled "Network management action" describes the preferred action to be taken by the network management entity.

The column entitled "User management action" describes the preferred action to be taken by the user side management entity on a given error condition.

II.3 Preferred management actions

The various preferred layer management actions on an error situation may be described as one of the following:

a) Error log

This suggests that the network side connection management entity has the preferred action of logging the event into an error counter. The length and the operation of the counter mechanisms for the error situations is implementation dependent.

b) TEI check

This means that the network side layer management entity invokes the TEI check procedure.

c) TEI verify

This means that the user side layer management entity may optionally invoke a TEI verify request procedure that asks the network side layer management entity to issue a TEI check procedure.

d) TEI remove

This means that the user side layer management entity may directly remove its TEI value from service.

In most of the described error situations, there is either no action to be taken on the user side layer management or the action to be taken is implementation dependent, as Table II-1/Q.921 shows. "Implementation dependent" means that it is optional whether the user side layer management has incorporated any form of error counter to log (store) the reported event. If action is taken, the layer management has to take into account that the data link layer will have initiated a recovery procedure.

TABLE II-1/Q.921

Management Entity Actions for MDL Error Indications

<table>
<tr><th>Error Type</th><th>Error Code</th><th>Error Condition</th><th>Affected states (See Note 1)</th><th>Network Management Action</th><th>User Management Action</th></tr>
<tr><td rowspan="5">Receipt of unsolicited response</td><td>A</td><td>Supervisory (F = 1)</td><td>7</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>B</td><td>DM (F = 1)</td><td>7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>C</td><td>UA (F = 1)</td><td>4,7,8</td><td rowspan="2">TEI removal procedure or TEI check procedure; then, if TEI:
– free, remove TEI
– single, no action
– multiple, TEI removal procedure</td><td rowspan="2">TEI identity verify procedure
or
remove TEI</td></tr>
<tr><td>D</td><td>UA (F = 0)</td><td>4,5,6,7,8</td></tr>
<tr><td>E</td><td>Receipt of DM response (F = 0)</td><td>7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>Peer initiated re-establishment</td><td>F</td><td>SABME</td><td>7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td rowspan="3">Unsuccessful retransmission (N200 times)</td><td>G</td><td>SABME</td><td>5</td><td rowspan="2">TEI check procedure; then, if TEI:
– free, remove TEI
– single, error log
– multiple, TEI removal procedure</td><td rowspan="2">TEI identity verify procedure
or
remove TEI</td></tr>
<tr><td>H</td><td>DISC</td><td>6</td></tr>
<tr><td>I</td><td>Status Enquiry</td><td>8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td rowspan="6">Other</td><td>J</td><td>N(R) Error</td><td>7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>K</td><td>Receipt of FRMR response</td><td>7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>L</td><td>Receipt of non-implemented frame</td><td>4,5,6,7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>M (See Note 2)</td><td>Receipt of I field not permitted</td><td>4,5,6,7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>N</td><td>Receipt of frame with wrong size</td><td>4,5,6,7,8</td><td>Error log</td><td>implementation dependent</td></tr>
<tr><td>O</td><td>N201 Error</td><td>4,5,6,7,8</td><td>Error log</td><td>implementation dependent</td></tr>
</table>

Note 1 – For the description of the affected states, see Annex B.

Note 2 – According to § 5.8.5, this error code will never be generated.

APPENDIX III

(to Recommendation Q.921)

Optional basic access deactivation procedures

III.1 Introduction

This appendix provides one example of a deactivation procedure which can be used by the network side system management to control deactivation of the access. Figure III-1/Q.921 provides a conceptual model of the interactions which are required for this deactivation procedure.

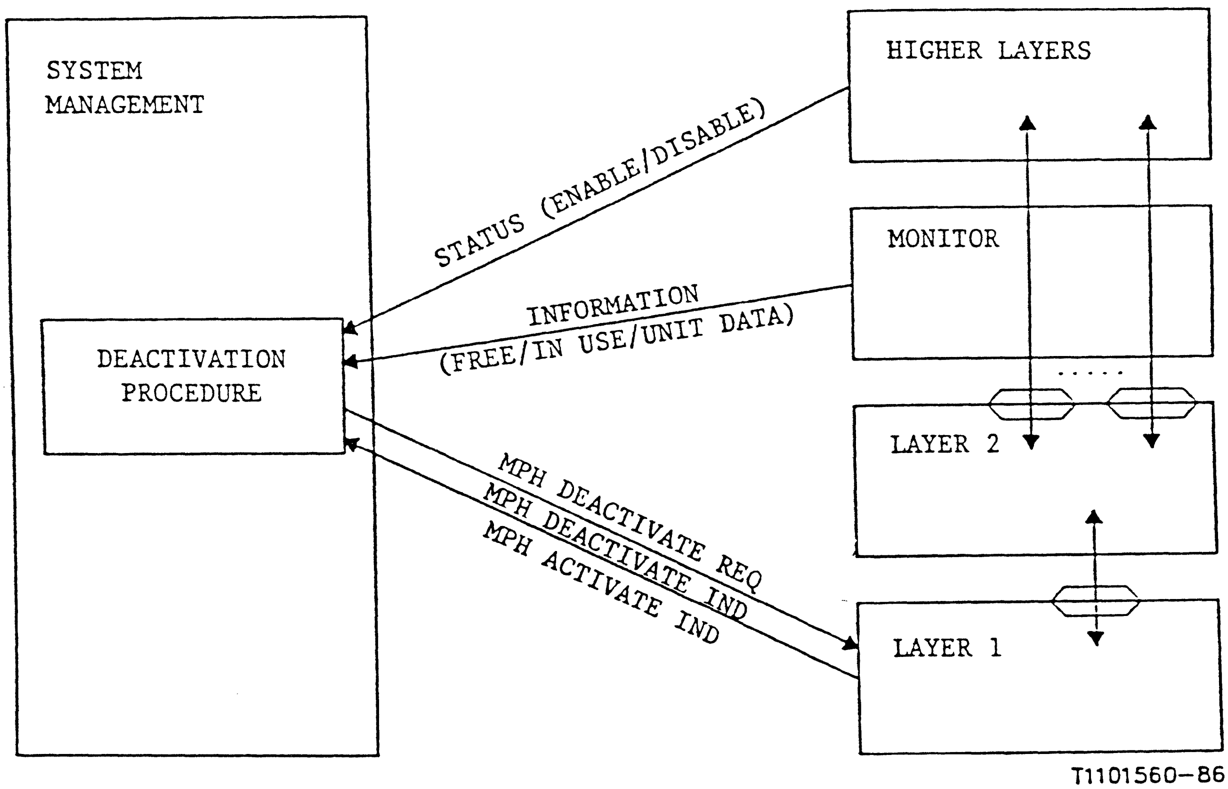


FIGURE III-1/Q.921

Conceptual model of the interactions for an Example Deactivation Procedure

III.2 Description of the Conceptual Model

The monitor function uses layer 2 activity as the basis for establishing whether deactivation of the access can take place. The signal INFORMATION is used to report the layer 2 activity in the following manner:

- INFORMATION (FREE) indicates that there is no data link connection in the multiple-frame mode of operation;
- INFORMATION (IN USE) indicates that there is at least one data link connection in the mode-setting or multiple-frame mode of operation; and
- INFORMATION (UNIT DATA) indicates that a UI frame is about to be transmitted, or has just been received.

Within the data link layer entity the DL-ESTABLISH-REQUEST/INDICATION primitives and DL-RELEASE-INDICATION/CONFIRM mark the duration of the multiple-frame mode of operation, and the MDL/DL/UNIT DATA-REQUEST/INDICATION primitives mark the transmission and reception of UI frames.

A signal Status is used to represent the ability of higher layers to enable or disable the deactivation procedures:

- STATUS (ENABLE) deactivation procedures enabled; and
- STATUS (DISABLE) deactivation procedures disabled.

The MPH-DEACTIVATE-REQ, MPH-DEACTIVATE-IND and MPH-ACTIVATE-IND primitives are used as described in § 4. The definition and usage of these primitives are also described in Recommendation I.430 [4] which specifies layer 1.

Since, in Recommendation I.430, the usage of the MPH-DEACTIVATE-IND primitive is an implementation option, two cases of deactivation are described below.

§ III.3 provides a description of the deactivation procedure when the MPH-DEACTIVATE-IND primitive is delivered to the system management entity.

§ III.4 provides a description of the deactivation procedure when the MPH-DEACTIVATE-IND primitive is not delivered to the system management entity.

Note — These procedures require that all layer 3 entities making use of the acknowledged information transfer service, must release the data link connection at an appropriate point after the completion of the information transfer.

III.3 Deactivation procedure with MPH-DEACTIVATE-IND

This deactivation procedure makes use of the MPH-DEACTIVATE-IND primitive to provide an option of layer 1 implementation.

Figure III-2/Q.921 provides a state transition diagram of the deactivation procedure with the MPH-DEACTIVATE-IND primitive.

This deactivation procedure can be represented by six states:

State 1 Information transfer not available and free; (No info xfer and free)

State 2 Information transfer available and free; (Info xfer and free)

State 3 Information transfer available and in use; (Info xfer and in use)

State 4 Information transfer not available and in use; (No info transfer and in use)

State 5 Information transfer interrupted and free; (Info interrupted and free)

State 6 Information transfer interrupted and in use; (Info interrupted and in use)

These six states are described as follows:

- State 1 represents the state where the access is assumed to be deactivated and no data link connections are in a mode setting or multiple-frame mode of operation.

- State 2 represents the state where the access is activated and no data link connection is in a mode setting or multiple-frame mode of operation. Timer TM01 is running, and upon its expiry, if deactivation is enabled, then an MPH-DEACTIVATE-REQ primitive may be issued to layer 1. The access is then assumed to be deactivated.

- State 3 represents the state where the access is activated and at least one data link connection is in a mode setting or multiple-frame mode of operation.

- State 4 represents the state where the access is regarded as being in an transient state (neither deactivated nor activated) and at least one data link connection is in a mode setting or multiple-frame mode of operation. [This state can be entered, for example, due to the arrival of an INFORMATION (IN USE) signal before an MPH-ACTIVATE-IND primitive.]

- State 5 represents the state where the access is regarded as being in a transient state (neither deactivated nor activated) and no data link connection is in a mode setting or multiple-frame mode of operation. Timer TM01 is running and upon its expiry, if deactivation is enabled, then an MPH-DEACTIVATE-REQ primitive will be issued to layer 1. The access is assumed to be deactivated.

- State 6 represents the state where the access is regarded as being in the transient state (neither deactivated nor activated) and at least one data link connection is in a mode setting or multiple frame mode of operation.

Timer TM01 is started whenever state 2 is entered:

- on receipt of an MPH-ACTIVATE-IND primitive in state 1; and

- on receipt of an INFORMATION (FREE) signal in state 3.

Timer TM01 is started whenever state 5 is entered:

- on receipt of an INFORMATION (FREE) signal in state 6.

Timer TM01 is restarted in states 2 and 3 when:

- TM01 expires while deactivation is disabled by the receipt of a STATUS (DISABLE) signal; and

- an INFORMATION (UNIT DATA) signal is received in order to allow sufficient time for current and further unacknowledged information transfer.

Timer TM01 has a value of ten seconds at the network side.

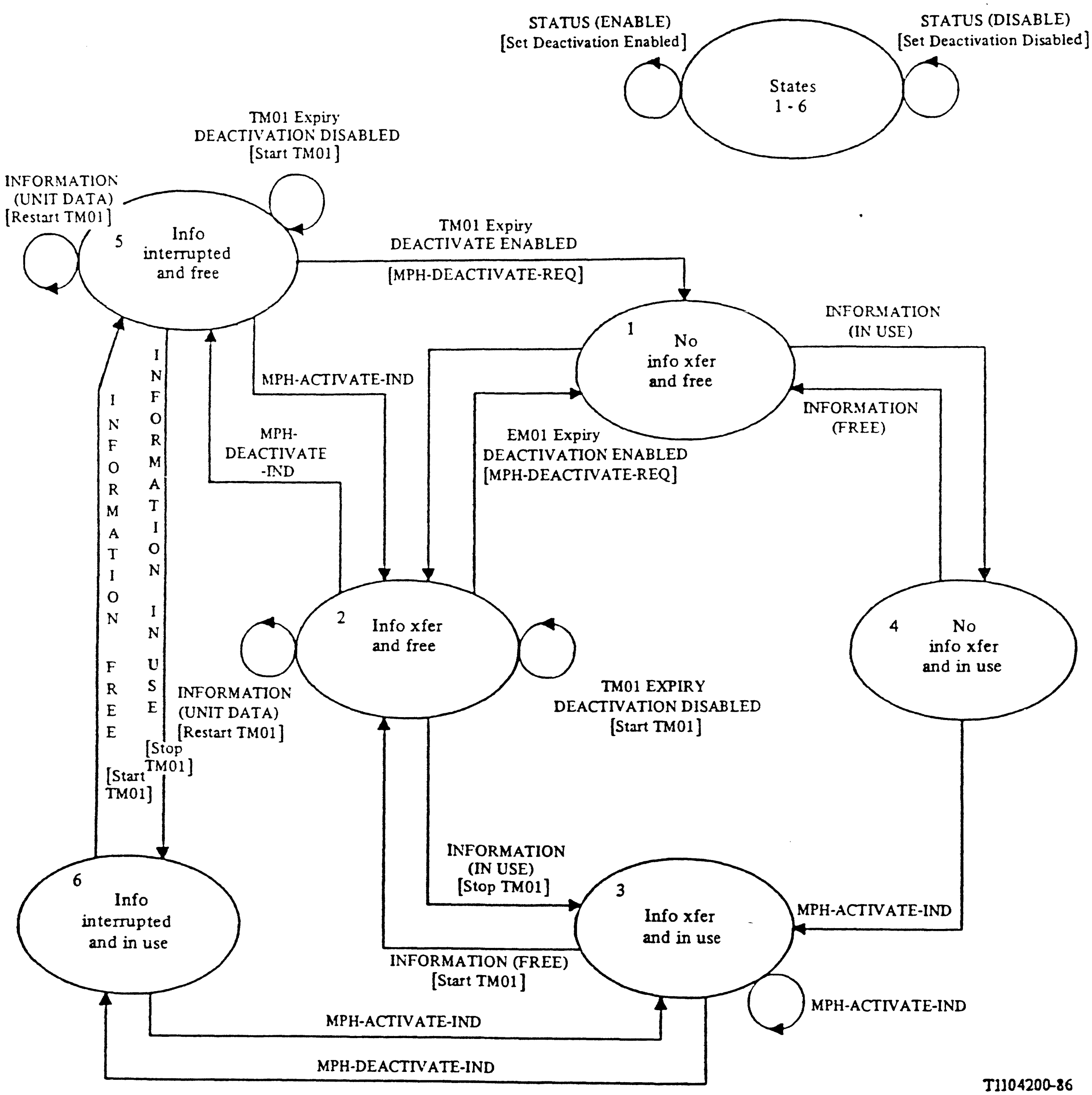


FIGURE III-2/Q.921

State transition diagram of a deactivation procedure with MPH-DEACTIVATE-IND

III.4 Deactivation procedure without MPH-DEACTIVATE-IND

This deactivation procedure does not make use of the MPH-DEACTIVATE-IND primitive to provide an option of layer 1 implementation. Thus this procedure can be represented by only four states, i.e. state 1, rtate 2, state 3, and state 4. States 5 and 6 have disappeared.

Figure III-3/Q.921 provides a state transition diagram of this deactivation procedure without the MPH-DEACTIVATE-IND primitive.

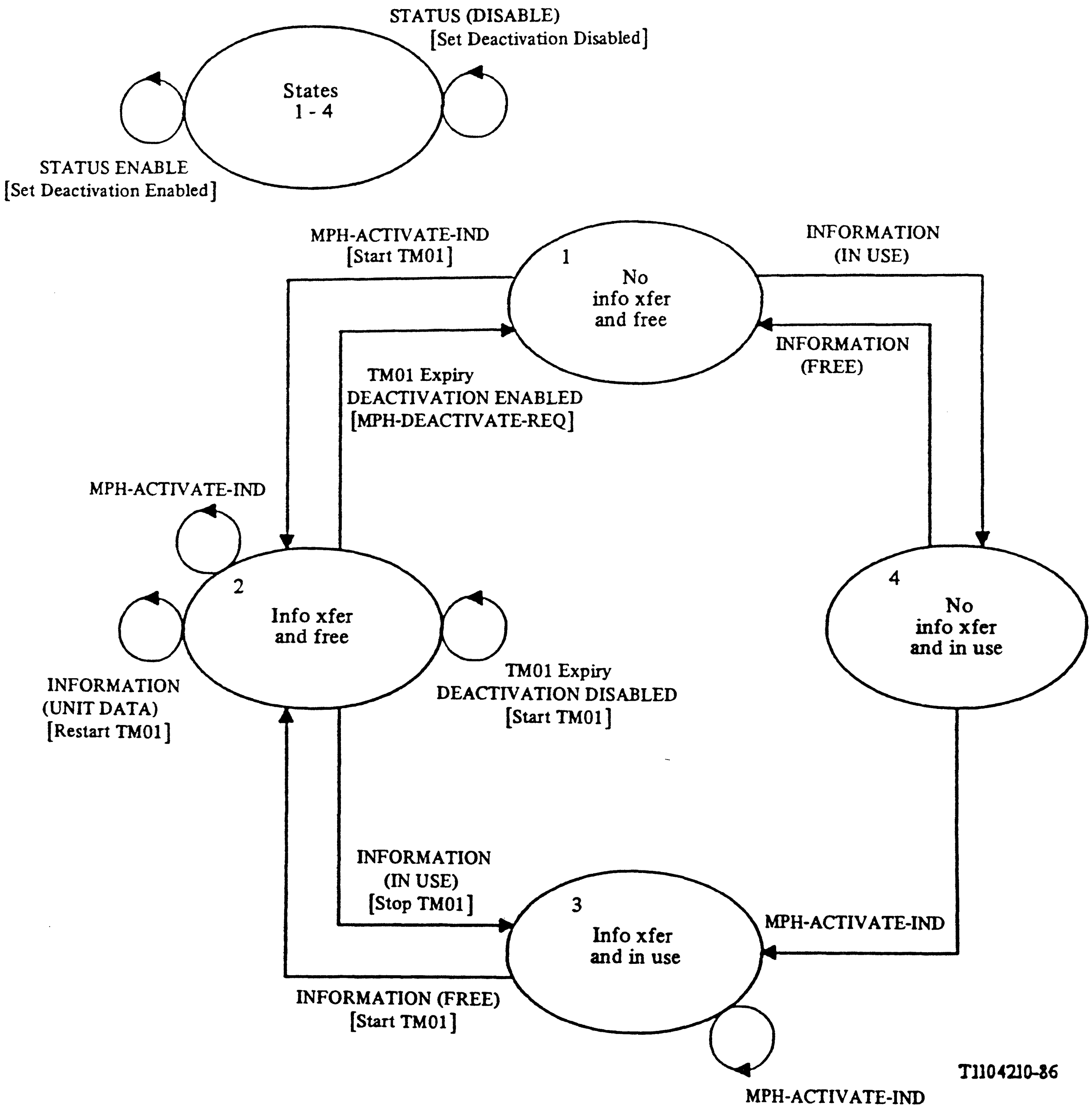


FIGURE III-3/Q.921

State transition diagram of a deactivation procedure without MPH-DEACTIVATE-IND

APPENDIX IV

(to Recommendation Q.921)

Automatic negotiation of data link layer parameters

IV.1 General

Each data link layer entity has an associated data link connection management entity. The data link connection management entity has the responsibility for initializing the link parameters necessary for correct peer-to-peer information transport.

The method of initialization of the parameters follows one of the two methods below:

- initialization to the default values as specified in § 5.9; or

- initialization based on the values supplied by its peer entity.

The latter method utilizes the parameter negotiation procedure described in this appendix. Typically, after the assignment of a TEI value to the management entity, the data link connection management entity is notified by its layer management entity that parameter initialization is required.

The data link connection management entity will invoke the peer-to-peer notification procedure. After parameter initialization, the data link connection management entity will notify the layer management entity that parameter initialization has occurred, and the layer management entity will issue the MDL-ASSIGN-REQUEST.

IV.2 Parameter initialization

The parameter initialization procedure may invoke either the internal initialization procedure or the automatic notification of data link parameter procedure.

IV.3 Internal parameter initialization

When the layer management entity notifies the connection management entity of TEI assignment, the connection management entity shall initialize the link parameters to the default values and notify the layer management of task completion.

IV.4 Automatic notification of data link layer parameter values

For each data link layer an exchange of certain data link layer parameters may take place between the peer data link connection management entities before entering the TEI-assigned state. This exchange may be initiated after acquiring a TEI, that is, after:

- receipt of a DL-ESTABLISH-REQUEST or a DL-UNIT DATA-REQUEST primitive following a power-up condition associated with non-automatic TEI user equipment.

- receipt of the Identity assigned response for automatic TEI assignment user equipment. This message contains the TEI received by the layer management entity.

The data link connection management entity, following assignment of a TEI from the layer management entity, shall issue an XID command with the P bit set to 0 and containing the parameter message shown in Figure IV-1/Q.921, and start the connection management timer TM20.

The I field of the XID command frame shall reflect the parameters desired for future communications across this data link layer connection.

The peer data link connection management entity, upon receipt of this XID command frame, shall transmit an XID response with the F bit set to 0 containing the list of parameter values that the peer can support.

If the data link connection management entity receives the above XID response prior to expiry of timer TM20, it shall stop the timer, and shall notify the layer management entity of a successful parameter exchange. However, if timer TM20 expires before receiving the XID response, the data link connection management entity shall retransmit the XID command, increment the retransmission counter and restart timer TM20. This retransmission process is repeated if timer TM20 expires again. Should the retransmission counter equal NM20, or an XID response frame with a zero length I field be received, the data link connection management entity shall issue an indication to the layer management entity and initialize the parameters to the default values. The layer management entity may log this condition and then issue the MDL-ASSIGN-REQUEST primitive to the data link layer.

The timer TM20 is set to 2.5 seconds and NM20 is set to 3.

Octet	8	7	6	5	4	3	2	1	
5	1	0	0	0	0	0	1	0	Format Identifier (FI)
6	1	0	0	0	0	0	0	0	Group Identifier (GI)
7	0	0	0	0	0	0	0	0	Group Length (GL)
8	0	0	0	0	1	1	1	0	
9	0	0	0	0	0	1	0	1	PI - Frame Size (Transmit)
10	0	0	0	0	0	0	1	0	PL - 2
11	2^{15}							2^{8}	PV - N201 Value of Transmitter
12	2^{7}							2^{0}	
13	0	0	0	0	0	1	1	0	PI - Frame Size (Receive)
14	0	0	0	0	0	0	1	0	PL - 2
15	2^{15}							2^{8}	PV - N201 Value of Receiver
16	2^{7}							2^{0}	
17	0	0	0	0	0	1	1	1	PI - Window Size (Transmit)
18	0	0	0	0	0	0	0	1	PL - 1
19	0	2^{6}						2^{0}	PV - K Value
20	0	0	0	0	1	0	0	1	PI - Retransmission Timer (T200)
21	0	0	0	0	0	0	0	1	PL - 1
22	2^{7}							2^{0}	PV - T200 Value*

* Increments of 0.1 seconds; maximum range 25.5 seconds

FIGURE IV-1/Q.921

Parameter message encoding

ABBREVIATIONS AND ACRONYMS USED IN RECOMMENDATION Q.921

Abbreviation of acronym	Meaning
Ai	Action indicator
ASP	Assignment source point
CEI	Connection endpoint identifier
CES	Connection endpoint suffix
C/R	Command/response field bit
DISC	Disconnect
DL—	Communication between Layer 3 and data link layer
DLCI	Data link connection identifier
DM	Disconnected mode
EA	Extended address field bit
ET	Exchange termination
FCS	Frame check sequence
FRMR	Frame reject
I	Information
ID	Identity
ISDN	Integrated Services Digital Network
L3	Layer 3
L2	Layer 2
L1	Layer 1
LAPB	Link access procedure — Balanced
LAPD	Link access procedure on the D-channel
M	Modifier function bit
MDL—	Communication between management entity and data link layer
MPH—	Communication between system management and physical layer
N(R)	Receive sequence number

N(S)	Send sequence number
P/F	Poll/Final bit
PH—	Communication between data link layer and physical layer
RC	Retransmission counter
REC	Receiver
REJ	Reject
Ri	Reference number
RNR	Receive not ready
RR	Receive ready
S	Supervisory
S	Supervisory function bit
SABME	Set asynchronous balanced mode extended
SAP	Service access point
SAPI	Service access point identifier
TE	Terminal equipment
TEI	Terminal endpoint identifier
TX	Transmit
U	Unnumbered
UA	Unnumbered acknowledgement
UI	Unnumbered information
V(A)	Acknowledge state variable
V(M)	Recovery state variable
V(R)	Receive state variable
V(S)	Send state variable
XID	Exchange identification

References

[1] CCITT Recommendation Q.920 (I.440), ISDN user-network interface data link layer – General aspects.

[2] CCITT Recommendation Q.930 (I.450), ISDN user-network interface layer 3 – General aspects.

[3] CCITT Recommendation Q.931 (I.451), ISDN user-network interface layer 3 specification.

[4] CCITT Recommendation I.430, Basic user-network interface layer 1 specification.

[5] CCITT Recommendation I.431, Primary rate user-network interface layer 1 specification.

[6] CCITT Recommendation X.25, Interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.