EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 752

September 1997

Source: RES

Reference: DE/RES-05-01/2

ICS: 33.020

Key words: Aeronautical, data, packet mode, radio, TFTS

Radio Equipment and Systems (RES); Terrestrial Flight Telecommunications System (TFTS); Packet mode data

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Contents

Foreword

This European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Transposition dates	
Date of adoption:	5 September 1997
Date of latest announcement of this ETS (doa):	31 December 1997
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	30 June 1998
Date of withdrawal of any conflicting National Standard (dow):	30 June 1998

Blank page

1 Scope

This European Telecommunication Standard (ETS) deals with the procedures allowing the technical realization of packet mode data with the Terrestrial Flight Telecommunications System (TFTS) environment using transparent network support according to the teleservice definitions contained in ETS 300 326-1 [1].

The TFTS packet data transmission services build on the existing architecture defined in ETS 300 326 [1], [2] and [3] introducing a new network function termed the Centralised Interworking Function (CIF). The selection of a networking protocol, and its definition is outside the scope of this ETS. The use of a particular protocol does not constrain the actual implementation of CIF functionality.

Transport layer aspects

In order to ensure the resolution of lost or duplicated packets arising from handover, it is assumed that the higher layers implement an end to end acknowledgement function.

2 Normative references

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

[1] ETS 300 326-1: "Radio Equipment and Systems (RES); Terrestrial Flight Telephone System (TFTS); Part 1: Speech services, facilities and requirements".

[2] ETS 300 326-2 (1996): "Radio Equipment and Systems (RES); Terrestrial Flight Telephone System (TFTS); Part 2: Speech services, radio interface".

[3] ETS 300 326-3: "Radio Equipment and Systems (RES); Terrestrial Flight Telephone System (TFTS); Part 3: Speech services, network aspects".

[4] ITU-T 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] ITU-T Recommendation X.121: "International numbering plan for public data networks".

[6] ARINC Characteristic 746-4: "Cabin Communication Systems (CCS)".

[7] ISO 9577: "Information technology - Protocol identification in the network layer".

[8] ITU-T Recommendation Q.931: "Digital subscriber Signalling System No. 1 (DSS1) - ISDN user-network interface layer 3 specification for basic call control".

[9] Internet Architecture Board RFC 791: "Internet Protocol - DARPA Internet Program protocol specification".

[10] Internet Architecture Board RFC 793: "Transmission Control Protocol - DARPA Internet Program protocol specification".

3 Abbreviations

3.1 Definitions

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

Ba channel: A channel which carries either:

- a 9,6 kbit/s bit stream with an error structure and transmission delay suitable to carry voice encoded information; or
- a bit stream at a gross rate of 9,6 kbit/s with an error structure and transmission delay adapted to a wider range of services.

La channel: A channel with a gross data rate of 2,4 kbit/s.

Ma channel: A channel with a gross data rate of 4,8 kbit/s.

PACKET DATA TRANSFER: The mechanism of transporting messages between the avionic termination and the ground station system.

Ua interface: The interface between the Avionic Termination (AT) and the Ground Station System (GSS) (ETS 300 326-2 [2]).

3.2 Abbreviations

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

ACARS	Aircraft Communications, Addressing and Reporting System
AS	Aircraft Station
AT	Avionic Termination
ATEI	Avionic Termination Equipment Identifier
BCCH(D)	Broadcast Control CHannel (Data)
CC	Call Control
CIF	Centralised Interworking Function
CM	Connection Management
CTU	Cabin Telecommunication Unit
DCCH	Dedicated Control CHannel
DT	Data Transmission
DTM	Data Transmission Management
DTM-SAP	Data Transmission Management Service Access Point
FACCH	Fast Associated Control CHannel (a case of a DCCH)
FCT	Flow Control Threshold
GS	Ground Station
GSC	Ground Switching Centre
GSIC	Ground Station Identity Code
GSS	Ground Station System
IE	Information Element
IEI	Information Element Identifier
IPI	Initial Protocol Identifier
MF	Mandatory with Fixed length
MN-SAP	Mobile Network Service Access Point
MV	Mandatory with Variable length
OF	Optional with Fixed length
OV	Optional with Variable length
PSDN	Packet Switched Data Network
RR	Radio Resources
RRM	Radio Resource Management
SACCH	Slow Associated Control CHannel (a case of a DCCH)
SAP	Service Access Point
SAPI	Service Access Point Identifier
SDL	System Description Language

TCT	Throughput Control Threshold
TE	Terminal Equipment
TFTS	Terrestrial Flight Telecommunications System
TI	Transaction Identifier
VC	Virtual Circuit
X.25 RNR	X.25 [4] Receiver Not Ready message
X.25 RR	X.25 [4] Receiver Ready message

3.3 Symbols

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

bps	bits per second
clr	clear
cnf	confirm
conn	connection
CONN	CONNECT
DISC	DISCONNECT
est	establish
ind	indication
kbit/s	kilobits per second
PD	Packet Data
pend	pending
rel	release
req	request
resp	response
trans	transport

4 Service definition

This ETS specifies support for the following data types:

- packet transport on the TFTS radio interface.

The TFTS packet data transmission service allows an aircraft application to send and receive data in an end-to-end, point-to-point, connection-oriented mode.

4.1 Packet mode services

The types of packet mode services supported by the TFTS packet transport service may include the following:

- status update information;

- file transfer;

- information update;

- interactive services.

Annex A provides further information.

5 Network architecture

The TFTS packet data transmission services builds on the existing architecture defined in ETS 300 326 [1], [2] and [3] introducing a new network function termed the Centralised Interworking Function (CIF). This function provides the interworking between the transport mode used between the Avionic Termination (AT) and the Ground Station System (GSS), and that used in the public data network. The interface between the AT and the GSS for the TFTS packet data transmission is defined in clause 7 of this ETS. The interface between the GSS and the CIF is defined in clause 9 of this ETS. The interface between the CIF and the public network is not defined in this ETS but is assumed to be compliant with international standards for data services and in particular for packet data, e.g. ITU-T Recommendation X.25 [4]. Similarly, the interface between the AT and the aircraft Terminal Equipment (TE) is not defined in this ETS, but is assumed to be compliant with international standards for data services and in particular for packet data, e.g. ITU-T Recommendation X.25 [4] or ARINC Characteristic 746-4 [6].

This ETS defines the basic packet transport mechanism required to transport packets from the AT to the GSS and the reverse. It does not address the way in which the end-to-end packet service operates.

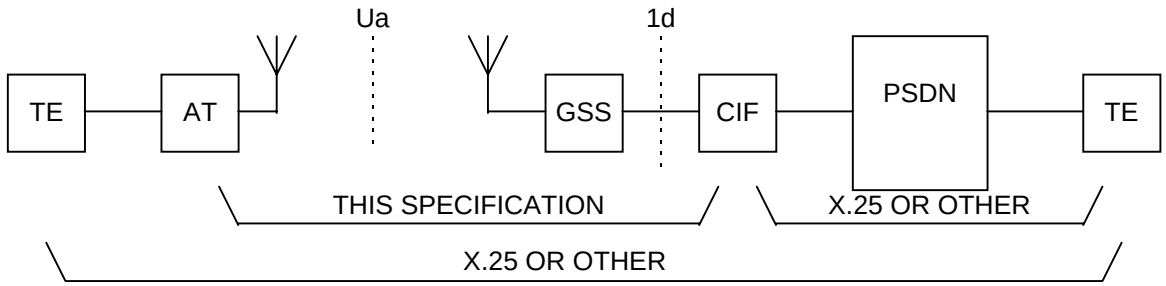

Figure 1: Packet mode architecture

Figure 1 shows the architecture of the system showing the Ua interface defined in ETS 300 326-2 [2], subclause 6.2 figure 5 and a new interface 1d between the GSS and CIF.

5.1 Support of multiple network layer protocols

The TFTS packet mode service provides for the transparent transfer of arbitrary binary data between onboard avionics equipment and the ground user. The TFTS packet mode service provides no constraints on network protocol used. Typical examples of protocols that may be used are ITU-T Recommendation X.25 [4] and Internet Architecture Board RFC 791 [9] and RFC 793 [10].

The interworking between the ground user and the TFTS network is carried out by the CIF. The first octet of the data field defined in subclause 7.9.1 shall be an Initial Protocol Identifier (IPI). IPIs can conform to ISO 9577 [7], in which case the message shall conform to subclause 7.9.1.3; or be defined within TFTS, in which case the message shall conform to subclause 7.9.1.4.

5.2 Data transmission

Data transmission is managed, both on the Avionic Termination (AT) side and on the ground side by the Data Transmission Management (DTM) entity.

The Data Transmission Management (DTM) is part of the Connection Management Layer, i.e. upper part of layer 3.

To distinguish Call Control (CC) messages, Maintenance Resource messages and Data Transmission (DT) messages, a specific protocol discriminator is used.

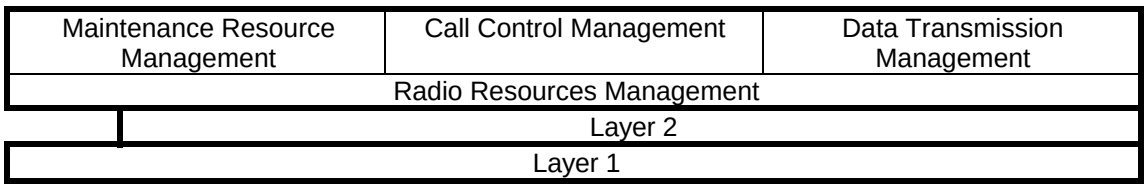

Figure 2: Sublayer relationship

Figure 2 illustrates the relationship between the components of layer 3.

5.3 AT functionality

5.3.1 Interworking function

The AT shall provide an interworking function between the application messages and the PACKET DATA TRANSFER messages.

For air-to-ground transfer, the interworking function shall encapsulate the application message into a PACKET DATA TRANSFER message.

For ground-to-air messages the AT shall strip off the PACKET DATA TRANSFER message header and forward the resultant application message to the TE.

There are two cases of PACKET DATA TRANSFER message dependent upon the coding standard of the IPI employed (see subclause 7.9.1).

5.3.2 Location registration procedure

The AT shall carry out the location registration procedure (see subclause 7.7.3) if it is to provide ground-initiated data transfer service.

The location registration procedure allows the AT to inform the CIF that it is capable of receiving data. The message shall be sent every time the AT selects a new cell.

Furthermore, each AT shall also send a periodic location registration message (using the same mechanism) after a pre-defined timeout period (T350).

To differentiate between location registration messages and other services a specific IPI value is used as specified in table 11.

The mandatory contents of the location registration message is defined in subclause 7.9.1.4 with the IPI identifying the TFTS location registration protocol.

The location registration procedure is optional. However, the functionality required for the support of this procedure shall be implemented in all equipment. It shall be possible to enable and disable the location registration functions defined in this ETS in both airborne and CIF equipment in service.

5.3.3 Dynamic resource management

The AT shall dynamically manage Radio Resources (RR) in conjunction with the GSS based on the amount of traffic. This shall be achieved using the mechanism defined in subclause 7.6.

5.4 GSS functionality

The GSS shall provide a gateway function between the AT and the CIF.

On the air interface side (Ua), when receiving a PACKET DATA TRANSFER message (see subclause 9.6.2.2 or subclause 9.6.2.3), the GSS function shall extract the user data transferred and encapsulate it in the corresponding PACKET DATA TRANSFER message (see subclause 9.6.2.2 or 9.6.2.3) before sending it on the ground interface.

On the ground interface side, when a PACKET DATA TRANSFER message is received, the GSS function shall extract the user data transferred and encapsulate it in the corresponding PACKET DATA TRANSFER message and send it on the air interface.

The GSS shall establish, upon request, a Virtual Circuit (VC) for each AT and maintain this until it receives a clear down message or internal time-out.

Routing to the appropriate aircraft shall be achieved by the one-to-one mapping between AT and VC.

For air to ground calls the VC shall be established on receipt of the first PACKET DATA TRANSFER message from a particular aircraft. All subsequent PACKET DATA TRANSFER messages to or from a particular AT shall be passed over this virtual circuit.

For ground to air calls to registered aircraft, if no VC is present then the GSS shall accept the request from the CIF for establishment of a VC.

Additional functionality is required if no RR are available. The GSS shall buffer the first message received from the CIF whilst it sends a PAGE REQUEST message to the AT alerting it that it has data for it. Once a Dedicated Control CHannel (DCCH) is established the GSS shall forward the PACKET DATA TRANSFER message to the aircraft.

The GSS shall dynamically manage RR in collaboration with the AT based on the amount of traffic. This shall be achieved using the mechanism defined in subclause 7.6 of this ETS.

5.4.1 Administrative aspects

5.4.1.1 Data call phases and activities

A chargeable packet data call is assumed to begin when an aircraft first makes contact with the ground station network in order to log on to the CIF which handles its interface between the GSS and ground data networks. The call ends when the aircraft is no longer accessible to the ground network and its associated VC between GSS and CIF has been cleared. During this time, the GSS may repeatedly establish and clear RR as required in order to allow transmission of data packets between the aircraft and the ground network. The following diagram gives an example of how resources might be used during a packet data call:

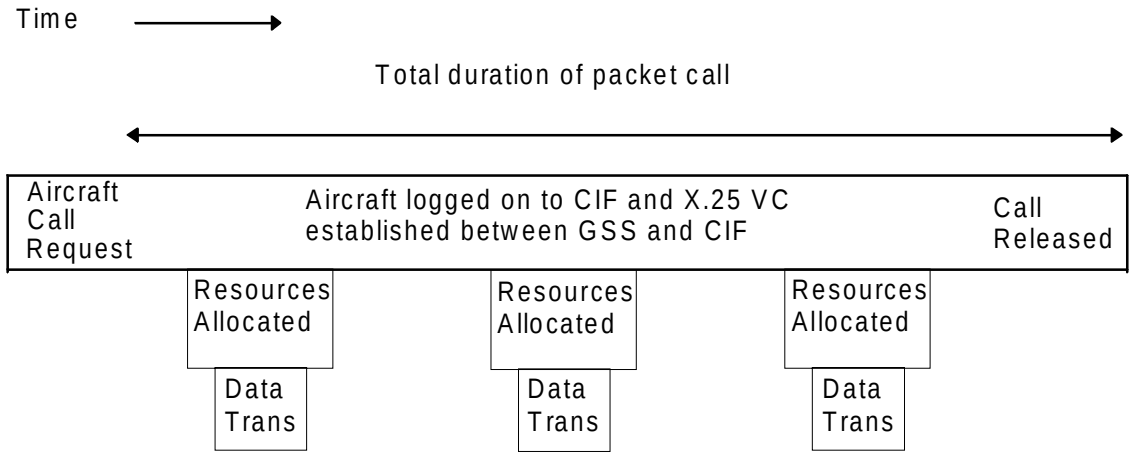

Figure 3: Phases of a packet data call

The phases of a packet data call are illustrated in figure 3.

5.4.1.2 Collection of data for call charging

The GSS shall collect call data for use for billing. The following paragraphs are for guidance only.

Operators may base call charges on a number of factors associated with the above packet data call profile. The following elements may be identified as cost/utility factors during a call:

1) initiation and clearing of a packet data call, including establishment and clearing ITU-T Recommendation X.25 [4] virtual circuits with the CIF;

2) occupancy of Slow Associated Control CHannel (SACCH) channels during those phases of a call when Radio Resources (RR) are in use;

3) occupancy of Fast Associated Control CHannel (FACCH) channels during those phases of a call when Radio Resources (RR) are in use;

4) amount of data transmitted air to ground and onwards to the CIF;

5) amount of data transmitted from the CIF and onwards from the GSS to the aircraft.

The occupancy of radio channels may be expressed as the number of seconds a data call occupies a given class of channel and its bandwidth. For example, use of a SACCH associated with a voice call may use no extra RR. Thus, a 9 600 bps channel would accumulate "La seconds" four times faster than a 2 400 bps channel. Charges for the use of packet data networks generally depend on the time during which a VC is established and on the amount of data transmitted. This is accounted for in blocks of 64 bytes (segments) or kilosegments.

The content and format of the call record for data calls are defined by the TFTS Forum.

5.5 CIF functionality

The following subclause defines the functionality of the CIF assuming an end-to-end service using a standard networking protocol, such as ITU-T Recommendation X.25 [4].

The CIF shall perform the interworking between the TFTS network and public or private data networks. The gateway shall be connected to public and/or private networks as required by the CIF operator and shall have addressing schemes which allow individual aircraft to be called.

The CIF shall provide the following functionality:

- interworking with the Ground Switching Centre (GSC) network;

- conversion between TFTS packet messages and public and/or private message formats;

- address conversion between TFTS network addressing and public and/or private networks;

- support of dynamic routing tables.

The CIF may provide support for:

- billing functions;

- closed user groups.

Figure 4 illustrates the functionality of the CIF.

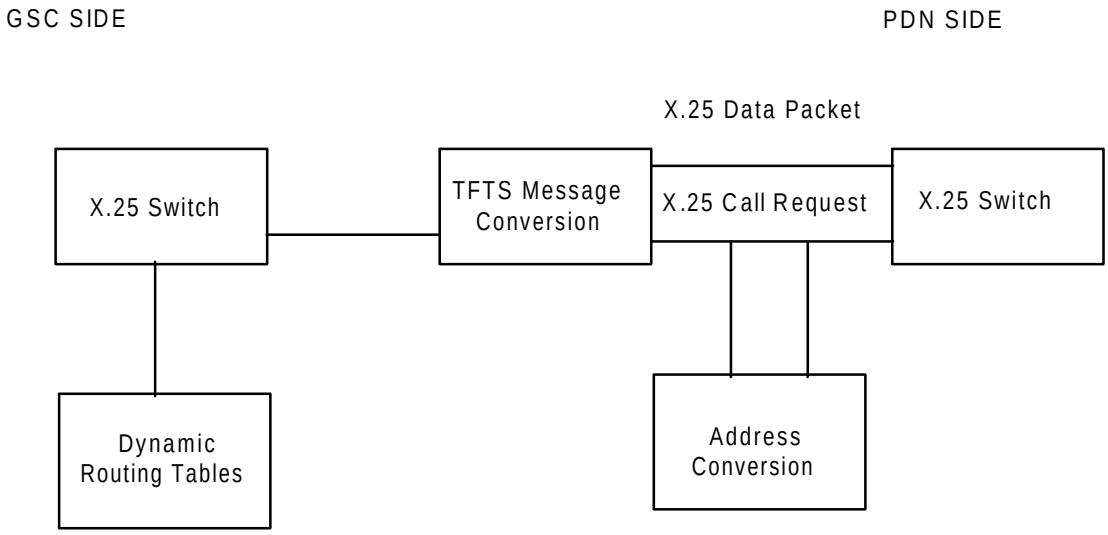

Figure 4: CIF functional overview (X.25)

5.5.1 Interworking with GSSs

Together with the GSSs, the CIF shall manage a set of X.25 [4] Virtual Circuits (VCs) corresponding to the active set of ATs currently using its facilities. The CIF shall accept VCs requested by GSSs and shall maintain these until internal processes dictate that they are released. The CIF shall accept requests from the GSS to release a VC. The CIF may also establish and release VCs to the GSS.

It is possible that two GSSs will set up a virtual circuit for a particular AT (e.g. as the aircraft moves from the coverage of one GSS to that of another). Under these circumstances, the CIF shall retain the most recently established virtual circuit and clear down the other.

Clause 9 of this ETS presents details of the protocol used for communication and data transmission between GSC and CIF.

5.5.2 TFTS packet messages conversion

The CIF shall convert the TFTS message format into the format required for communication on the data network side of the CIF (as opposed to the TFTS side). On receipt of a data packet from a GSC the CIF shall perform the following procedures:

1) remove the PACKET DATA TRANSFER header message (see subclauses 9.6.2.1 and 9.6.2.2);

2) examine the contents of the message to determine whether to set up a network data call (in the case of a Call Request packet) or to route the information to the appropriate port or circuit (if it is a data message).

On receipt of a message from a terrestrial user the CIF shall add a PACKET DATA TRANSFER (see subclauses 9.6.2.2 and 9.6.2.3) message header and envelop the whole message in an X.25 [4] data packet and forward the resultant packet to the appropriate GSC (determined from the internal dynamic routing table).

5.5.3 Address conversion

The CIF shall convert the private aircraft addressing scheme to public or private addressing schemes depending on the networks used for terrestrial user access. For example, the CIF may convert an aircraft address to an X.121 [5] address if using an X.25 [4] Packet Switched Data Network (PSDN). In such a case, the calling DTE address would be changed to one assigned to the CIF by the packet data network. For ground to air calls this procedure shall be reversed.

Ground to air call		
	AT <-------> CIF	Network (note) <----> CIF
Calling address	Terminal number	Terminal number
Called address	Private terminal number	Public terminal address

NOTE: Illustrated assuming X.25 [4] packet data network on terrestrial user side.

Figure 5: Ground to air number translation

Air to ground call		
	AT <-------> CIF	Network (note) <----> CIF
Calling address	Private terminal number	Public terminal address
Called address	Terminal number	Terminal number

NOTE: Illustrated assuming X.25 [4] packet data network on terrestrial user side.

Figure 6: Air to ground number translation

The CIF shall provide translation between addresses known by the terrestrial network user and the private addressing scheme that achieves correct routing to the application on the aircraft. Figures 5 and 6 illustrate the number relationships on the ground to air and air to ground calls.

6 End to end data flow

6.1 CALL management procedures

This clause defines the transfer mechanism between the Air Termination (AT) and the Central Interworking Function (CIF).

Two types are defined:

- AT originated;
- CIF originated.

6.1.1 AT originated call establishment

When the AT receives a request from a higher layer to send packet mode data, it shall establish an appropriate connection to the GSS (see subclause 7.7.4). The GSS responds with the establishment of an appropriate connection to the CIF (see subclause 9.1).

6.1.2 CIF originated call establishment

When the CIF receives a DTM_DATA_REQUEST from a higher layer to send packet mode data, it shall establish an appropriate connection to the GSS (see subclause 7.4). The GSS responds in one of two ways depending upon whether or not it has physical resources to the target AT.

On receipt of PACKET DATA TRANSFER, the GSS shall determine whether a Data Transmission (DT) connection exists between itself and the target AT.

If physical RR exist between the GSS and target AT, the GSS establishes a connection in accordance with subclause 7.7.5 of this ETS.

If physical RR do not exist between the GSS and the target AT, the GSS initiates a page message addressing the target AT using procedures defined in clause 10 of ETS 300 326-2 [2] and subclause 7.7.5 of this ETS.

On receipt of a DTM-PAGE REQUEST for data transmission the AT shall establish RR to the GSS by using the Data Transmission (DT) connection establishment as defined in subclause 6.1.1.

6.1.3 Data transfer

The AT and GSS shall support transparent transfer of data packets between the aircraft application and the CIF. These processes are illustrated in scenarios 7 and 8 in annex B. This shall be achieved by the mechanisms defined in subclauses 7.7.7.1, 7.7.7.2, 9.4.6.1 and 9.4.6.2 of this ETS.

6.1.4 Handover procedures

When a change of cell is necessary, the AT and the network shall ensure that any association between the AT and the CIF shall be maintained. This shall be the case irrespective of whether dedicated RR are allocated to the AT.

If dedicated resources are allocated to the AT, these shall be maintained as the AT moves from the coverage of one cell to another using the handover procedures defined in clause 10 of ETS 300 326-2 [2]. Handover aspects specific to the packet data service on the radio interface are defined in subclause 7.7.7.4.

The network shall ensure that the flow of packet data between AT and CIF shall be by the most direct route through the TFTS network. This shall be achieved by maintaining only a single GSC in the path between AT and CIF. The procedures for the network handling of handover of TFTS packet data connections are defined in subclause 9.4.6.3.

6.1.5 Call clearing procedures

Clearing of packet mode data connections shall be supported in both air-to-ground and ground-to-air directions. Call clearing procedures shall utilize the Radio Resources Management (RRM) procedures defined in clause 10 of ETS 300 326-2 [2]. Clearing of the Radio Resource (RR) shall be as detailed in subclause 7.7.6, whilst clearing of the GSS-CIF resource shall be as described in subclause 9.4.5.

6.2 Scenarios

Information flows are provided in annex B for the most common scenarios.

7 AT to GSS interface aspects

7.1 General

On the AT-GSS layer 3 interface, the TFTS packet Data Transmission (DT) is an additional signalling function using the services provided by the layer 2 as defined in clause 9 of ETS 300 326-2 [2].

Data Transfer is an additional part of the Connection Management (CM) sublayer as defined in subclause 10.1.1 of ETS 300 326-2 [2].

In addition to the objectives and basic groups of functions defined in subclause 10.1.2 and subclause 10.2.1 of ETS 300 326-2 [2] the layer 3 shall:

- provide the means for establishment, maintenance and termination of transactions for Data Transmission (DT);

- comprise the group of signalling functions for Data Transmission Management (DTM).

The protocol architecture of layer 3 shall be divided into two sublayers (figure 7).

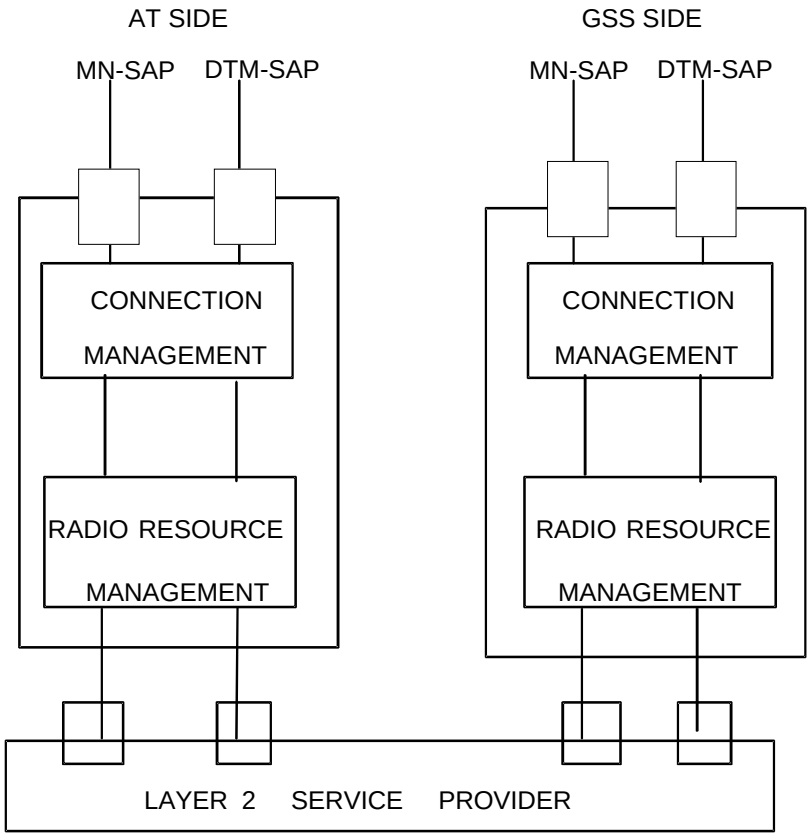

Figure 7: Protocol architecture on signalling layer 3 AT-GSS

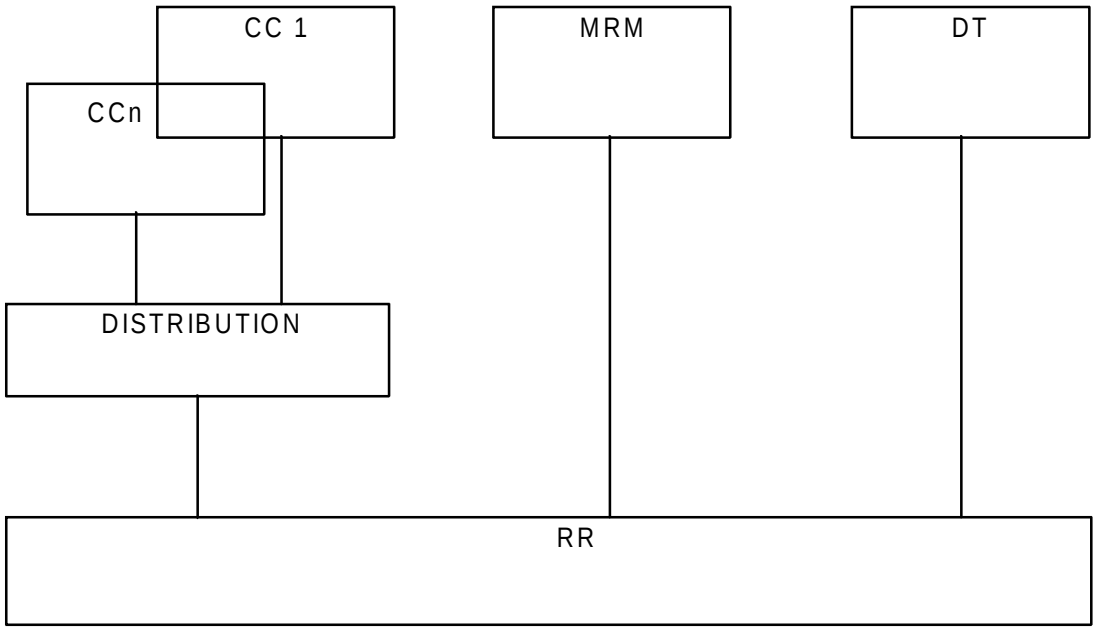

Figure 8: Parallel transactions on the CM sublayer

7.2 Layer 2 aspects

In order to separate correctly the traffic due to control information and packet data, the data communications shall be established with a different Service Access Point Identifier (SAPI) in the Data Link Layer.

As defined in subclause 9.3.6 of ETS 300 326-2 [2], the SAPI value already defined for Call Control (CC), Radio Resource Management (RRM) and Maintenance Resource Management signalling is SAPI = 0. For Packet Data Transfer, the SAPI value shall be set to SAPI = 1. The header field format shall follow that defined in subclause 9.6.3.2 of ETS 300 326-2 [2].

When required, flow control shall be applied to SAPIs independently.

7.3 AT location registration procedure

In order to receive packet data from ground applications, each AT providing this service shall register its location to the CIF via the GSS. This is achieved by sending a PACKET-DATA-TRANSFER message to the GSS in order to inform the network (CIF) of its presence and availability for packet communications. The message shall conform to the definition in subclause 9.6.2.2.

Location registration shall be repeated at each change of cell irrespective of the RR allocated to the AT, i.e. the AT shall perform Location updating in the following cases:

1) in idle mode (i.e. no Radio Resources (RR) allocated) when cell selection indicates a change of preferred cell;

2) in connected mode (i.e. Radio Resources (RR) allocated) when a hand-over has taken place.

7.4 Data transfer services provided by signalling layer 3 on the AT side

7.4.1 General

The DTM services shall be provided at the access point Data Transmission Management Service Access Point (DTM-SAP). The service class consists of the following services:

- data transmission transaction establishment;

- data transmission transaction maintenance;

- data transmission transaction clearance.

In addition to these direct services, the DTM provides management of the resources allocated to data transmission in conjunction with the GSS peer. This service is defined in subclause 7.6.

In addition to the objectives and basic groups of functions defined in subclause 10.1.2 and subclause 10.2.1 of ETS 300 326-2 [2], the layer 3 shall:

- provide the means for establishment, maintenance and termination of transactions for Data Transmission (DT);

- comprise the group of signalling functions for Data Transmission Management (DTM).

7.4.2 Service states at the AT side of the AT-GSS interface

The DTM services provided at the Data Transmission Management Service Access Point (DTM-SAP) are illustrated in the state diagram in figure 9.

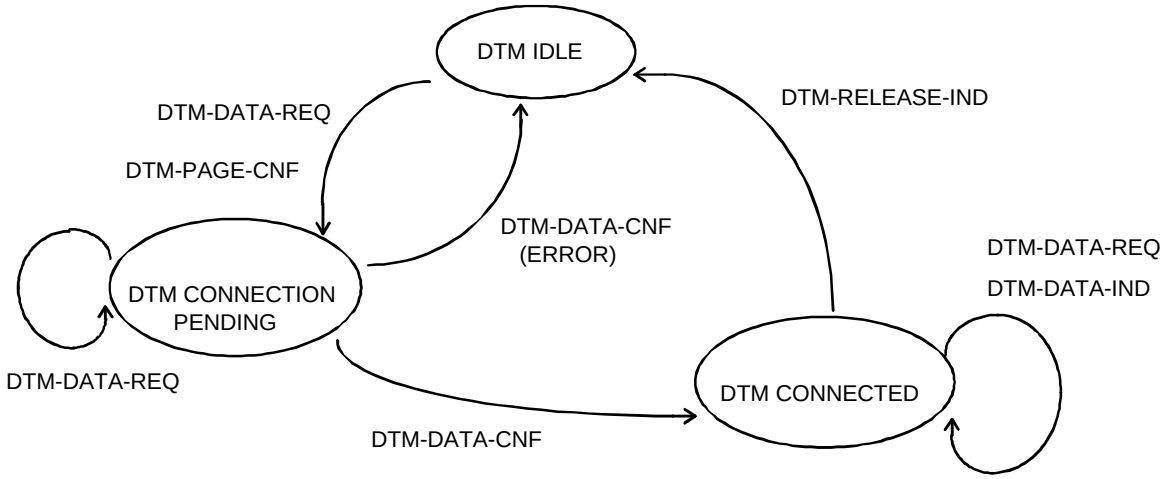

Figure 9: Overview service state diagram of the DTM entity on the AT side

7.5 Data transfer services provided by signalling layer 3 on the GSS side

7.5.1 General

The DTM services shall be provided at the Data Transmission Management-SAP (DTM-SAP). The service class consists of the following services:

- aircraft originating data transmission transaction establishment;
- data transmission transaction maintenance;
- data transmission transaction clearance.

In addition to these direct services, the DTM supports the AT peer to provide management of the resources allocated to data transmission. This service is defined in subclause 7.6.

7.5.2 Service states at the GSS side of the AT-GSS interface

The DTM services provided at the service access point Data Transmission Management-SAP (DTM-SAP) are illustrated in the state diagram in figure 10.

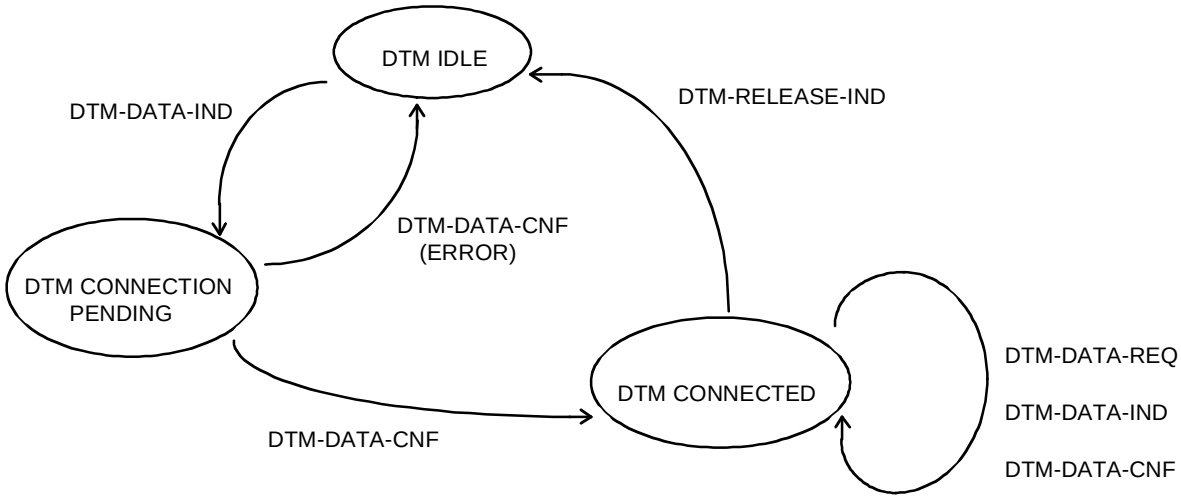

Figure 10: Overview service state diagram of the DTM entity on the GSS side

7.6 Dynamic resource management

7.6.1 General

The GSS assigns resources on the combined basis of its own buffer and the message received from the AT. This shall reflect the needs of the direction carrying the higher data rate.

For the purposes of Radio Resource Management (RRM) for packet communications, the GSS shall act as the controlling entity both for air to ground and ground to air packets (the packets being carried on the DCCH which is a symmetric duplex channel).

Once packet communications have been established, DTM shall monitor the utilization of the data channel by testing regularly the length of its input queue.

7.6.2 Varying throughput transmission

Varying throughput transmission is used when channel capacity has to be adapted to a varying data volume presented by the application. To achieve this, peer to peer messages are passed between Radio Resource Management (RRM) entities. These messages are used to inform the peer entity that a throughput modification has been requested. These messages are illustrated in figure 11.

7.6.2.1 Aircraft-originated throughput modification

When needing to modify the throughput, the AT shall send to the GSS a REQUEST message.

Following a REQUEST message, the ground shall send a COMMAND message or a REJECT message to accept or refuse the throughput modification.

7.6.2.2 Ground initiated throughput modification

When the GSS needs to modify the throughput, it shall send a COMMAND message to the AT.

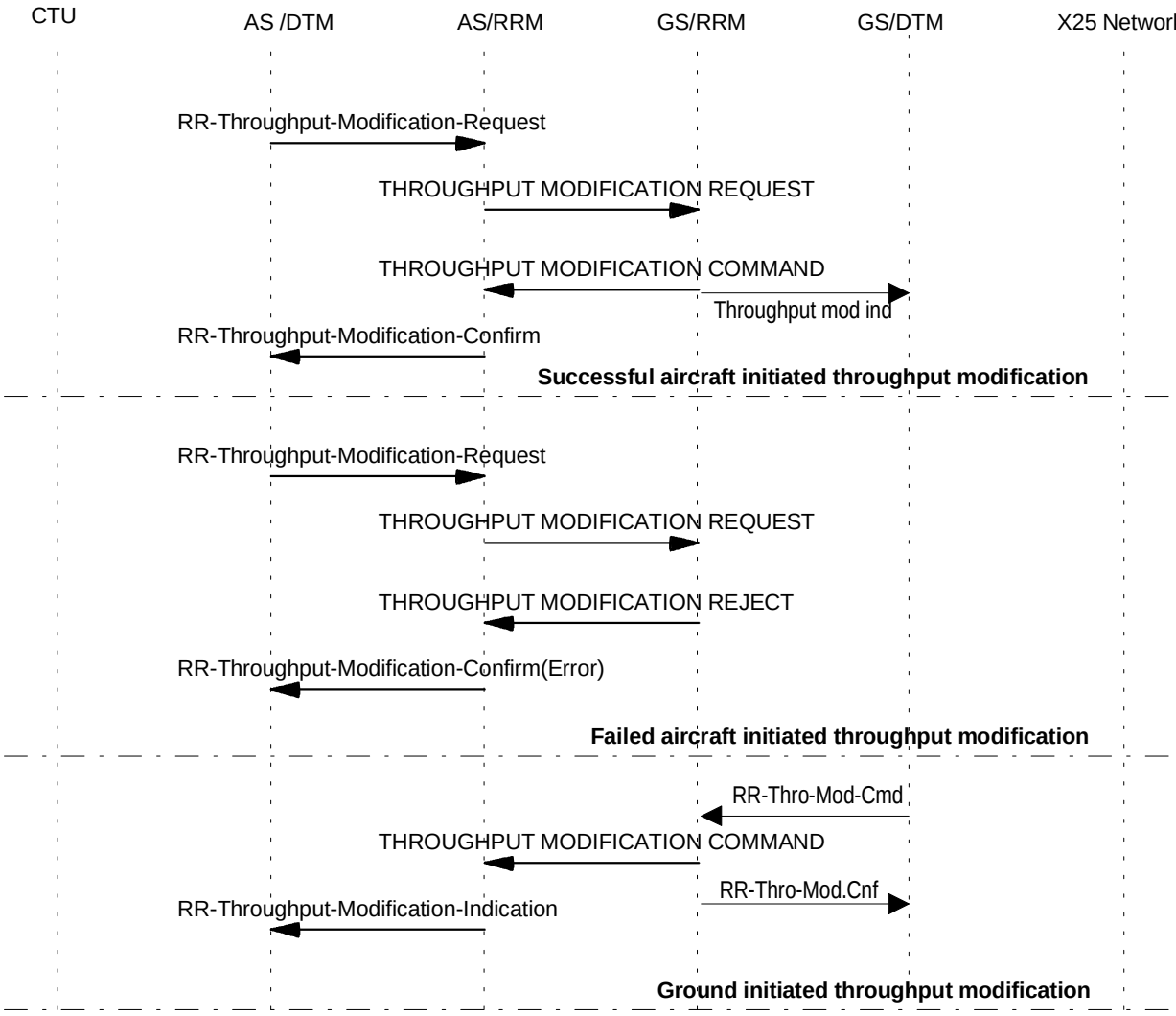

Figure 11: Message flow illustration for throughput modification

7.6.3 Decision strategy

7.6.3.1 Throughput increase

To decide if the throughput needs to be modified, DTM shall check the length of its output queue and compare it with two thresholds: the Throughput Control Threshold (TCT) and the Flow Control Threshold (FCT).

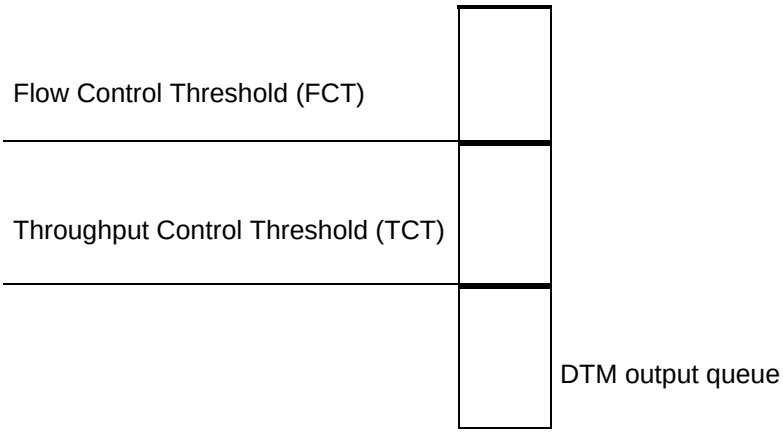

Figure 12: Throughput modification thresholds

When the length exceeds the TCT then DTM asks its own RRM entity for a faster transmission rate. RRM transmits the request to the peer RRM entity. If the fastest rate is already reached, then no action is taken by DTM.

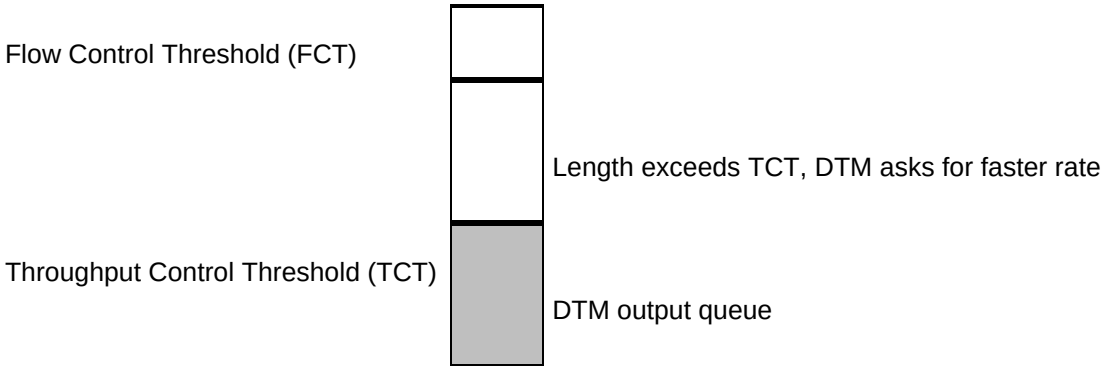

Figure 13: Throughput modification thresholds

When, at fastest rate, the length exceeds the FCT, then DTM asks for flow control to its own application.

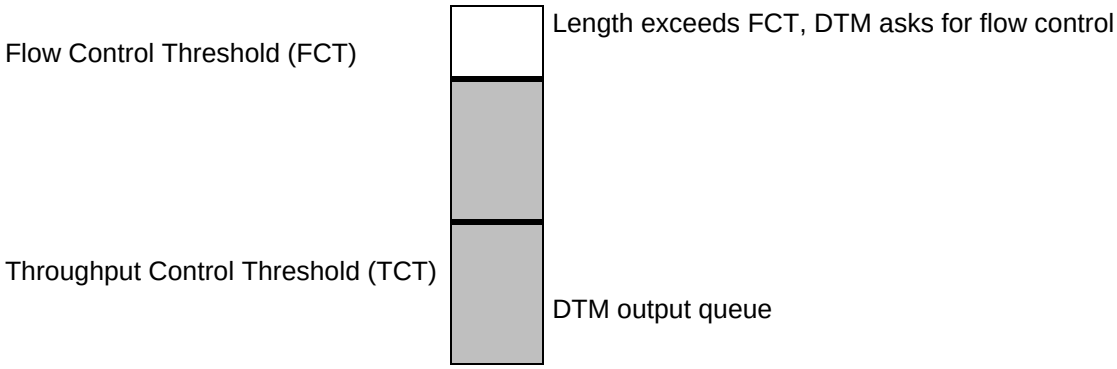

Figure 14: Throughput modification thresholds

7.6.3.2 Throughput decrease

A similar mechanism to throughput increase shall be used to stop flow control and to decrease throughput, when the length goes below the thresholds.

To avoid rapid modifications of the throughput, a hysteresis value is applied to the thresholds. That means that throughput decrease shall be decided when the length of the DTM input queue falls below the value of FCT or TCT minus the hysteresis value (i.e. 30 %).

The value of the thresholds and of the hysteresis value shall be defined by the manufacturers after testing.

7.7 Elementary procedures for packet switched data transfer

7.7.1 General

This subclause describes a set of procedures combined in the DTM entity. The general purpose of these procedures is to establish, maintain and terminate packet-switched connections across a TFTS network and other networks to which the TFTS network is connected.

Detailed description of the procedures for DTM are given in this subclause in terms of:

- the sequence of messages defined which are transferred across the radio interface (reference point Ua); and

- the information processing and actions that take place at the AT and GSS sides of this interface.

Detailed System Description Language (SDL) diagrams for handling of packet-switched calls (DTM) are contained in figures C.1 and C.2 of this ETS.

7.7.2 DTM states

7.7.2.1 Call states at the AT side of the interface (see figure C.1)

The call states that may exist on the AT side of the radio interface are defined in this subclause.

DTM IDLE: No packet data connection exists.

RR connection pending: This state exists when the AT has made a request for Radio Resources (RR).

DTM connection pending: This state exists when the AT has requested a packet data connection.

DTM connected: This state exists when a packet data connection exists between the AT and the ground network.

RR release pending: This state exists when the AT has requested release of Radio Resources (RR) and is awaiting a response from the GSS.

DTM release pending: This state exists when the AT has requested release of an ongoing packet data connection and is awaiting a response from the GSS.

DTM handover pending: This state exists when the RRM sublayer has indicated that a change of dedicated Radio Resource (RR) is taking place.

7.7.2.2 Call states at the GSS side of the interface (see figure C.2)

The call states that may exist on the GSS side of the radio interface are defined in this subclause.

DTM IDLE: No packet data connection exists.

DTM connection pending: This state exists in the GSS when Radio Resources (RR) have been allocated and the GSS is awaiting a request for a packet data connection from the AT.

AT connection pending: This state exists when the GSS has sent a PAGE REQUEST message to the AT and is awaiting establishment of Radio Resources (RR).

CIF connection pending: This state exists when the request for a packet data connection has been received from the aircraft, forwarded to the CIF and a response is awaited from the CIF.

DTM connected: This state exists when a packet data connection exists between the AT and the CIF, through-connected by the GSS.

RR release pending: This state exists when the GSS is awaiting release of the Radio Resources.

DTM disconnection pending: This state exists when the Ground Station (GS) is awaiting disconnection of the packet data connection.

7.7.2.3 Packet-switched DTM procedures

The call states referred to cover the states perceived by the GSS, states perceived by the AT and states which are common to both AT and GSS.

All messages in this subclause contain functional information elements. Functional information elements are characterized as requiring a degree of intelligent processing by the terminal in either their generation or analysis.

The procedures needed for DTM are:

- aircraft location management procedures;
- call establishment procedures;
- call clearing procedures; and
- miscellaneous procedures.

NOTE: The contents of the specific messages are only given for better understanding. A complete description of the messages and their contents is given in subclause 7.9.

7.7.3 Aircraft location management

7.7.3.1 General

In order to facilitate the efficient establishment of calls in the ground-to-air direction, aircraft stations shall inform the network of their current location (GSS) within the TFTS network prior to the establishment of any packet data calls. The PACKET DATA TRANSFER (PD2) message shall be used as an envelope to carry these application messages.

7.7.3.2 Location registration

7.7.3.2.1 General

When the RRM sublayer first notifies the AT DTM entity that Radio Resources (RR) are available, the AT DTM shall request the Radio Resources (RR) sublayer for the establishment of indicated Radio Resources (RR). Timer T333 (table 18) shall then be set and the "RR-CONNECTION PENDING" state entered.

When the indicated Radio Resources (RR) are established, a confirmation shall be given to indicate that RR is ready for data transfer, T333 shall be stopped and the first DTM message (PACKET DATA TRANSFER) to the GSS shall be sent.

On the GSS side, RR shall indicate that RR have been established on request by the peer DTM entity and the "DTM CONNECTION PENDING" state shall be entered.

Abnormal case:

If timer T333 expires in the "RR-CONNECTION PENDING" state, the RR establishment request in progress shall be aborted and the AT DTM shall then return to the "DTM IDLE" state.

7.7.3.2.2 Connection request

When establishment of the indicated RR has been confirmed, the DTM entity of the AT shall initiate call establishment by transferring a PACKET DATA TRANSFER message across the radio interface and shall set timer T334. Following the transmission of the PACKET DATA TRANSFER message (PD2 with the appropriate IPI value), the call shall be considered by the AT to be in the "DTM CONNECTION PENDING" state.

Abnormal case:

If timer T334 expires in the "DTM connection pending" state, the Radio Resource (RR) establishment request in progress shall be aborted and the AT DTM shall then return to the "DTM IDLE" state.

7.7.3.2.3 Connection confirmation

Upon receiving an indication that the call has been accepted, the GSS shall send a CONNECT message across the radio interface to the calling AT and shall enter the "DTM connected" state.

NOTE: This message indicates to the calling AT that a connection has been established through to the CIF.

On receipt of the CONNECT message the calling AT shall stop timer T334, start timer T335 and shall enter the "DTM connected" state.

7.7.3.2.4 Connection rejection

Upon receiving an indication that the connection to the CIF is not possible, the GSS shall initiate call clearing at the radio interface to the AT which originated the call, as described in subclause 7.7.6 using the cause provided by the CIF or GSS.

7.7.3.2.5 Connection release

The AT shall release the connection using the procedures defined in subclause 7.7.6.2 of this ETS.

7.7.3.3 Location update

On indication of a change of cell the AT DTM entity shall indicate to the network its new location using one of the following procedures:

- if no packet data connection exists between the AT and the network the procedure defined in subclause 7.7.3.2 of this ETS shall be used; or

- if a packet data connection exists between the AT and the network, the AT DTM entity shall transfer a PACKET DATA TRANSFER (PD2) message suitably formatted and with the appropriate contents using the data transfer procedures defined in subclause 7.7.7.1 of this ETS.

7.7.4 Aircraft originating call establishment procedures

7.7.4.1 General

Before call establishment may be initiated the peer-to-peer connection between the RRM sublayers in the AT and in the GSS shall be established.

The DTM entity of the AT shall request the RR-sublayer for the establishment of indicated Radio Resources (RR). Timer T333 shall then be set and the "RR-CONNECTION PENDING" state shall be entered.

When indicated Radio Resources (RR) are established, a confirmation shall be given to indicate that RR is ready for data transfer, timer T333 shall be stopped and the first DTM message (PACKET DATA TRANSFER) to the GSS shall be sent.

On the GSS side, RR shall indicate that Radio Resources (RR) have been established on request by the peer DTM entity and the "DTM connection pending" state shall be entered.

Abnormal case:

If timer T333 expires in the RR-CONNECTION PENDING state, the Radio Resource (RR) establishment request in progress shall be aborted and the user shall be informed about the rejection of the call and the AT DTM shall then return to the "DTM IDLE" state.

7.7.4.2 Call request

When establishment of indicated RR has been confirmed, the DTM entity of the AT shall initiate call establishment by transferring a PACKET DATA TRANSFER message across the radio interface and shall set timer T334. Following the transmission of the PACKET DATA TRANSFER message, the call shall be considered by the AT to be in the "DTM connection pending" state.

Abnormal case:

If timer T334 expires in the "DTM connection pending" state, the Radio Resource (RR) establishment request in progress shall be aborted and the user shall be informed about the rejection of the call and the AT DTM shall then return to the "DTM IDLE" state.

7.7.4.3 Call connected

Upon receiving an indication that the call has been accepted, the GSS shall send a CONNECT message across the radio interface to the calling AT and shall enter the "DTM connected" state (see figure C.2).

NOTE: This message indicates to the calling AT that a connection has been established through to the CIF.

On receipt of the CONNECT message the calling AT shall stop timer T334, start timer T335 and shall enter the "DTM connected" state.

7.7.4.4 Call rejection

Upon receiving an indication that the connection to the CIF is not possible, the GSS shall initiate call clearing at the radio interface to the AT which originated the call, as described in subclause 7.7.6 using the cause provided by the CIF or GSS.

7.7.5 Ground originating call establishment procedures

7.7.5.1 General

In order to establish calls in the ground-to-air direction, the GSS shall broadcast on the Broadcast Control CHannel (Data) (BCCH(D)) a page request contained in SYSTEM INFO 6. To identify the packet data paging the resource request Information Element (IE) shall be in conformance with figure 1 which supplements table 87 in subclause 10.11.8.5.2.9 in ETS 300 326-2 [2]:

Table 1: Resource request information element (supplementary value)

8	7	6	5	4	3	2	1	
0	0	1	0	0	0	0	0	PACKET MODE DATA

On receipt of the DTM-PAGE REQUEST message, the AT shall select a Transaction Identifier (TI) (see subclause 7.10.3), request RRM to establish Radio Resources (RR), set timer T333 and enter the "RR connection pending" state.

Abnormal case:

On expiry of timer T340 in the "AT connection pending" state, the GSS shall indicate to the user that the call cannot be connected and shall enter the "DTM IDLE" state.

7.7.5.2 Call connected

When establishment of indicated RR has been confirmed, the DTM entity of the AT shall stop timer T333, confirm call establishment by transferring a CONNECT message to the GSS and enter the "DTM connected" state.

Abnormal case:

On expiry of timer T333 in the "RR connection pending" state, the AT shall indicate to the higher layer that the call cannot be connected and shall enter the "DTM IDLE" state.

On indication from the RRM sublayer that RR cannot be activated, the AT shall stop timer T333, indicate to the higher layer that the call cannot be connected and shall enter the "DTM IDLE" state.

7.7.6 Call clearing

7.7.6.1 Exception conditions

Under normal conditions, call clearing shall be initiated when the AT or the GSS sends a DISCONNECT message and shall follow the procedures defined in subclauses 7.7.6.2 and 7.7.6.3 respectively.

As an exception to the above requirement, the GSS, in response to an initial PACKET DATA TRANSFER message, shall reject a call by responding with a DISCONNECT message.

7.7.6.2 Clearing initiated by the AT

Apart from the exception identified in subclause 7.7.6.1, the AT shall initiate clearing by sending a DISCONNECT message, setting timer T337 and entering the "DTM release pending" state.

On receipt of the DISCONNECT message the GSS shall clear the connection to the CIF, reply to with a DISCONNECT message to the AT, start timer T342 and enter the "DTM disconnection pending" state.

On receipt of the DISCONNECT message the AT shall:

- stop timer T337;
- set timer T336;
- request the release of used Radio Resources (RR); and
- enter the "RR-RELEASE PENDING" state awaiting confirmation.

Abnormal cases:

If the AT does not receive a DISCONNECT message in response to the DISCONNECT message before timer T337 expires, it shall request release of Radio Resources (RR), set timer T336 and enter the "RR release pending" state.

7.7.6.3 Clearing initiated by the GSS

Apart from the exception condition identified in subclause 7.7.6.1, the GSS shall initiate clearing by sending a DISCONNECT message, setting timer T342 and entering the "DTM DISCONNECTION PENDING" state.

7.7.6.4 Completion of clearing

Following confirmation from the RRM sublayer of the release of Radio Resources (RR), the AT shall stop timer T336, release the DTM transaction identifier and enter the "DTM IDLE" state.

Following the release of Radio Resources (RR) (by the AT), the GSS shall:

- stop timer T342; and

- enter the "DTM IDLE" state.

Abnormal cases:

If confirmation of release of RR is not received by the AT before the expiry of timer T336, the AT shall release DTM transaction identifier and enter the "DTM IDLE" state.

If confirmation of release of RR is not received by the AT before the expiry of timer T342, the GSS shall enter the "DTM IDLE" state.

7.7.6.5 Clear collision

Clear collision occurs when both the AT and the GSS simultaneously transfer DISCONNECT messages specifying the same call.

When the GSS receives a DISCONNECT message whilst in the "DTM disconnection pending" state, the GSS shall ignore this message and remain in the "DTM disconnection pending" state.

7.7.7 Miscellaneous procedures

7.7.7.1 Data transfer air-to-ground

On receipt of a request from a higher layer to send a data packet, the AT DTM shall reset T335, encapsulate the received data in a PACKET DATA TRANSFER message and send this to the GSS.

On receipt of a PACKET DATA TRANSFER message, the GSS shall reset timer T335, extract the data field from the message and pass this to the higher layer (CIF).

7.7.7.2 Data transfer ground-to-air

On receipt of a request from a higher layer (CIF) to send a data packet, the GSS DTM shall reset timer T335, encapsulate the received data in a PACKET DATA TRANSFER message and send this to the AT.

On receipt of a PACKET DATA TRANSFER message, the AT shall reset timer T335, extract the data field from the message and pass this to the higher layer.

7.7.7.3 Timer expiry

On expiry of timer T335, the AT DTM shall release the DTM connection using the procedure defined in subclause 7.7.6.2.

7.7.7.4 Handover

7.7.7.4.1 AT side

On receipt of an indication from the RRM sublayer that a handover is pending the AT DTM shall reset timer T335 and enter the "DTM Handover pending" state.

On receipt of an indication from the RRM sublayer that handover has completed successfully, the AT DTM shall reset timer T335 and perform a "location update" according to the procedure defined in subclause 7.7.3.3 of this ETS.

After completion of the procedure defined in ETS 300 326-2 [2], subclause 10.11.3.5.2.3, any slots remaining shall be assigned to the control channel.

Abnormal cases:

On receipt of an indication from the RRM sublayer that handover has failed, the AT DTM shall determine from the RRM whether dedicated RR remain available. If resources are available, the AT DTM shall reset timer T335 and enter the "DTM connected" state. If no resources are available, the AT DTM shall stop timer T335, indicate to the higher layer that the packet data connection has been released and enter the "DTM IDLE" state.

7.7.7.4.2 GSS side

On receipt of an indication from the RRM sublayer that a handover is pending the GSS DTM shall request the higher layer (CIF) to suspend sending data and remain in the "DTM connected" state.

On receipt of an indication from the RRM sublayer that handover has completed successfully, the GSS DTM shall indicate to the higher layer (CIF) that the data link is being released and shall enter the "DTM IDLE" state.

Abnormal case:

On receipt of an indication from the RRM sublayer that handover has failed, the GSS DTM shall request the higher layer (CIF) to resume sending data, reset timer T335 and remain in the "DTM connected" state.

7.7.7.5 Resource management

7.7.7.5.1 General

As specified in subclause 7.6 of this ETS, whilst in the "DTM CONNECTED" state the AT and GSS shall manage a pair of buffers (i.e. one each) which shall be used to determine whether the allocated RR are adequate for the prevailing data transmission requirements. These buffers shall be filled when the application is sending data faster than the RRM is capable of transporting it to the peer DTM entity.

Similarly when the RRM is capable of transporting data to the peer DTM faster than the application is sent the buffer shall be progressively emptied. The level in the buffer shall determine the action to be taken by the DTM.

7.7.7.5.2 Throughput increase

7.7.7.5.2.1 AT side

If the level of the buffer maintained by the AT DTM exceeds the Throughput Control Threshold (TCT, see subclause 7.6.3.1) the AT DTM shall request the RRM to increase the throughput of the DCCH with a RR-THROUGHPUT-MODIFICATION-REQUEST primitive, indicating an increase in the DCCH is required. The AT DTM shall remain in the "DTM CONNECTED" state.

If the RRM is able to achieve the increase in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-CONFIRM primitive. On receipt of this primitive the AT DTM shall remain in the "DTM CONNECTED" state.

Abnormal case:

If the RRM is unable to achieve the increase in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-REJECT primitive and the AT DTM shall, on receipt of this primitive remain in the "DTM CONNECTED" state.

7.7.7.5.2.2 GSS side

If the level of the buffer maintained by the GSS DTM exceeds the Throughput Control Threshold (TCT, see subclause 7.6.3.1) and a request to decrease resources has not been received from the AT DTM, the GSS DTM shall request the RRM to increase the throughput of the DCCH with a RR-THROUGHPUT-MODIFICATION-REQUEST primitive, indicating an increase in the DCCH is required. The GSS DTM shall remain in the "DTM CONNECTED" state.

If the RRM is able to achieve the increase in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-CONFIRM primitive. On receipt of this primitive the GSS DTM shall remain in the "DTM CONNECTED" state.

Abnormal case:

If the RRM is unable to achieve the increase in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-REJECT primitive and the GSS DTM shall, on receipt of this primitive remain in the "DTM CONNECTED" state.

7.7.7.5.3 Throughput decrease

7.7.7.5.3.1 AT side

If the level of the buffer maintained by the AT DTM falls below the Throughput Control Threshold (TCT, see subclause 7.6.3.1) the AT DTM shall request the RRM to decrease the throughput of the DCCH with a RR-THROUGHPUT-MODIFICATION-REQUEST primitive, indicating an decrease in the DCCH is required. The AT DTM shall remain in the "DTM CONNECTED" state.

If the RRM is able to achieve the decrease requested, it shall return a RR-THROUGHPUT-MODIFICATION-CONFIRM primitive. On receipt of this primitive the AT DTM shall remain in the "DTM CONNECTED" state.

Abnormal case:

If the RRM is unable to achieve the increase in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-REJECT primitive and the AT DTM shall, on receipt of this primitive remain in the "DTM CONNECTED" state.

7.7.7.5.3.2 GSS side

If the level of the buffer maintained by the GSS DTM falls below the Throughput Control Threshold (TCT, see subclause 7.6.3.1) and a request to increase resources has not been received from the AT DTM, the GSS DTM shall request the RRM to decrease the throughput of the DCCH with a RR-THROUGHPUT-MODIFICATION-REQUEST primitive, indicating a decrease in the DCCH is required. The GSS DTM shall remain in the "DTM CONNECTED" state.

If the RRM is able to achieve the decrease in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-CONFIRM primitive. On receipt of this primitive the GSS DTM shall remain in the "DTM CONNECTED" state.

Abnormal case:

If the RRM is unable to achieve the decrease in resources requested, it shall return a RR-THROUGHPUT-MODIFICATION-REJECT primitive and the GSS DTM shall on receipt of this primitive remain in the "DTM CONNECTED" state.

7.8 Handling of error conditions

7.8.1 General treatment of error conditions

The detection and handling of error conditions in the protocol between the AT and GSS will, in general, be as described in ETS 300 326-2 [2], subclause 10.11.6. This describes handling of errors in the following protocol elements:

1) protocol discriminator error;

2) message too short;

3) transaction identifier errors;

4) message type error;

5) information element out of sequence;

6) duplicated information element;

7) mandatory information element errors;

8) non-mandatory information element errors.

Error conditions for packet data service supplementary to those referenced in subclause 10.11.6 of ETS 300 326-2 [2] are described in the following subclauses.

7.8.2 Message type error

DT management:

If a message containing a non-existent message type, a message type not consistent with the protocol discriminator, not consistent with the direction or not consistent with the state, the DTM entity shall ignore the message.

7.8.3 Mandatory information element error

DT management:

When a message other than those listed below is received with mandatory information element errors, no action shall be taken on the message and no state change shall occur.

When a CONNECT message is received with mandatory information element errors, the receiving entity shall send a DISCONNECT message with DTM-CAUSE "invalid information element contents" and shall remain in the NULL state.

When a DISCONNECT message is received with mandatory information element errors, it shall be treated as a normal DISCONNECT message.

Radio Resource (RR):

If a THROUGHPUT MODIFICATION REQUEST message is received with mandatory information element errors, the receiving entity shall respond with a THROUGHPUT MODIFICATION REJECT message with RR-CAUSE value "invalid information element contents" and shall remain in the same state.

7.9 Message functional definitions and contents

This subclause provides an overview of the message structure and highlights the functional definition and information content (i.e. semantics) of each message. Each definition includes:

1) a brief description of the message, its direction of use and whether it has:

   - local significance i.e. relevant only on the originating or terminating access;
   - access significance i.e. relevant in the originating and terminating access, but not in the network;
   - dual significance i.e. relevant in either the originating or terminating access and in the network;
   - global significance i.e. relevant in the originating and terminating access and in the network;

2) a table listing the information elements in the order of their appearance in the message (mandatory before optional and for the latter in the same relative order for all message types). For each information element the table indicates:

   - the subclause of this specification describing the information element;
   - the direction in which it may be sent i.e. AT to GSS, GSS to AT or both;
   - the type of information element i.e. whether it is Mandatory with Fixed length (MF), Mandatory with Variable length (MV), Optional with Fixed length (OF) or Optional with Variable length (OV). For each optional information element a reference to a note is given. The note explains the circumstances under which the information element shall be included;
   - the length of the information element (or permissible range of lengths) in octets, where "?" denotes an undefined maximum length.

The message types shown in table 2 are required for the achievement of the Data Transmission Management (DTM) process.

Table 2: Message types for DTM

Message type	Reference subclause
CONNECT	7.9.1.1
DISCONNECT	7.9.1.2
PACKET DATA TRANSFER (PD1)	7.9.1.3
PACKET DATA TRANSFER (PD2)	7.9.1.4

7.9.1 DTM messages

7.9.1.1 Connect

This message shall be sent by the AT to the GSS to indicate that resources have been established after a DTM page or by the GSS to the AT to indicate that a channel to the CIF has been established. The message content shall be as defined in table 3b.

Table 3a: CONNECT message

Message type:	CONNECT
Significance:	Global
Direction:	Both

Table 3b: CONNECT message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.1.2 Disconnect

This message shall be sent by either end of the air interface to indicate that the link is no longer required. The message content shall be as defined in table 4b.

Table 4a: DISCONNECT message

Message type:	DISCONNECT
Significance:	Global
Direction:	Both

Table 4b: DISCONNECT message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
DTM-Cause	7.10.6.1	both	MF	1
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.1.3 Packet data transfer (PD1)

This message is sent by either end of the air interface to encapsulate data containing an IPI coded in accordance with ISO 9577 [7] that is to be passed across the interface. The message content shall be as defined in table 5b.

Table 5a: PACKET DATE TRANSFER (PD1) message

Message type:	PACKET DATA TRANSFER (PD1)
Significance:	dual
Direction:	both

Table 5b: PACKET DATA TRANSFER (PD1) message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction Identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
Data information	7.10.6.2	both	MV	2 - 241
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.1.4 Packet data transfer (PD2)

This message is sent by either end of the air interface to encapsulate data conforming to the IPI coding defined in table 12 that is to be passed across the interface. The message content shall be as defined in table 6b.

Table 6a: PACKET DATA TRANSFER (PD2) message

Message type:	PACKET DATA TRANSFER (PD2)
Significance:	dual
Direction:	both

Table 6b: PACKET DATA TRANSFER (PD2) message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction Identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
Data information	7.10.6.2	both	MV	2 - 241
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.2 Supplementary RRM messages

7.9.2.1 Throughput modification request

This message shall be sent by the AT to GSS to indicate that a resource modification is requested. The message content shall be as defined in table 7b.

Table 7a: THROUGHPUT MODIFICATION REQUEST message

Message type:	THROUGHPUT MODIFICATION REQUEST
Significance:	dual
Direction:	AT to GSS

Table 7b: THROUGHPUT MODIFICATION REQUEST message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction Identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
Capacity request	7.10.5.1	both	MF	1
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.2.2 Throughput modification command

This message shall be sent by the GSS to the AT to indicate that the resource allocation shall change as indicated. Allocated resources can differ from those requested. The message content shall be as defined in table 8b.

Table 8a: THROUGHPUT MODIFICATION COMMAND message

Message type:	THROUGHPUT MODIFICATION COMMAND
Significance:	dual
Direction:	GSS to AT

Table 8b: THROUGHPUT MODIFICATION COMMAND message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction Identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
Slot allocation	7.10.5.2	both	MF	2
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.9.2.3 Throughput modification reject

This message shall be sent by the GSS to the AT to indicate that the resource requested is rejected and there is no change to the resource allocated. The message content shall be as defined in table 9b.

Table 9a: THROUGHPUT MODIFICATION REJECT message

Message type:	THROUGHPUT MODIFICATION REJECT
Significance:	dual
Direction:	GSS to AT

Table 9b: THROUGHPUT MODIFICATION REJECT message contents

Information element	Reference subclause	Direction	Type	Length
Protocol discriminator	7.10.2	both	MF	(note)
Transaction Identifier	7.10.3	both	MF	
Message type	7.10.4	both	MF	
RR-Cause	10.11.8.5.2.2 in ETS 300 326-2 [2]	both	MF	1
NOTE: The combined length of the protocol discriminator, the transaction identifier and the message type is two octets.				

7.10 General message format and information elements coding

The message contents for the Data Transfer and supplementary RRM messages shall conform to the requirements defined in ETS 300 326-2 [2], subclause 10.11.8 except where identified below.

7.10.1 Overview

Within this protocol every message shall include some or all of the following parts:

- protocol discriminator;
- transaction identifier;
- message type;
- other information elements as required.

All equipment shall ignore any extra information present in a message which is not required for the proper operation of that equipment.

Unless specified otherwise, a particular information element may be present only once in a given message.

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

When a field extends over more than one octet, the order of bit values shall progressively decrease as the octet number increases. The least significant bit of the field shall be represented by the lowest numbered bit of the highest numbered octet in the field as shown in figure 15.

8	7	6	5	4	3	2	1	
transaction identifier					protocol discriminator			Octet 1
message type								Octet 2
other information elements as required								etc.

Figure 15: General message organization

7.10.2 Protocol discriminator

The protocol discriminator shall conform to the requirements of ETS 300 326-2 [2], subclause 10.11.8.2. The protocol discriminator shall be assigned the additional value defined in table 10.

Table 10: Additional protocol discriminator values

bits	3	2	1	
values	0	1	1	data transfer

7.10.3 Transaction identifier

The purpose of the Transaction Identifier (TI) shall be to distinguish multiple parallel activities (transactions) within one AT. The TI shall be equivalent to the call reference defined in ITU-T Recommendation Q.931 [8].

The transaction identifier shall be the second part of every message. It shall be set to zero for DTM.

7.10.4 Message type

The purpose of the message type shall be to identify the function of the message being sent.

The message type shall be inserted in messages as shown in figure 15. The message type shall be coded as shown in table 11 and table 13.

Table 11: DTM message type coding

8	7	6	5	4	3	2	1	
x	x	0	0	0	0	0	1	CONNECT
x	x	0	0	0	0	1	0	DISCONNECT
x	x	0	0	1	0	0	0	PACKET DATA TRANSFER (PD1)
x	x	0	1	0	0	0	0	PACKET DATA TRANSFER (PD2)

NOTE 1: Bits 7 and 8 shall be reserved for the send sequence number in messages sent from the AT. In messages sent from the network, bits 7 and 8 shall be coded with zeros.
NOTE 2: PD1 shall be used when the IPI conforms to ISO 9577 [7].
PD2 shall be used when the IPI conforms to table 12.

Table 12: TFTS specific IPI coding

Initial Protocol Identifier value								**Protocol description**
0	0	0	0	0	0	0	1	TFTS location registration protocol
0	0	0	0	0	0	1	0	ACARS
								All other values reserved

Table 13: RRM message type coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	1	0	1	THROUGHPUT-MODIFICATION-REQUEST
0	0	0	0	0	1	1	0	THROUGHPUT-MODIFICATION-COMMAND
0	0	0	0	0	1	1	1	THROUGHPUT-MODIFICATION-REJECT

Messages with different protocol discriminators are permitted to have the same message type i.e. the function of a message shall be determined by the protocol discriminator and the message type together.

7.10.5 Supplementary RRM information elements

The information elements for RRM shall be in conformance with table 78 in subclause 10.11.8.5.2 in ETS 300 326-2 [2] supplemented by those identified in table 14:

Table 14: Radio resource management information element (supplementary values)

8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Type 3 and 4 information elements**	**Reference subclause**	**Length in octets**
0	0	1	0	0	1	1	1	Capacity request	7.10.5.1	F2

7.10.5.1 Capacity request

The capacity request Information Element (IE) shall conform to the requirements of figure 16 and table 15.

8	7	6	5	4	3	2	1	
0	0	0	1	0	1	1	1	Octet 1
capacity request								
capacity request								Octet 2

Figure 16: Capacity request information element format

Table 15: Capacity request information element coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	38,4 kbit/s signalling
0	0	0	0	0	1	0	0	28,8 kbit/s signalling
0	0	0	0	1	0	0	0	19,2 kbit/s signalling
0	0	0	0	1	1	0	0	9,6 kbit/s signalling
0	0	0	0	1	1	1	0	4,8 kbit/s signalling
0	0	0	0	1	1	1	1	2,4 kbit/s signalling
0	0	0	1	0	0	0	0	SACCH
0	0	0	1	0	0	0	1	Increase capacity
0	0	0	1	0	0	1	0	decrease capacity

7.10.5.2 Slot allocation

The Slot Allocation IE shall conform to the requirements of ETS 300 326-2 [2], subclause 10.11.8.5.2.12.

7.10.6 DTM information elements

The information elements for DTM are identified in table 16.

Table 16: DTM information elements

8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Type 3 and 4 information elements**	**Reference subclause**	**Length in octets**
0	0	0	0	0	0	0	1	DT cause	7.10.6.1	F2
1	0	0	0	0	0	0	0	Data information	7.10.6.2	3 - 242

7.10.6.1 DTM-cause

The DTM-Cause IE shall conform to the requirements of ETS 300 326-2 [2], subclause 10.11.8.5.2 with the exception that table 80 in ETS 300 326-2 [2] shall be supplemented as defined in table 14.

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	Octet 1
DTM cause								
DTM cause								Octet 2

Figure 17: DTM cause information element format

Table 17: DTM cause information element coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	normal clearing (AT-DTM request)
0	0	0	0	0	0	1	0	normal clearing (CIF-DTM request)
0	0	0	0	0	0	1	1	normal clearing (GSS request)
0	0	0	0	0	1	0	0	AT not authorized
0	0	0	0	0	1	0	1	unknown AT
0	0	0	0	0	1	1	0	GSS-CIF temporary link failure
0	0	0	0	0	1	1	1	CIF not existing
0	0	0	0	1	0	0	0	GSS-CIF connection rejected
0	0	0	0	1	0	0	1	invalid IE content
1	0	0	0	0	0	0	0	unspecified

7.10.6.2 Data information

The data information IE shall conform generally to the requirements of ETS 300 326-2 [2], subclause 10.11.8.5.2. The IE shall be coded as defined in figure 18.

8	7	6	5	4	3	2	1	
0	1	0	0	0	0	0	0	octet 1
	packet data Information Element Identifier (IEI)							
length								octet 2
IPI								octet 2
Packet Data								octets 4 - 242

Figure 18: Data information encoding

7.11 List of system parameters

7.11.1 Timers for data transfer on the AT side

Timers for data transfer on the AT Side are defined in table 18.

Table 18: Timers on the AT side

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry	Normal reset
333	20	RR-con-pend	RR-est-req	RR-est-cnf	clear call	n/a
334	30	DTM-con-pend	PDT	CONN	clear call	n/a
335	50	DTM-conn	DTM-dat-conf		Disconnect	(note)
336	20	RR-rel-pend	DISC	RR-rel-ind	clear call	n/a
337	20	DTM-rel-pend	DISC (Tx)	DISC (Rx)	RR-rel-req	n/a
350	1800	IDLE	Loc Reg	-	Loc Reg	-
NOTE: There are four normal reset conditions for this timer: DISCONNECT; PACKET DATA TRANSFER; DTM-Data-Req.; RR-HO-Ind.						

7.11.2 Timers for data transfer on the GSS side

Timers for data transfer on the GSS Side are defined in table 19.

Table 19: Timers for data transfer on the GSS Side

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry	Normal reset
336	20	RR-rel-pend	DISC	RR-rel-ind	clear call	n/a
340	80	AT-con-pend	RR-est	PDT	clear call	n/a
341	30	DTM-con-pend	RR-est-resp	PDT	clear call	n/a
342	10	DTM-dis-pend	DISC	RR-rel-ind	clear call	n/a

7.12 Definition of primitive parameters

7.12.1 Primitive parameters for DTM

The additional primitives required for the DTM service are listed in table 20.

Table 20: Primitives required for DTM service

Generic name and type	Appearance	Meaning and parameters
DTM-DATA-REQ	Both	A request to send DATA to the peer entity
DTM-DATA-IND	Both	An indication that DATA has been received from the peer entity.
DTM-DATA-RESP	Both	A response to the receipt of a DTM-Data-Cnf from the CIF side of the GSS DTM.
DTM-DATA-CNF	Both	A confirmation that DATA has been sent to the peer. If the parameter "error" is present, it shall indicate that the peer entity is unable to accept DATA.
DTM-RELEASE-REQ	CIF	A request to release resources from packet data service.
DTM-RELEASE-RESP	GSS	Response acknowledging receipt of DTM-REL-IND on air interface data link failure.
DTM-RELEASE-CNF	Both	Confirmation that resources have been released.
DTM-RELEASE-IND	Both	An indication that DATA TRANSFER is no longer available with the peer entity.

7.12.2 Additional primitive parameters for the RR service

The additional primitives required for the RR service are listed in table 21.

Table 21: Additional Primitives required for the RR Service

Generic name and type	Appearance	Meaning and parameters
RR-Thru-Mod-Req	Both	Increase Decrease
RR-Thru-Mod-Cnf	Both	Rate (value) Error (no change)

8 Interworking at the GSS

8.1 General

The GSS shall provide an interworking function between the AT-GSS and GSS-CIF interfaces. The location of this function within the GSS structure is shown in figure 19.

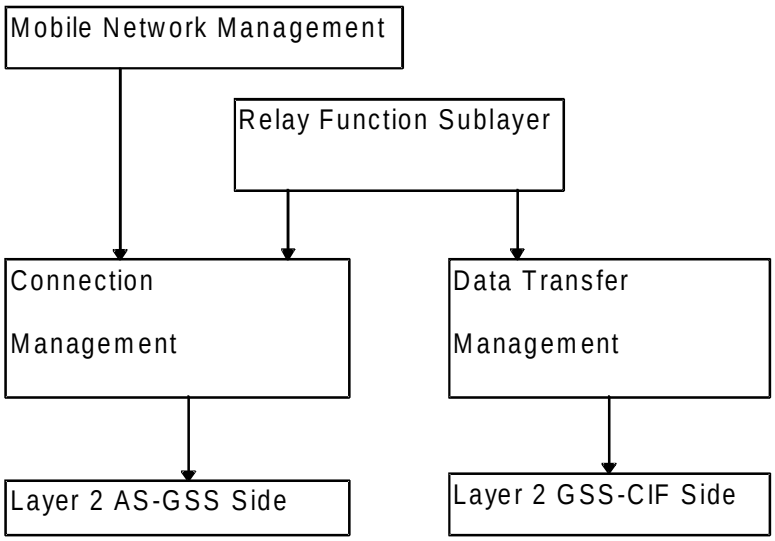

Figure 19: Location of interworking function within GSS structure

8.2 Relay function description

As the GSS side has to manage two different protocols, (one between AT and GSS on the Ua interface and the other between the GSS and CIF on the 1d interface) a relay function performs the gateway between these two protocols.

The relay function is situated at the same layer as the DTM layer in the AT and CIF sides but does not provide DTM services.

The main functionality of the relay is to synchronize all the events received from each side by translation of the primitives received from each side:

- indication received from one side is translated into request and transmitted to the other side;

- confirmation received from one side is translated into response and transmitted to the other side.

Taking into account the events received from both sides, the relay function provides the means for establishment, maintenance, and termination for data transmission between AT and CIF.

As the relay function is wholly internal to the GSS, its implementation is outside the scope of this ETS.

8.3 DTM states at the GSS side of the AT-GSS and GSS-CIF interfaces

DTM-IDLE (0): No data transfer transaction exists.

DTM-RR-CONNECTION-AVAILABLE (0.1): This state exists for a GSS, when Radio Resources (RR) are available on request by the peer entity at an AT and when no connection exists with the CIF.

DTM-CIF-CONNECTION-PENDING (0.2): This state exists when a GSS is receiving data transfer coming from an AT, and when the GSS has made a request for X25 connection to the CIF.

DTM-CONNECTED (10): This state exists for a GSS, when a transaction for data transfer has been established between an AT and a CIF.

DTM-AT-NOT-CONNECTED (20): This state exists for a GSS, when a transaction for data transfer has been released with an AT but not with the CIF.

DTM-RR-CONNECTION-AVAILABLE-AT-ORIGINATING (20.1): This state exists for a GSS, when Radio Resources (RR) are available on request by the peer entity at an AT and when X25 connection and data transfer transaction exist with the CIF.

DTM-AT-CONNECTION-PENDING (20.2): This state exists for a GSS, when an X25 connection is existing with the CIF, (data transfer transaction is not yet established) and when the AT has requested Radio Resources (RR).

DTM-RR-CONNECTION-AVAILABLE-CIF-ORIGINATING (20.3): This state exists for a GSS, when Radio Resources (RR) are available on request by the peer entity in an AT and when X25 connection is existing with the CIF (data transfer transaction is not yet established).

9 GSS to CIF interface aspects

9.1 General

On the GSS-CIF layer 3 interface, the TFTS packet Data Transmission (DT) is a function using the services provided by the layer 2 and 3 as defined in ITU-T Recommendation X.25 [4].

Data transfer shall use the services of X.25 [4] layer 3 and shall:

- provide the means for establishment, maintenance and termination of transactions for Data Transmission (DT);

- comprise the group of signalling functions for Data Transmission Management (DTM).

9.2 Data transfer services provided by signalling layer 3 on GSS side

9.2.1 General GSS

The DT services shall be provided at the access point Data Transmission Management-SAP (DTM-SAP). The DT service class consists of the following services:

- GSS originating data transmission transaction establishment;

- CIF originating data transmission transaction establishment;

- data transmission transaction maintenance;

- data transmission transaction clearance.

9.2.2 Service state diagram GSS

The DT services provided at the service access point Data Transmission Management-SAP (DTM-SAP) are illustrated in the state diagram on figure 20.

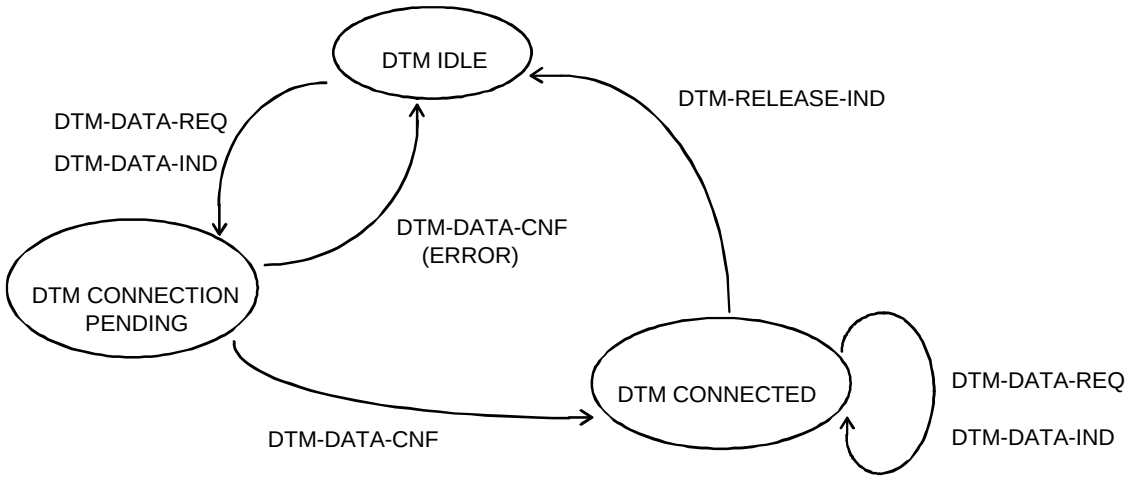

Figure 20: Overview service state diagram of DTM entity on the GSS side

9.3 Data transfer services provided by signalling layer 3 on the CIF side

9.3.1 General

The DT services shall be provided at the access point Data Transmission Management-SAP (DTM-SAP). The DTM service class consists of the following services:

- GSS originated data transmission transaction establishment;
- CIF originating data transmission transaction establishment;
- data transmission transaction maintenance;
- data transmission transaction clearance.

9.3.2 Service state diagram CIF

The DT services provided at the service access point Data Transmission Management-SAP (DTM-SAP) are illustrated in the state diagram on figure 21.

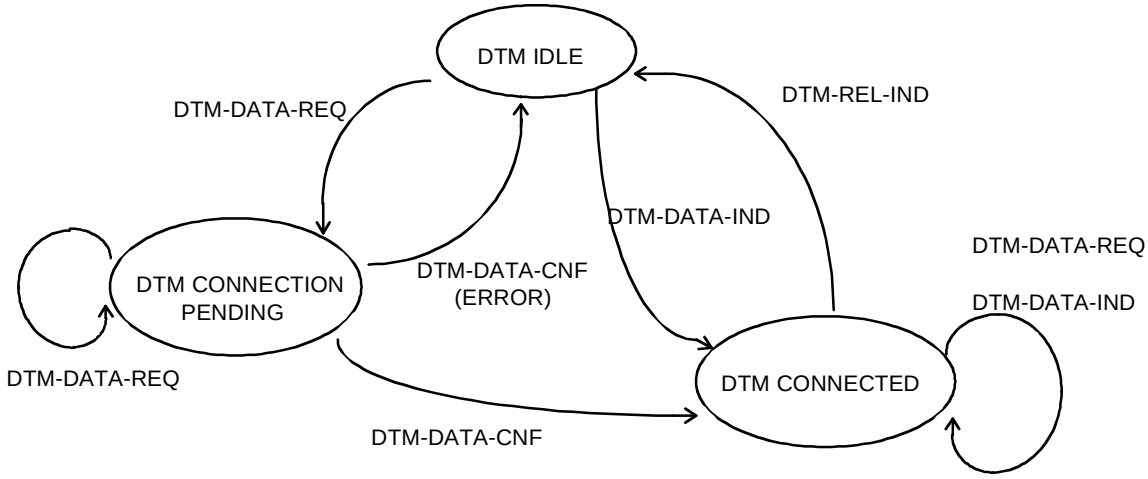

Figure 21: Overview service state diagram of DTM entity on the CIF side

9.4 Elementary procedures for packet switched DT

9.4.1 Overview

9.4.1.1 General

This subclause describes a set of procedures combined in the DTM entity. The general purpose of these procedures is to establish, maintain and terminate packet-switched connections across a TFTS network and other networks to which the TFTS network is connected.

Detailed description of the procedures for DT are given in this subclause in terms of:

- the sequence of messages defined which are transferred across the GSS-CIF interface; and
- the information processing and actions that take place at the GSS and CIF sides of this interface.

Detailed System Description Language (SDL) diagrams for handling of packet-switched calls (DTM) are contained in figures C.3 and C.4.

9.4.2 DTM states

9.4.2.1 Call states at the GSS side of the interface

The call states that may exist on the GSS side of the GSS-CIF interface are defined in this subclause (see figure C.3).

DTM IDLE: No packet data connection exists.

GSS to CIF connection pending: This state exists when the AT has requested a packet data connection.

GSS CIF connected: This state exists when the X.25 [4] link has been established between the GSS and the CIF.

DTM connected: This state exists when a packet data connection exists between the AT and the CIF (through the GSS).

CIF release pending: This state exists when the GSS has requested release of the X.25 [4] link to the CIF and is awaiting a response from the CIF.

9.4.2.2 Call states at the CIF side of the interface

The call states that may exist on the CIF side of the GSS-CIF interface are defined in this subclause (see figure C.4).

DTM IDLE: No packet data connection exists.

GSS connection pending: This state exists in the CIF when a request has been made to the GSS for establishment of an X.25 [4] link and the CIF is awaiting a response.

GSS connected: This state exists when an X.25 [4] link is present between the GSS and the CIF, but no packet data connection is through connected to an AT.

AT connection pending: This state exists when the CIF has sent an X.25 [4] data packet containing a first PACKET DATA TRANSFER message for onward transmission to the AT and is awaiting establishment of a packet data connection.

AT connected: This state exists when a packet data connection exists between the AT and the CIF, through-connected by the GSS.

AT suspended: This state exists in the CIF when the AT is engaged in a handover between GSS.

GSS release pending: This state exists when the CIF has requested release of the X.25 [4] link with the GSS and is awaiting a response.

9.4.2.3 Packet-switched DTM procedures

The call states referred to cover the states perceived by the GSS, states perceived by the CIF and states which are common to both CIF and GSS.

All messages in this subclause contain functional information elements. Functional information elements are characterized as requiring a degree of intelligent processing by the terminal in either their generation or analysis:

The procedures needed for DTM are:

- call establishment procedures;
- call clearing procedures;
- data transfer procedures; and
- miscellaneous procedures.

NOTE: The contents of the specific messages are only given for better understanding. A complete description of the messages and their contents is given in subclause 9.8.

9.4.3 GSS originating call establishment procedures

9.4.3.1 Call request

On receipt of a PACKET DATA TRANSFER message from an AT, the DTM entity of the GSS shall request the X.25 [4]-sublayer for the establishment of a switched virtual circuit (VC). Timer T300 (table 33) shall then be set and the "GSS to CIF CONNECTION PENDING" state entered.

On the CIF side, X.25 [4] sublayer shall indicate that a request for the establishment of an VC has been received. The CIF DTM shall indicate acceptance of the request and enter "GSS CONNECTED" state.

Abnormal cases:

If timer T300 expires in the "GSS to CIF CONNECTION PENDING" state, the X.25 [4] establishment request in progress shall be aborted, the AT shall be informed about the rejection of the call and the GSS DTM shall then return to the "DTM IDLE" state.

If the GSS DTM receives a request for the establishment of an X.25 [4] VC from the CIF this request shall be rejected and the GSS DTM shall remain in the "GSS to CIF CONNECTION PENDING" state.

9.4.3.2 Call connected

On the GSS side, when the VC is established, a confirmation shall be given to indicate that X.25 [4] is ready for data transfer, T300 shall be stopped, the first DTM message (PACKET DATA TRANSFER - received from the AT) shall be sent to the CIF and the "DTM CONNECTED" state shall be entered. On the CIF side when the first DTM message (PACKET DATA TRANSFER) is received this shall be passed to the user and the "AT CONNECTED" state shall be entered.

9.4.4 CIF originating call establishment procedures

9.4.4.1 Call request

On receipt of a request (DTM_data_req) from a higher layer to establish a packet data call to a given AT, the CIF DTM shall determine whether an X.25 [4] VC exists to the appropriate GSS (i.e. whether the CIF DTM is in the "DTM IDLE" or "GSS CONNECTED" state).

If no VC exists to the appropriate GSS, the CIF DTM shall request the establishment of a VC and shall enter the "GSS CONNECTION PENDING" state. On receipt of an indication that the VC is available the CIF DTM shall send the first DTM message (PACKET DATA TRANSFER) to the GSS using the VC and shall enter the "AT CONNECTION PENDING" state.

On receipt of a request to establish an X.25 [4] VC at the GSS side, the GSS DTM shall indicate the incoming call to the higher layer with a DTM-X25-call-ind primitive, confirm acceptance of the X.25 [4] call request by initiating the sending of a X.25 [4] Call Accepted packet, set T345 and enter the "GSS CIF CONNECTED" state.

If an VC exists to the appropriate GSS, the CIF DTM shall send the first DTM message (PACKET DATA TRANSFER) to the GSS using the VC and shall enter the "AT CONNECTION PENDING" state.

On receipt of a DTM message at the GSS side (with the GSS DTM in the "GSS CIF CONNECTED" state), the GSS DTM shall pass this to the higher layer , reset T345 and enter the "AT CONNECTION PENDING" state.

On expiry of T345 if the VC is to be released then it shall be released otherwise it shall be reset.

Abnormal case:

If (in the "GSS CONNECTION PENDING" state) the CIF DTM receives an indication that an X.25 [4] VC cannot be established, the CIF DTM shall indicate the rejection of the call to the higher layer (using a DTM-data-rej primitive) and shall enter the "DTM IDLE" state Call Connected.

9.4.4.2 Call connected

On the CIF side in the "AT CONNECTION PENDING" state, if the DTM receives from the GSS DTM a DTM message containing a PACKET DATA TRANSFER it shall indicate receipt of the message to the higher layer with a DTM-data-ind primitive and enter the "AT CONNECTED" state. Similarly, if the DTM receives from the GSS DTM a DTM message containing a CONNECTED message it shall confirm to the higher layer establishment of the end-to-end packet data link with a DTM-data-cnf primitive and enter "AT CONNECTED" state.

When the GSS DTM receives a DTM-data-resp primitive from the higher layer , it shall send the contents on the CIF DTM in a DTM message and shall enter the "DTM CONNECTED" state.

Abnormal case:

If the CIF DTM receives a DTM message containing a DISCONNECT message (received from the AT) it shall indicate to the higher layer with DTM-data-cnf (error) primitive that the packet data call cannot be completed and shall enter the "GSS CONNECTED" state.

9.4.5 Call clearing

9.4.5.1 Clearing initiated by the CIF

On receipt of a request from a higher layer to release the packet data connection, the CIF DTM shall send a DTM-DISCONNECT message to the GSS and enter the "GSS CONNECTED" state. If the CIF DTM is required to release the X.25 [4] VC to the GSS, it shall initiate the release procedure by sending an X.25 [4] Clear Request message and enter the "GSS RELEASE PENDING" state.

On receipt of the DTM-DISCONNECT message the GSS shall indicate release of the packet data connection to the higher layer and determine whether to release the X.25 [4] VC to the CIF.

If the GSS DTM determines that the VC is to be released it shall initiate the sending of an X.25 [4] Clear Request message to the CIF and enter the "CIF RELEASE PENDING" state.

If the VC is to remain, the GSS DTM shall enter the "GSS CIF CONNECTED" state.

9.4.5.2 Clearing initiated by the GSS

On receipt of a request from a higher layer to release the packet data connection, the GSS DTM shall send a DTM-DISCONNECT message to the CIF and determine whether to release the X.25 [4] VC to the CIF.

If the GSS DTM determines that the VC is to be released it shall initiate the sending of an X.25 [4] clear request message to the CIF and enter the "CIF RELEASE PENDING" state.

If the VC is to remain, the GSS DTM shall enter the "GSS CIF CONNECTED" state.

On receipt of a DTM-DISCONNECT message from the GSS, the CIF DTM shall enter the "GSS CONNECTED" state.

If the CIF DTM is required to release the X.25 [4] VC to the GSS, it shall initiate the release procedure by sending an X.25 [4] Clear Request message and enter the "GSS RELEASE PENDING" state.

9.4.5.3 Completion of clearing

If release of the X.25 [4] VC has been initiated by the CIF, the GSS shall respond to the X.25 [4] Clear Indication message with an X.25 [4] Clear Confirmation message and enter the "GSS RELEASE PENDING" state.

9.4.6 Miscellaneous procedures

9.4.6.1 Data transfer GSS-to-CIF

On receipt of a request from a higher layer to send a data packet, the GSS DTM shall encapsulate the received data in an X.25 [4] Data Packet, reset T345 and send this to the CIF.

On receipt of an X.25 [4] Data Packet, the CIF shall extract the data field from the message and pass this to the higher layer.

9.4.6.2 Data transfer ground to air

On receipt of a request from a higher layer to send a data packet, the CIF DTM shall encapsulate the received data in an X.25 [4] and send this to the GSS.

On receipt of an X.25 [4] Data Packet, the GSS shall extract the data field from the message, reset T345 and pass this to the higher layer.

9.4.6.3 Handover

9.4.6.3.1 GSS side

On receipt of an indication from the RRM sublayer that the handover is pending, the GSS DTM shall follow the general procedure described in ETS 300 326-3 [3], subclause 6.3.3.4.2. The GSS DTM on the CIF side shall send an X.25 [4] Receiver Not Ready (X.25 RNR) to the CIF.

9.4.6.3.2 CIF side

Following receipt of a request to suspend data transmission (X.25 RNR message, subclause 7.7.7.4.2), the CIF shall respond as follows:

1) in case of handover failure: wait until in receipt of a resume message (X.25 RR);

2) in case of a successful handover to the new GSS: The CIF will receive a new connection request from the new GSS. The CIF shall release the X.25 connection to the old GSS. The CIF shall take part in the location registration procedure described in subclause 7.7.7.4.1.

9.5 Handling of error conditions

9.5.1 General treatment of error conditions

The detection and handling of error conditions in the protocol between the GSS and CIF will, in general, be as described in ETS 300 326-2 [2], subclause 10.11.6. This describes handling of errors in the following protocol elements:

- protocol discriminator error;
- message too short;
- transaction identifier errors;
- message type error;
- information element out of sequence;
- duplicated information element;
- mandatory information element errors;
- non-mandatory information element errors.

Error conditions for packet data service supplementary to those referenced in ETS 300 326-2 [2], subclause 10.11.6 are described in the following paragraphs.

9.5.2 Message type error

DT management:

If a message containing a non-existent message type, a message type not consistent with the protocol discriminator, not consistent with the direction or not consistent with the state, the DTM entity shall ignore the message.

9.5.3 Mandatory information element error

DT management:

When a message other than those listed below is received with mandatory information element errors, no action shall be taken on the message and no state change shall occur.

When a connect message is received with mandatory information element errors, the receiving entity shall send a DISCONNECT message with DTM-CAUSE "invalid information element contents" and shall remain in the NULL state.

When a DISCONNECT message is received with mandatory information element errors, it shall be treated as a normal DISCONNECT message.

9.6 Message functional definitions and contents

9.6.1 X.25 layer 3 sublayer

The X.25 [4] layer 3 as defined by ITU-T offers services for the data transfer management sublayer.

CIF-GSS connection:

The connection between the CIF and the GSS is established by using the "X.25-CALL-CONNECT-REQUEST" message. In order to identify which parties are involved in the data transfer, the user data available in the "X.25-CALL-CONNECT-REQUEST" is used as follows.

Table 22: GSS originating connection

Information element	Reference	Direction	Type	Length
Connection type	(note)	GSS-CIF	MF	1
Avionic Termination Equipment Identifier (ATEI)	10.11.8.5.2.1 in ETS 300 326-2 [2]	GSS-CIF	MF	4
Ground Station Identity Code (GSIC)	10.11.8.5.2.15 in ETS 300 326-2 [2]	GSS-CIF	MF	3
Spare				8
NOTE: The values in tables are to be agreed between the implementers.				

Table 23: CIF originating connection

Information element	Reference	Direction	Type	Length
Connection type	(note)	CIF-GSS	MF	1
ATEI	10.11.8.5.2.1 in ETS 300 326-2 [2]	CIF-GSS	MF	4
CIF Indicator	9.7.1	CIF-GSS	MF	1
Spare				10
NOTE: The values in tables are to be agreed between the implementers.				

9.6.2 Data transfer management sublayer

9.6.2.1 Message type

The purpose of the message type shall be to identify the function of the message being sent.

The message type shall be inserted in messages as shown in figure 15. The message type shall be coded as shown in table 25 and table 26.

Table 24: DTM message type coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	CONNECT
0	0	0	0	0	0	1	0	DISCONNECT
0	0	0	0	1	0	0	0	PACKET DATA TRANSFER (PD1)
0	0	0	1	0	0	0	0	PACKET DATA TRANSFER (PD2)
NOTE: PD1 shall be used when the IPI conforms to ISO9577 [7]. PD2 shall be used when the IPI conforms to table 12.								

9.6.2.2 Packet data transfer (PD1)

This message is used to transfer user packet data carrying an IPI conforming to ISO 9577 [7] between the GSS and the CIF. The message content is defined in table 25b.

Table 25a: PACKET DATA TRANSFER (PD1) message

Message type:	PACKET DATA TRANSFER (PD1)
Significance:	dual
Direction:	both

Table 25b: PACKET DATA TRANSFER (PD1) message contents

Information element	Reference subclause	Direction	Type	Length
Message type	9.6.2	both	MF	1
Data information	9.7.3	both	MV	2 - 241

9.6.2.3 Packet data transfer (PD2)

This message is used to transfer user packet data carrying an IPI conforming to table 12 between the GSS and the CIF. The message content is defined in table 26b.

Table 26a: PACKET DATA TRANSFER (PD2) message

Message type:	PACKET DATA TRANSFER (PD2)
Significance:	dual
Direction:	both

Table 26b: PACKET DATA TRANSFER (PD2) message contents

Information element	Reference subclause	Direction	Type	Length
Message type	10.11.8.3 in ETS 300 326-2 [2]	both	MF	1
Data information		both	MV	2 - 241

9.6.2.4 Connect

Table 27a: CONNECT message

Message type:	CONNECT
Significance:	dual
Direction:	both

Table 27b: CONNECT message contents

Information element	Reference subclause	Direction	Type	Length
Message type	9.6.2	both	MF	1
DTM-Cause	9.7.2	both	MF	1

9.6.2.5 Disconnect

Table 28a: DISCONNECT message

Message type:	DISCONNECT
Significance:	dual
Direction:	both

Table 28b: DISCONNECT message contents

Information element	Reference subclause	Direction	Type	Length
Message type	9.6.2	both	MF	1
DTM-Cause	9.7.2	Both	MF	1

9.7 General message format and information elements coding

The information elements for DTM are identified in table 29.

Table 29: DTM information elements

8	7	6	5	4	3	2	1	Type 3 and 4 information elements	Reference subclause	Length in octets
0	0	0	0	0	0	1	0	DTM cause	9.7.2	F2
0	0	0	0	1	1	0	1	CIF indicator	9.7.1	F2
1	0	0	0	0	0	0	0	Data information	9.7.3	3 - 242

9.7.1 CIF indicator

The CIF Indicator is used to identify the CIF to which the data is directed such that the ground equipment can determine where to route the information contained in the signalling message carried on the air interface. The Service Provider Indicator information element is coded as shown in figure 22 and table 30.

8	10	6	5	4	3	2	1	
0	0	0	0	1	1	0	1	Octet 1
	CIF indicator IEI							
CIF indicator								Octet 2

Figure 22: CIF indicator information element

Table 30: CIF indicator information element (octet 2)

8	7	6	5	4	3	2	1	CIF indicator
0	0	0	0	0	0	0	0	"CIF not specified"
NOTE: The allocation of other values is outside the scope of this ETS								

9.7.2 DTM cause

The cause information element shall describe the reason for generating a "DISCONNECT" message.

The DTM cause information element is coded as shown in figure 23 and table 31.

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	1	0	Octet 1
	DTM cause							
DTM cause								Octet 2

Figure 23: DTM cause information element format

Table 31: DTM cause information element coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	normal clearing (AT-DTM request)
0	0	0	0	0	0	1	0	normal clearing (CIF-DTM request)
0	0	0	0	0	0	1	1	normal clearing (GSS request)
0	0	0	0	0	1	0	0	AT not authorized
0	0	0	0	0	1	0	1	unknown AT
0	0	0	0	0	1	1	0	AT-GSS temp link failure
0	0	0	0	0	1	1	1	no response from AT
0	0	0	0	1	0	0	0	invalid IE content
0	0	0	0	0	0	0	0	unspecified

9.7.3 Data information

The data information IE shall conform generally to the requirements of ETS 300 326-2 [2], subclause 10.11.8.5.2. The IE shall be coded as defined in figure 24.

8	7	6	5	4	3	2	1	
0	1	0	0	0	0	0	0	octet 1
packet data Information Element Identifier (IEI)								
length								octet 2
IPI								octet 3
packet data								octets 4 - 242

Figure 24: Data information encoding

9.8 List of system parameters

9.8.1 Timers for data transfer on the GSS side

Table 32: Timers for data transfer GSS side

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry
300	20	DTM Idle	X.25 Call request	X.25 Call connect	X.25 Clr request
345	60	X.25 incoming call	RR est resp	PD Transfer	review release VC

9.8.2 Timers for data transfer on the CIF side

Table 33: Timers for data transfer CIF side

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry
300	20	DTM IDLE	X.25 call req	X.25 call conn	X.25 clr req
345	60	X.25 incoming call	RR est resp	PD Transfer	review release VC

9.9 Definition of primitive parameters

The additional primitives required for the DTM service are listed in table 34.

Table 34: Primitives required for DTM service

Generic name and type	Appearance	Parameters
DTM-DATA-REQ	Both	A request to send DATA to the peer entity
DTM-DATA-IND	Both	An indication that DATA has been received from the peer entity.
DTM-DATA-RESP	Both	A response to the receipt of a DTM-Data-Cnf from the CIF side of the GSS DTM.
DTM-DATA-CNF	Both	A confirmation that DATA has been sent to the peer. If the parameter "error" is present, it shall indicate that the peer entity is unable to accept DATA.
DTM-RELEASE-REQ		A request to release resources from packet data service.
DTM-RELEASE-RESP	GSS	Response acknowledging receipt of DTM-REL-IND on air interface data link failure.
DTM-RELEASE-CNF	Both	Confirmation that resources have been released.
DTM-RELEASE-IND	Both	An indication that DATA TRANSFER is no longer available with the peer entity.

Annex A (informative): Information on expected usage of data service

This information is provided for background only and does not form part of the requirements of the specification.

A.1 Status update information

Status update information services will normally be originated by aircraft equipment reporting BITE or status changes to the relevant SP application network (i.e. the predominant information flow is in the air to ground direction). Information messages will be generally short (less than 256 bytes) and will not result in a response from the SP except in cases where an acknowledgement is required. In such cases, response times are not critical although, if required, a response should be transmitted without loss of connection between the aircraft and the SP application network. Status updates may be regular while the aircraft is in flight and within TFTS coverage with typical message intervals of 5 - 15 minutes.

A.2 File transfer

File transfers will be initiated from either aircraft or SP applications. They result in a highly asymmetric data flow with blocks of file data being transferred in one direction and acknowledgements and control information travelling in the other. Such transfers will result in very "bursty" traffic requiring as much capacity as possible during the transfer. Typical files transferred will be between 20 000 and 1 million bytes in size. Although timing is not critical, this type of transfer is susceptible to transmission delays which result in application time-outs and retransmission of data blocks and thus inefficient use of the TFTS resource.

A.3 Information update

Information updates will be originated by the SP application network. This type of service is characterized by short messages (typical sizes between 1 000 and 20 000 bytes) and will require no response or a simple acknowledgement from the aircraft. Such messages will be irregular and will be targeted at specific aircraft.

A.4 Interactive services

Interactive application services will be initiated by aircraft and will result in a two-way message dialogue. Typical applications will consist of a short message (100 to 300 bytes in length) from the aircraft to the service provider application network, followed almost immediately by a response of similar length from the application, followed by a pause of 5 seconds to 1 minute. This series of events may then be repeated 2 or 3 times in order to complete an application service dialogue. Response times from the service provider application network are critical in determining acceptability of an application and must not be more than 15s.

Annex B (informative): Scenarios

Case	Details	Scenario No.
1	Transaction establishment, Aircraft Station (AS) originating, GSS-CIF not connected.	B.1
2	Transaction establishment. AT originating, GSS-CIF connected.	B.2
3	Transaction establishment. AT originating, GSS-CIF rejected.	B.3
4	Transaction establishment. CIF originating, GSS-CIF not connected.	B.4
5	Transaction establishment. CIF originating, GSS-CIF connected.	B.5
6	Transaction establishment. CIF originating, GSS-CIF connection unsuccessful.	B.6
7	Transaction established. Transfer AT to CIF.	B.7
8	Transaction established. Transfer CIF to AT.	B.8
9	Transaction release, AT originating. GSS-CIF connection maintained.	B.9
10	TRANSFER transaction release. AT originating. GSS-CIF connection released.	B.10
11	Transaction release. AT-GSS data link failure. GSS-CIF connection maintained.	B.11
12	Transaction release. AT-GSS data link failure. GSS-CIF connection released.	B.12
13	Transaction release. CIF originating.	B.13
14	Transaction release. GSS-CIF data link failure.	B.14
15	Transaction Established, Handover Requested Complete	B.15
16	Transaction Established, Handover Requested Rejected	B.16

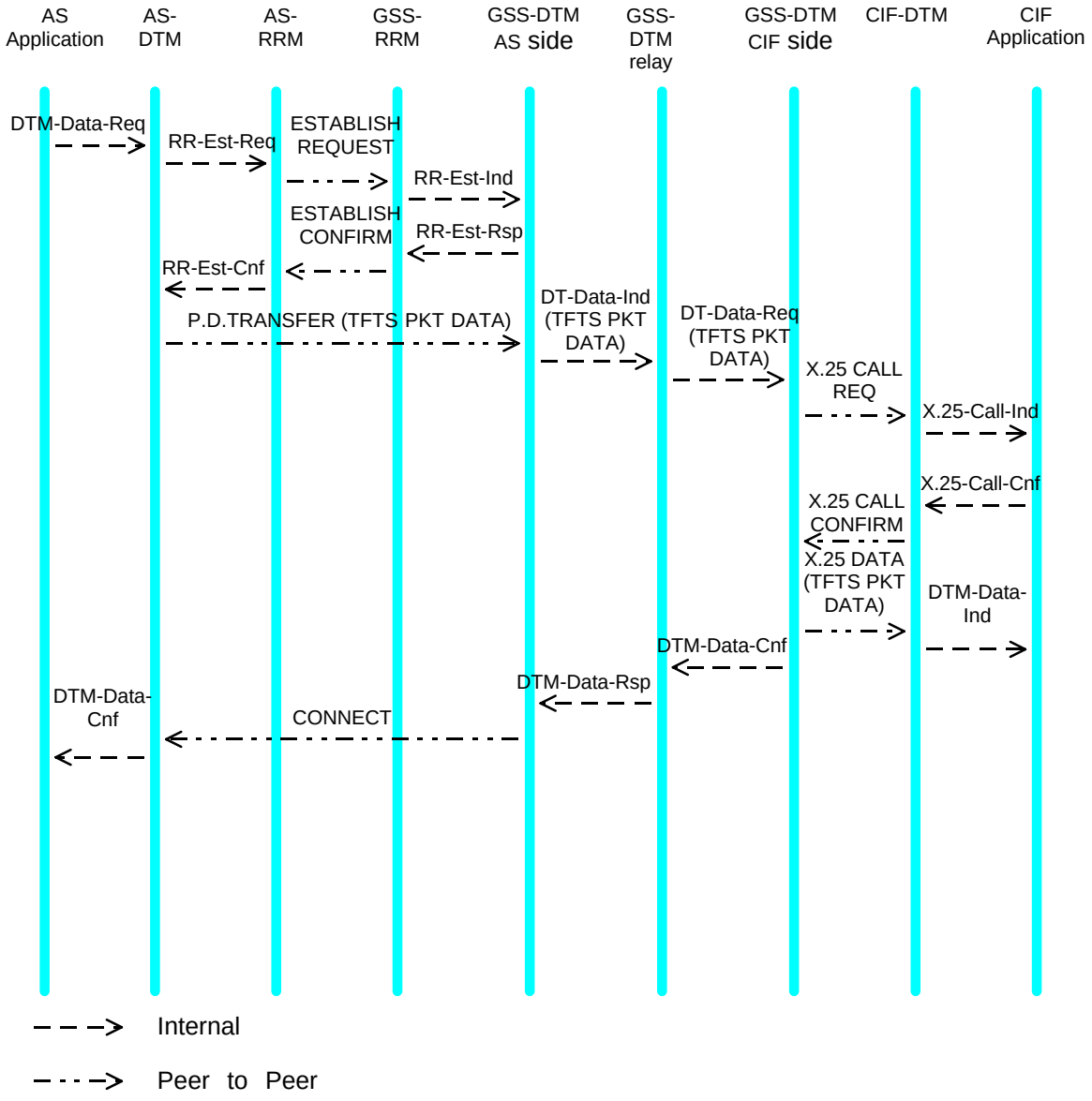

Figure B.1: Transaction establishment, AS originating, GSS-CIF not connected

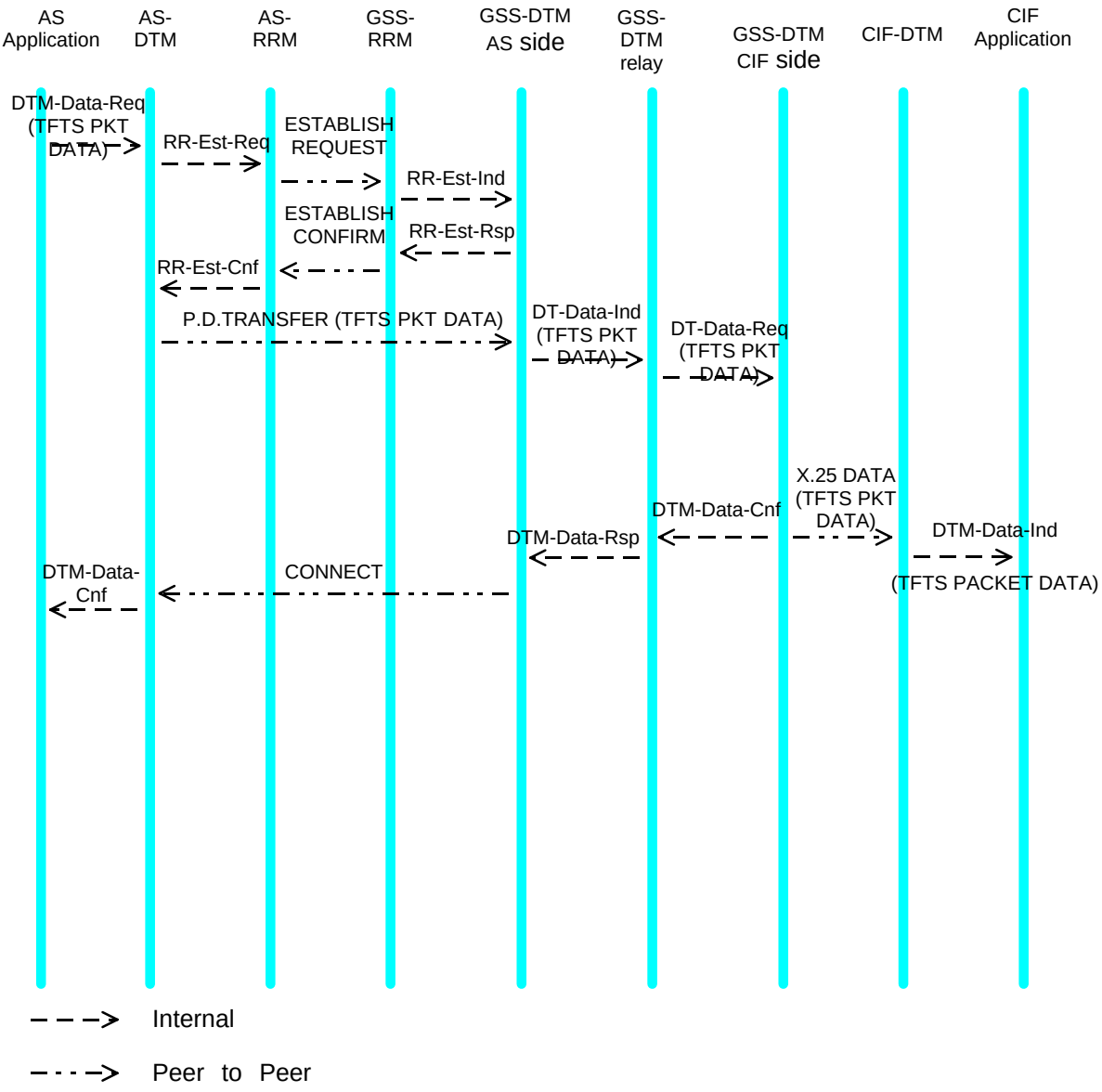

Figure B.2: Transaction establishment. AT originating, GSS-CIF connected

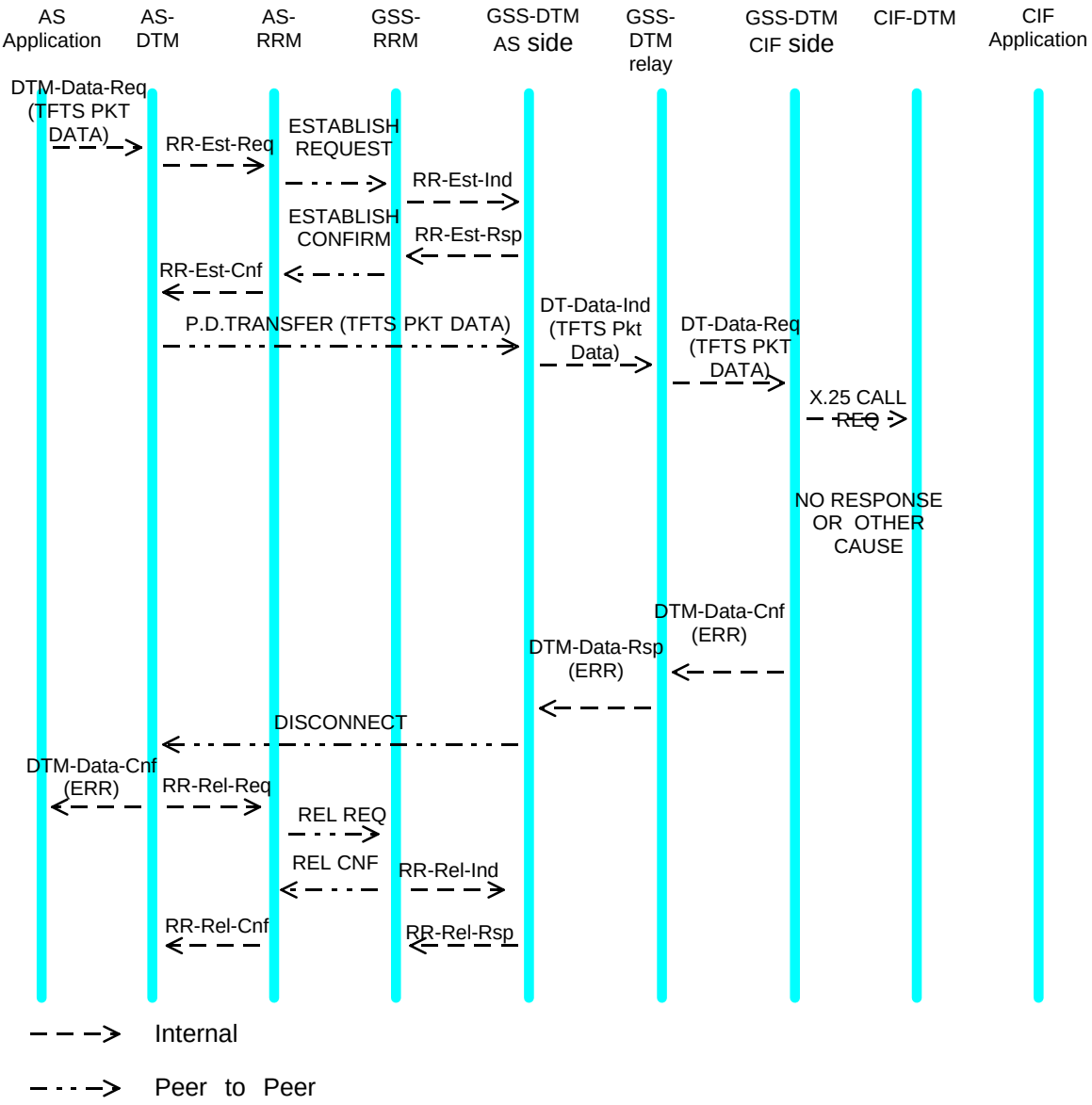

Figure B.3: Transaction establishment. AT originating, GSS-CIF rejected

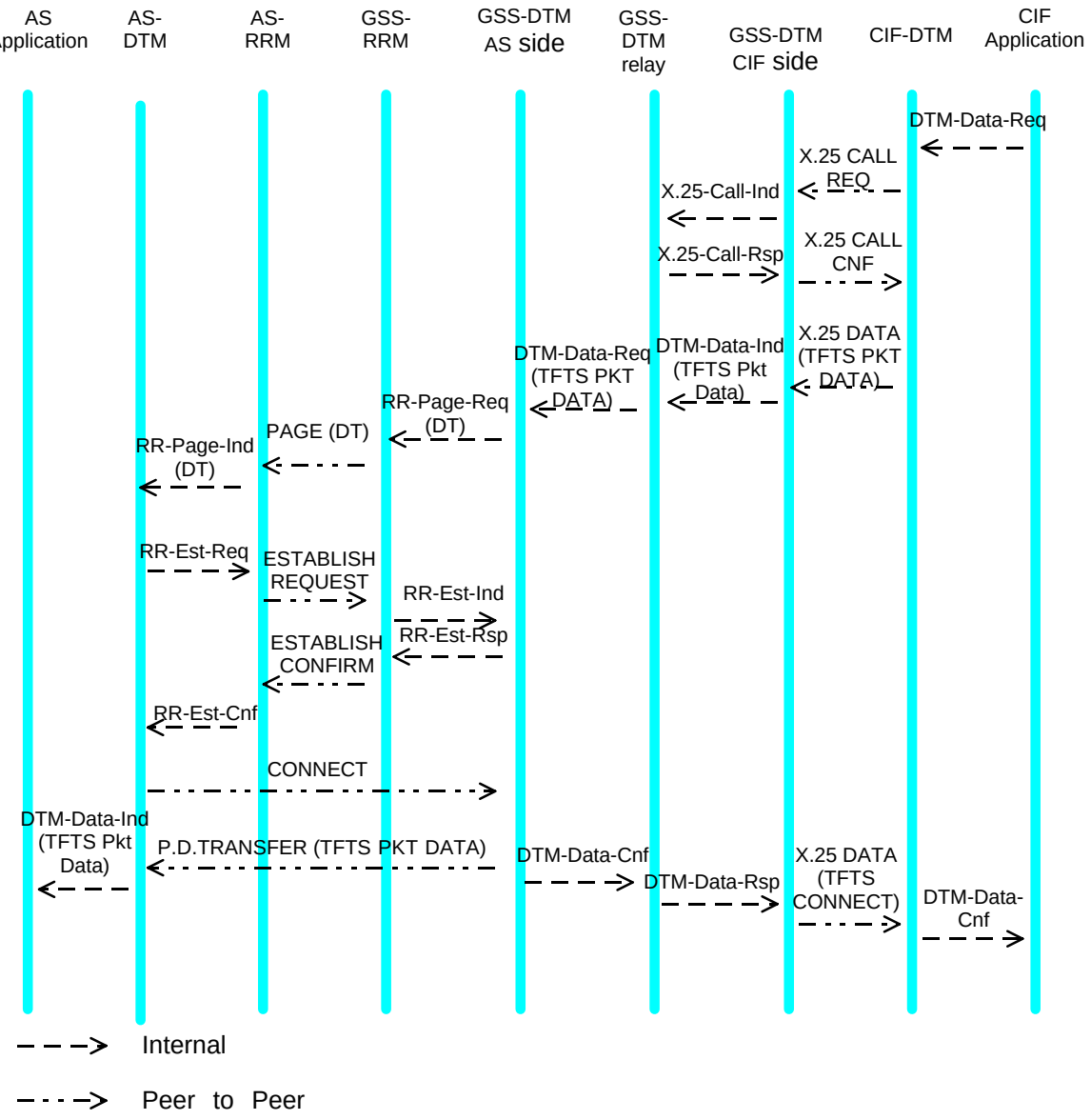

Figure B.4: Transaction establishment. CIF originating, GSS-CIF not connected

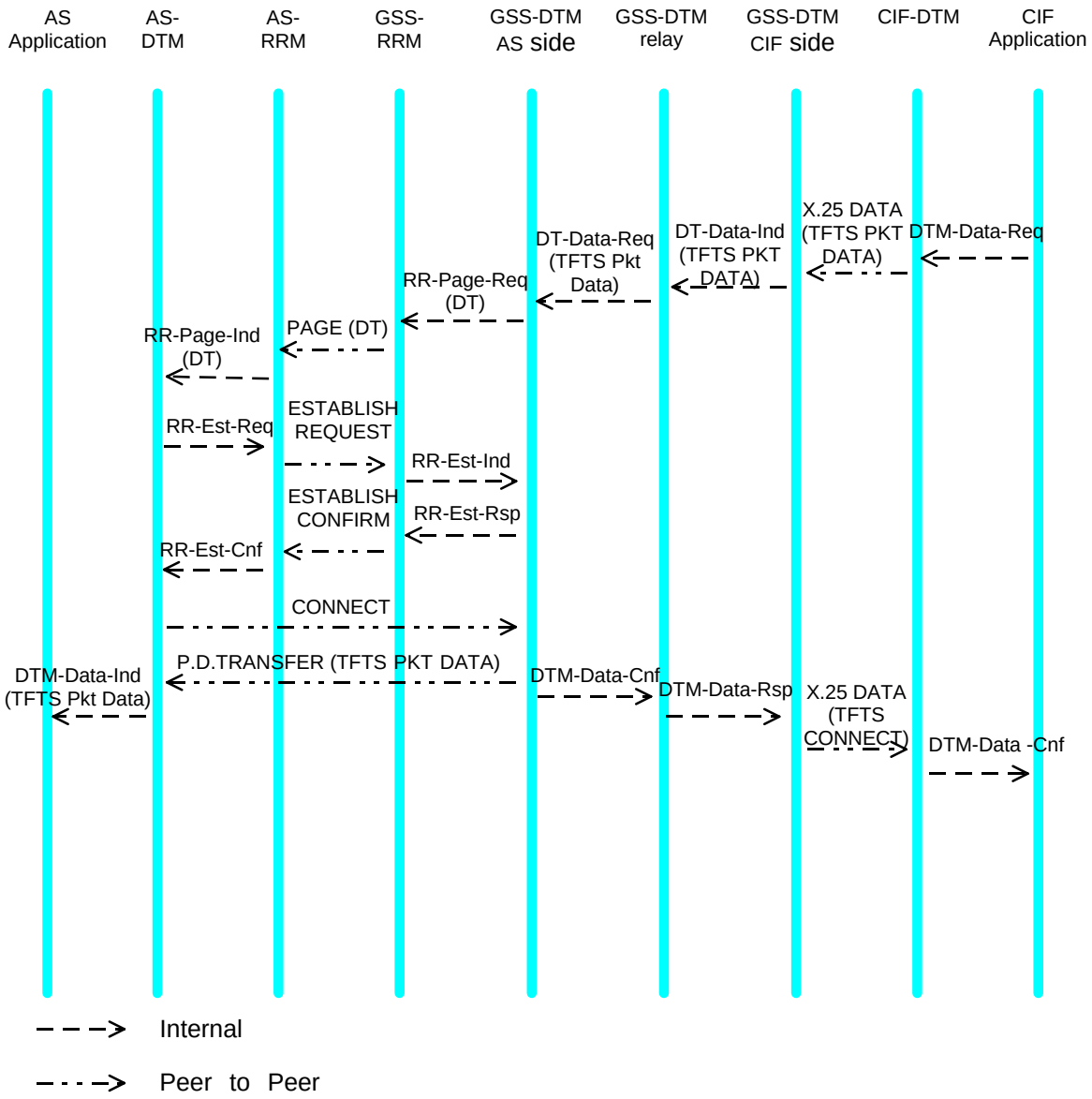

Figure B.5: Transaction establishment. CIF originating, GSS-CIF connected

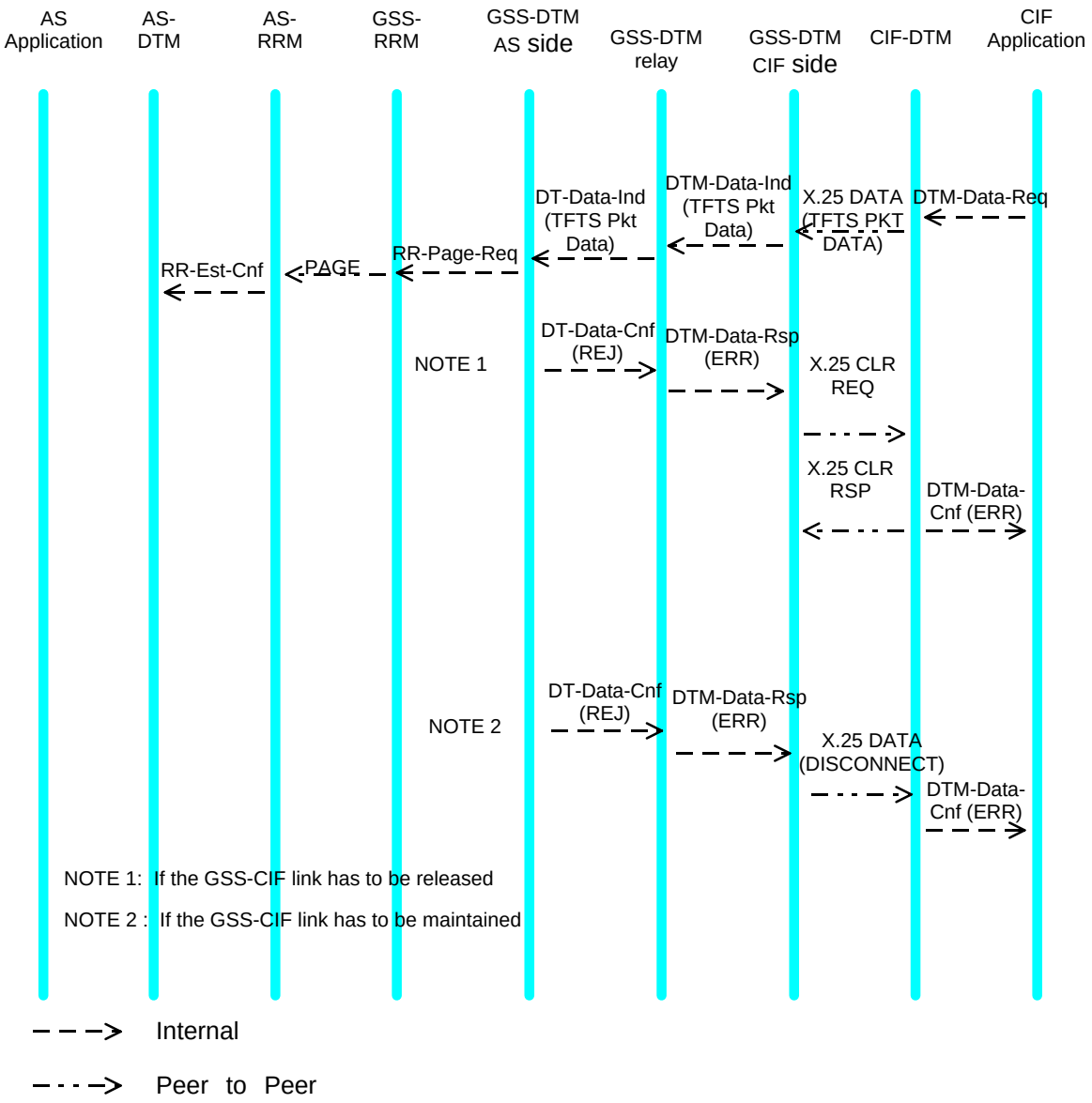

Figure B.6: Transaction establishment. CIF originating, GSS-CIF connection unsuccessful

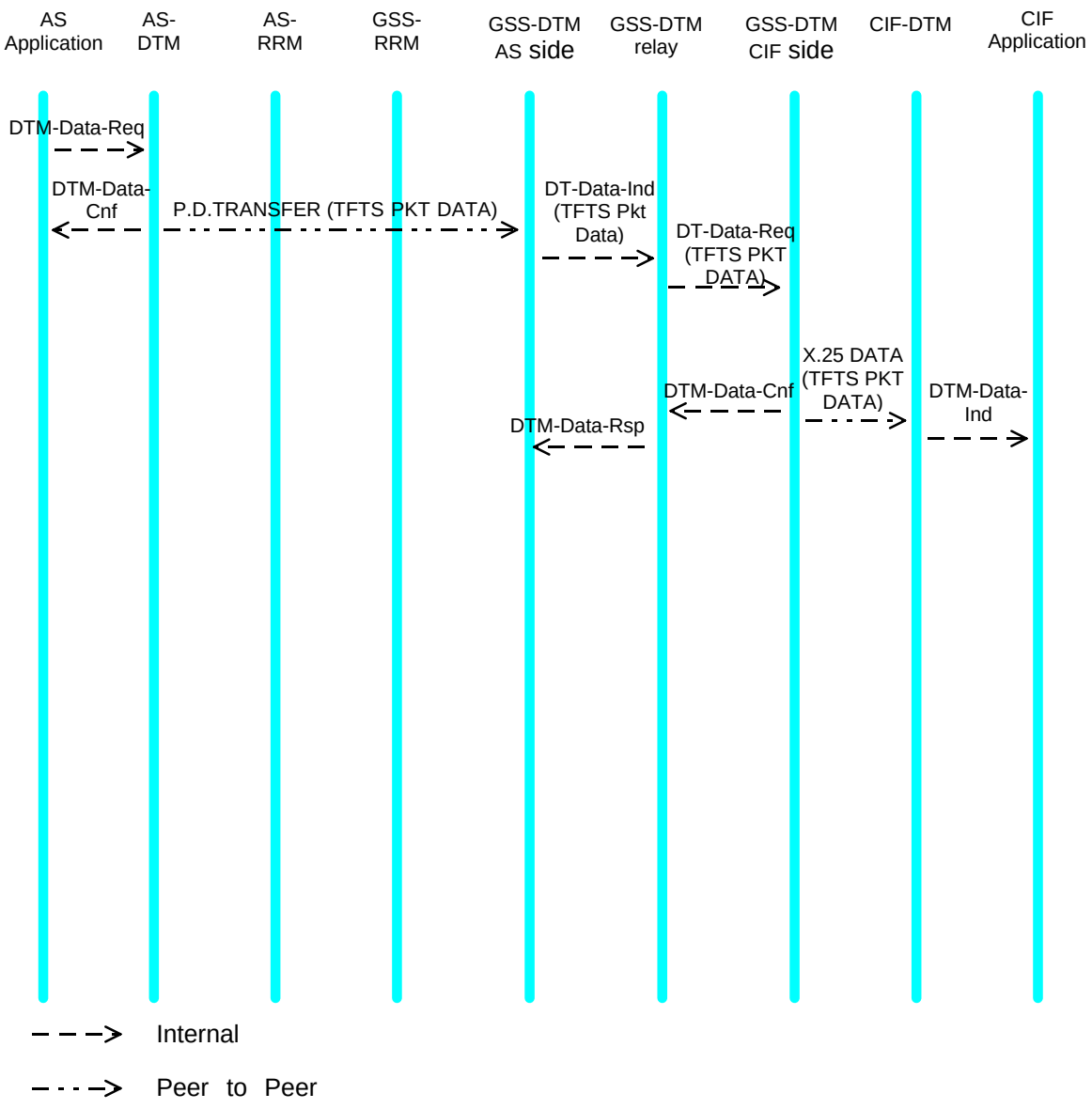

Figure B.7: Transaction established. Transfer AT to CIF

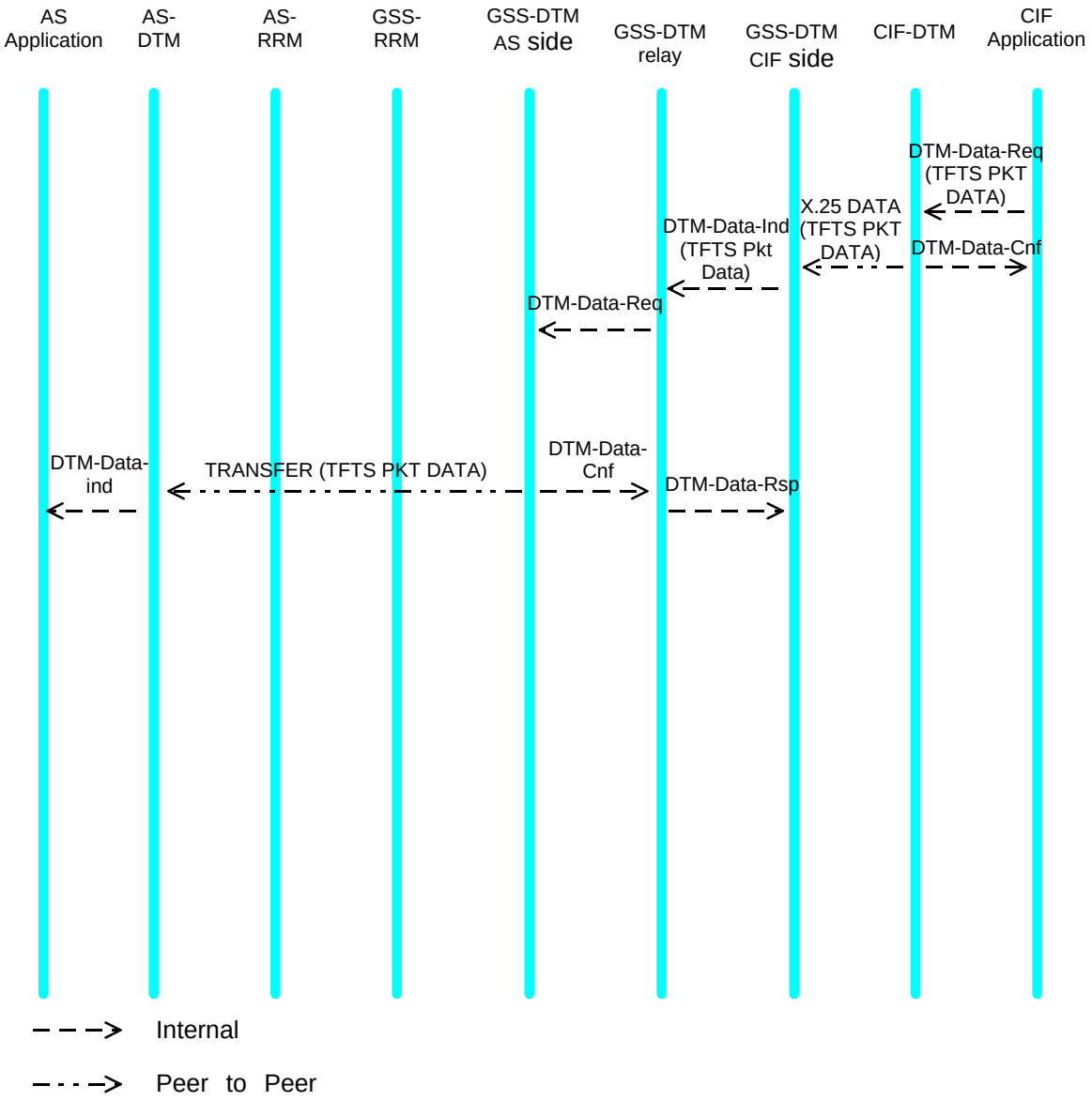

Figure B.8: Transaction established. Transfer CIF to AT

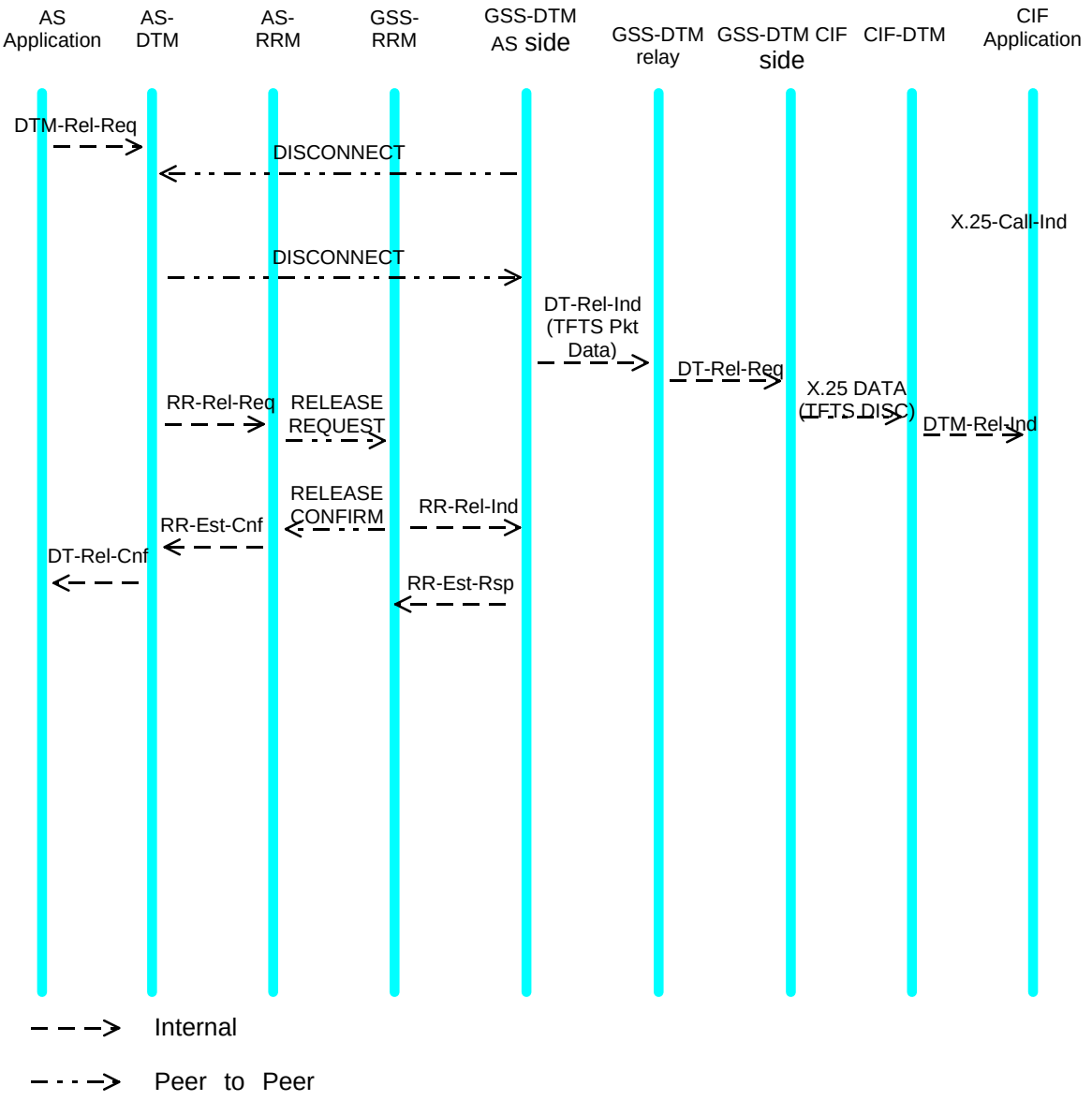

Figure B.9: Transaction release, AT originating. GSS-CIF connection maintained

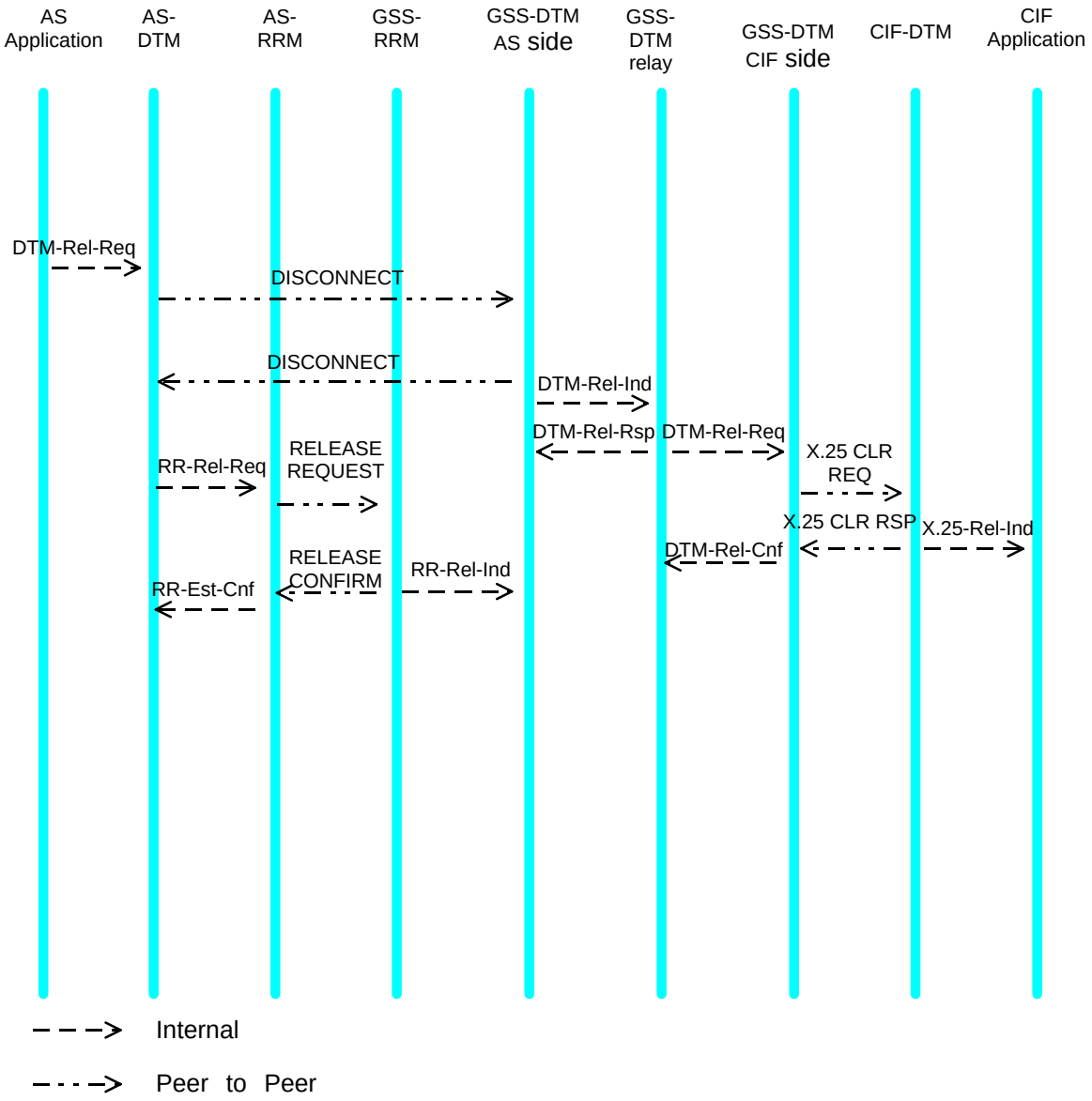

Figure B.10: TRANSFER transaction release. AT originating. GSS-CIF connection released

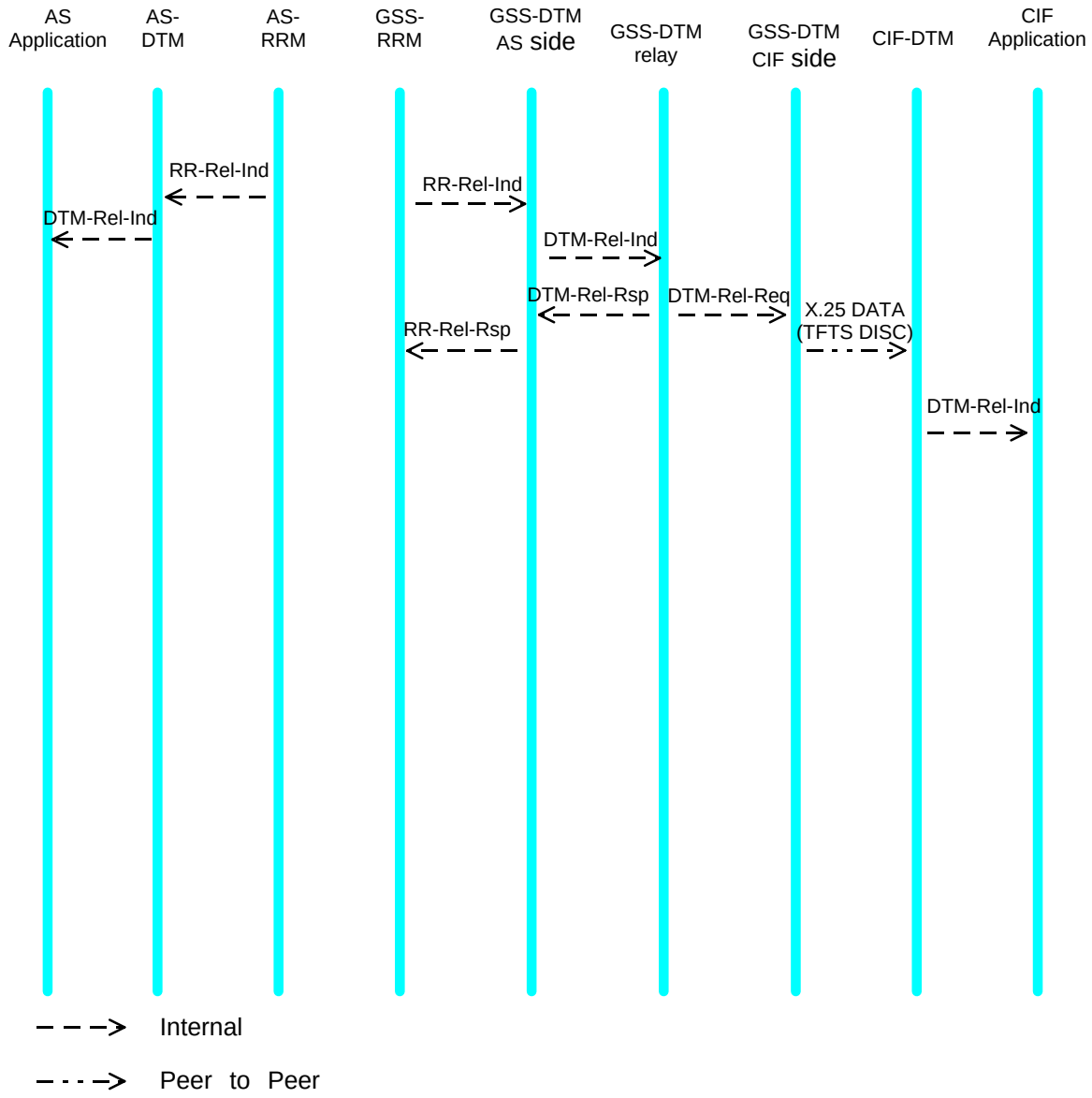

Figure B.11: Transaction release. AT-GSS data link failure. GSS-CIF connection maintained

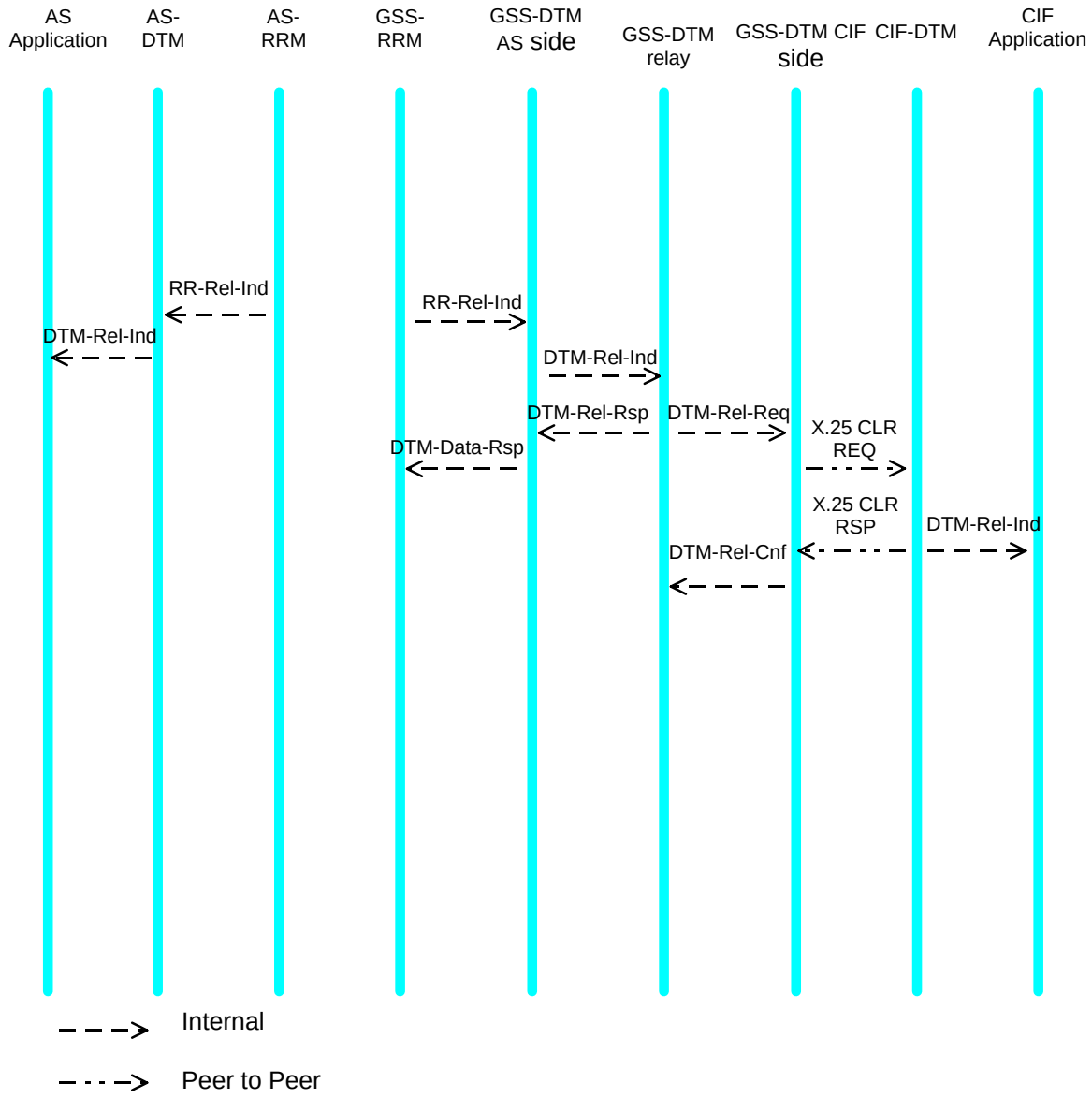

Figure B.12: Transaction release. AT-GSS data link failure. GSS-CIF connection released

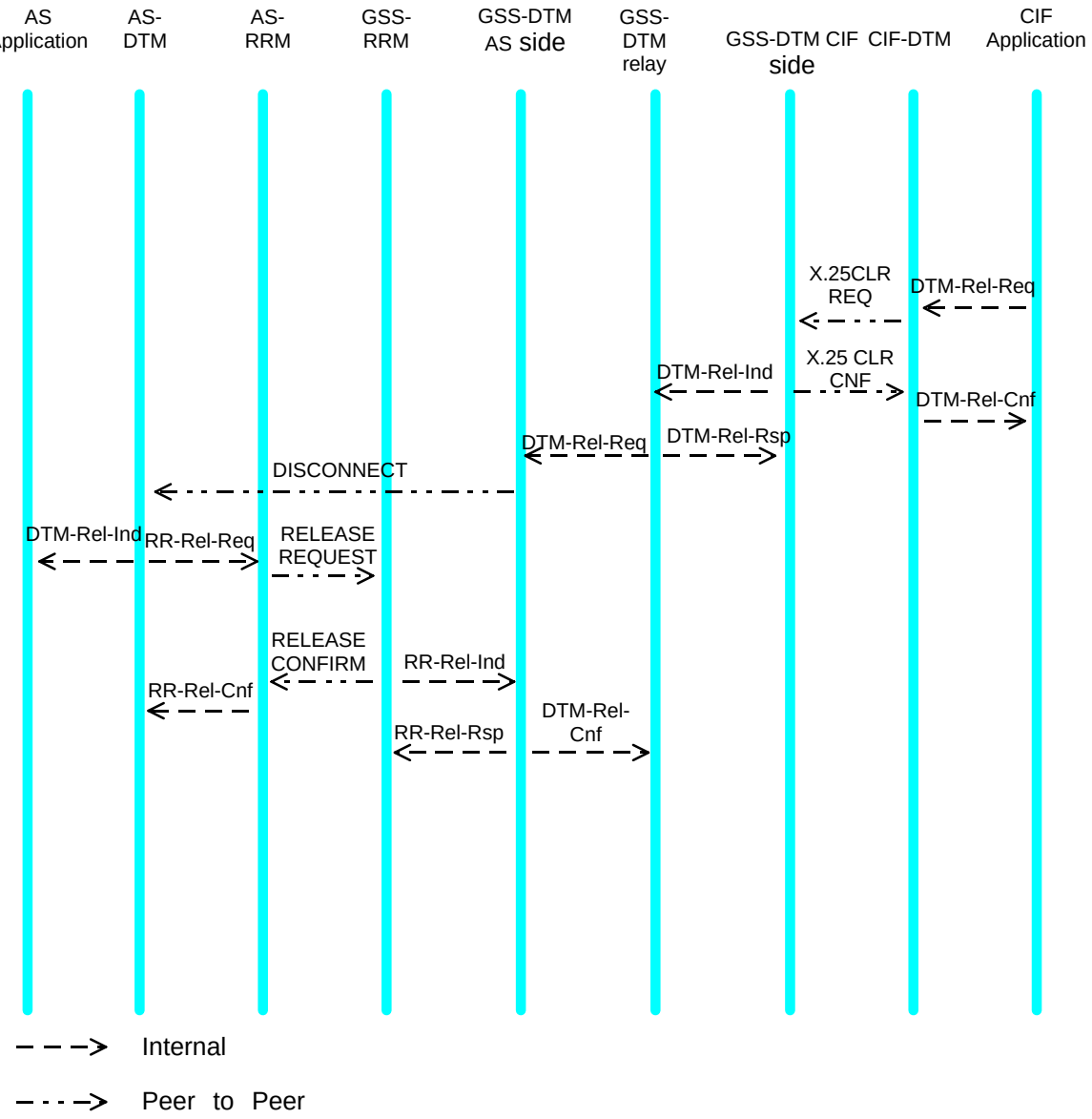

Figure B.13: Transaction release. CIF originating

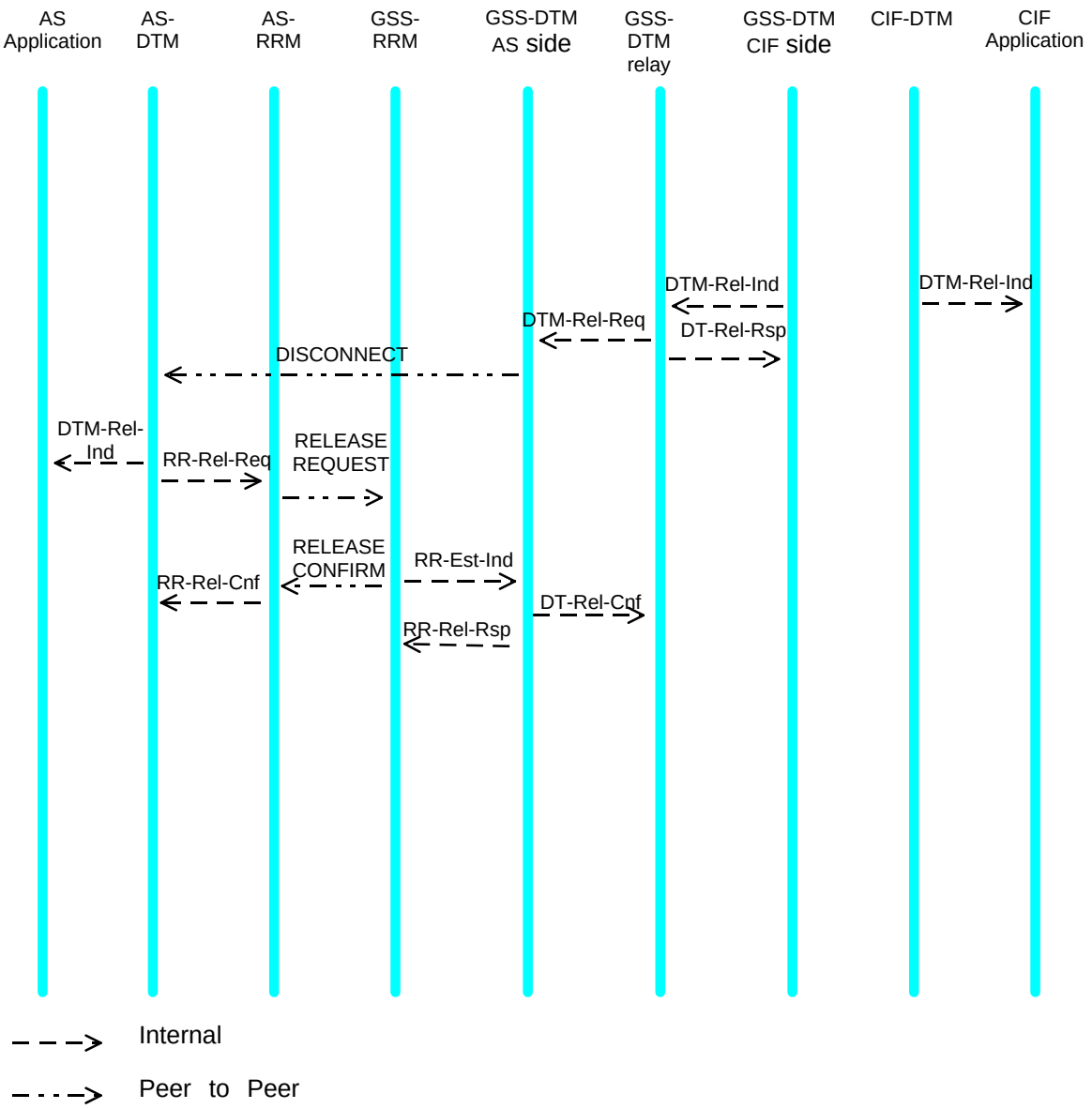

Figure B.14: Transaction release. GSS-CIF data link failure

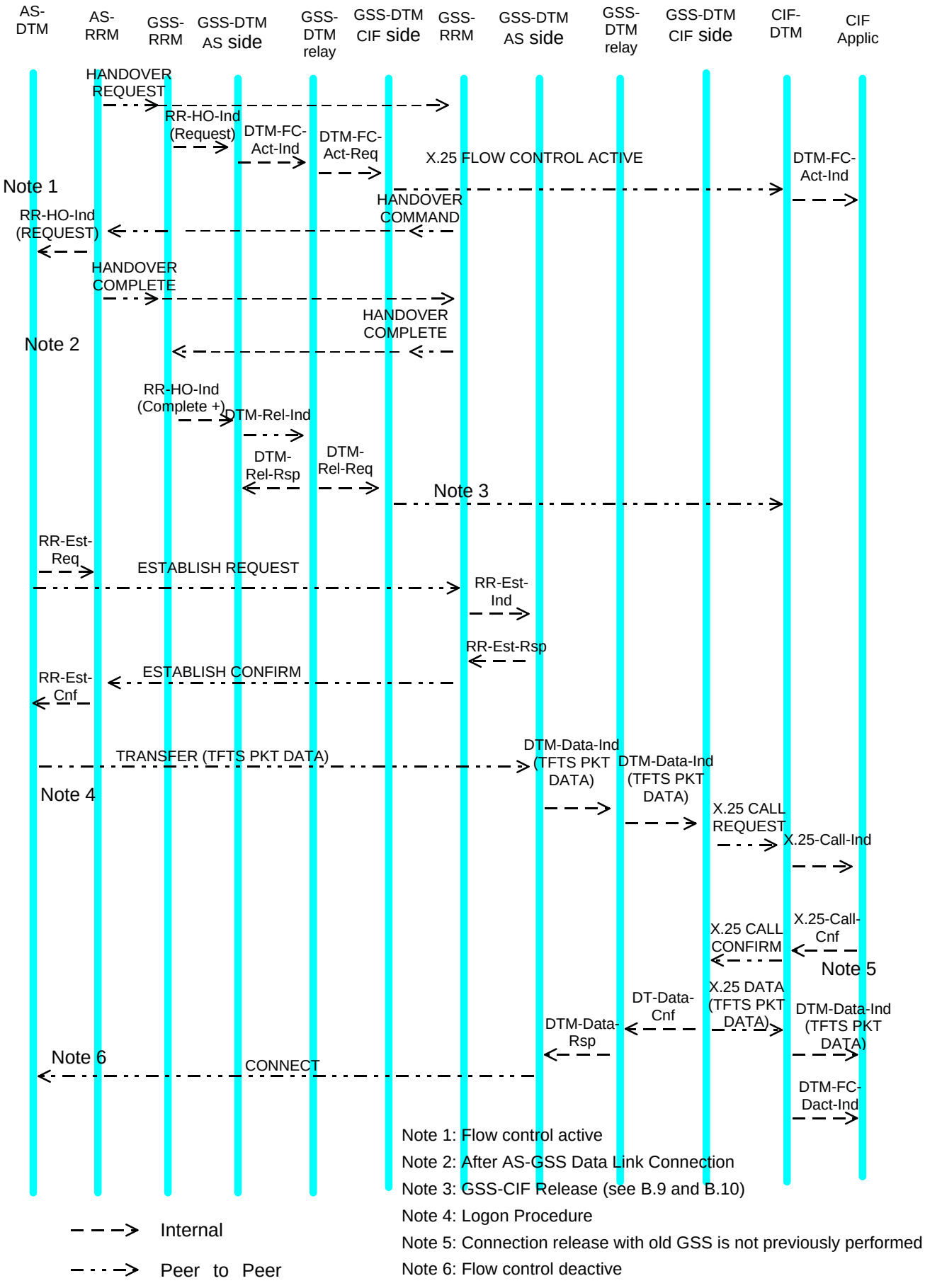

Figure B.15: Transaction established. Handover requested (Complete)

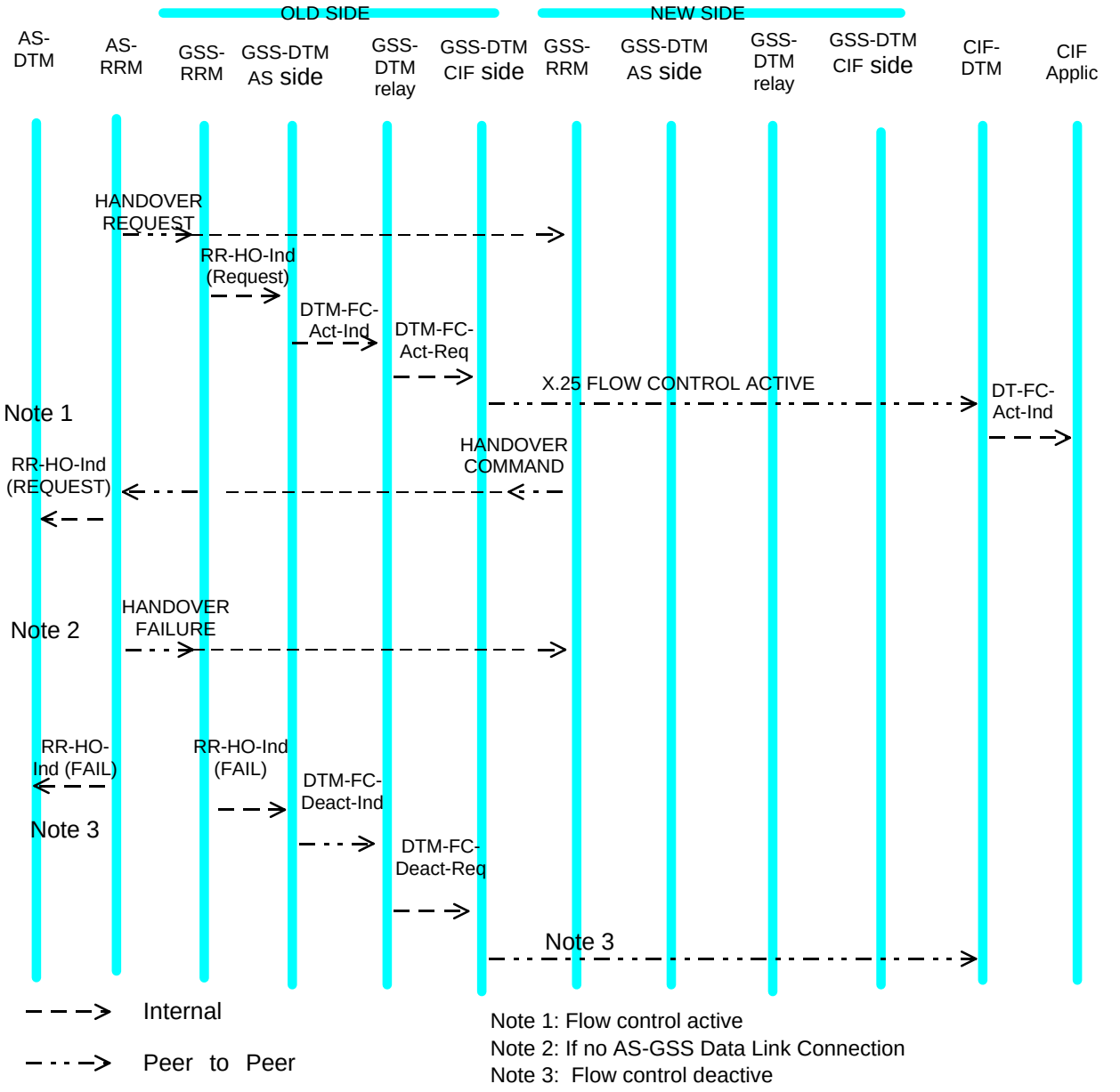

Figure B.16: Transaction established. Handover requested (Rejected)

Annex C (informative): SDL of TFTS layer 3 DTM processes

This annex contains SDL diagrams illustrating the DTM (Data Transmission Management) protocols between the AS: GSS and the GSS: CIF. In addition, the RRM protocols for the AS and GSS are shown in order to clarify the impact of the packet service upon the RRM protocols defined in ETS 300 326-2 [2]. Figure 1 shows the structure of the protocols and assigns the labels to be found on the top left hand corner of each of the following pages.

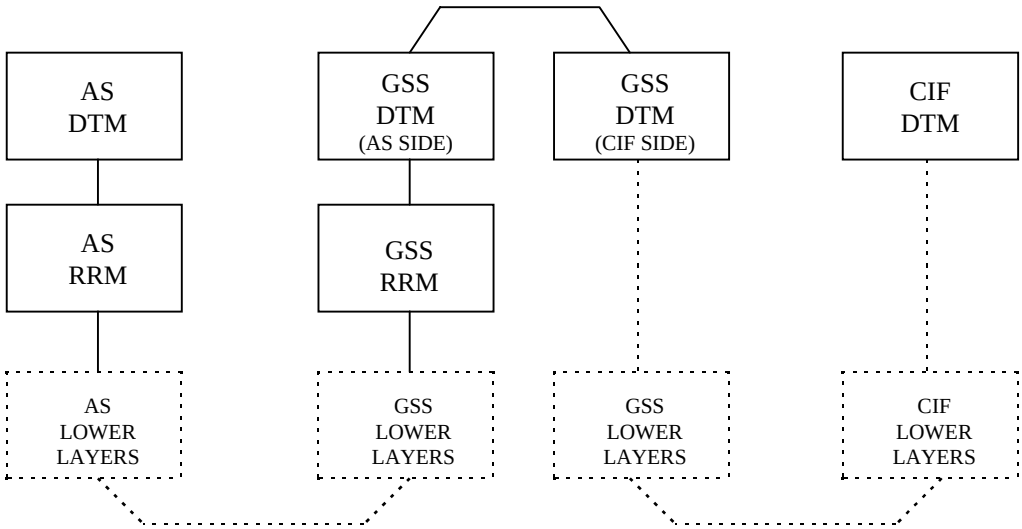

Figure C.1 Structure of SDL diagrams

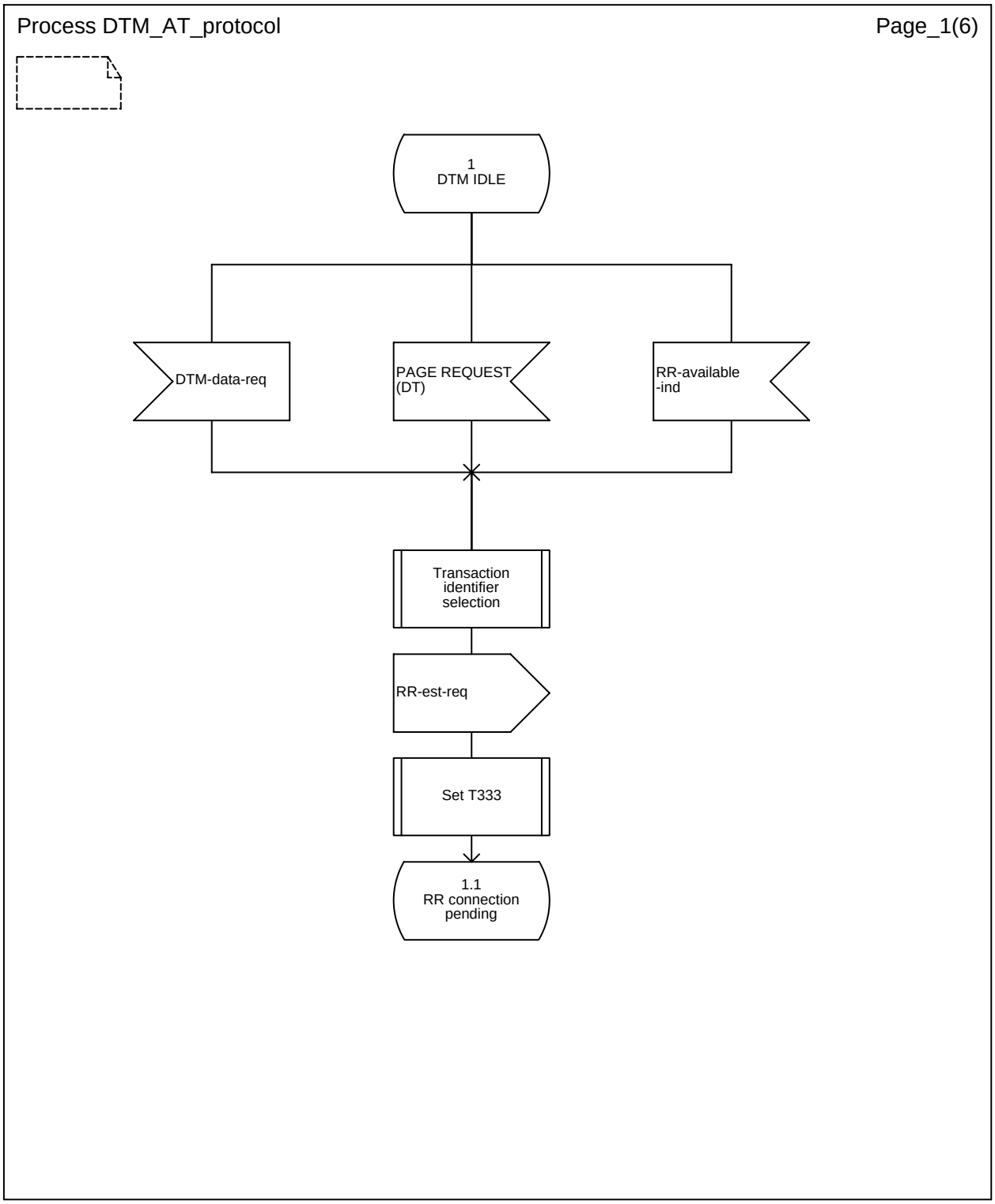

Figure C.2: (sheet 1 of 6) DTM AT protocol

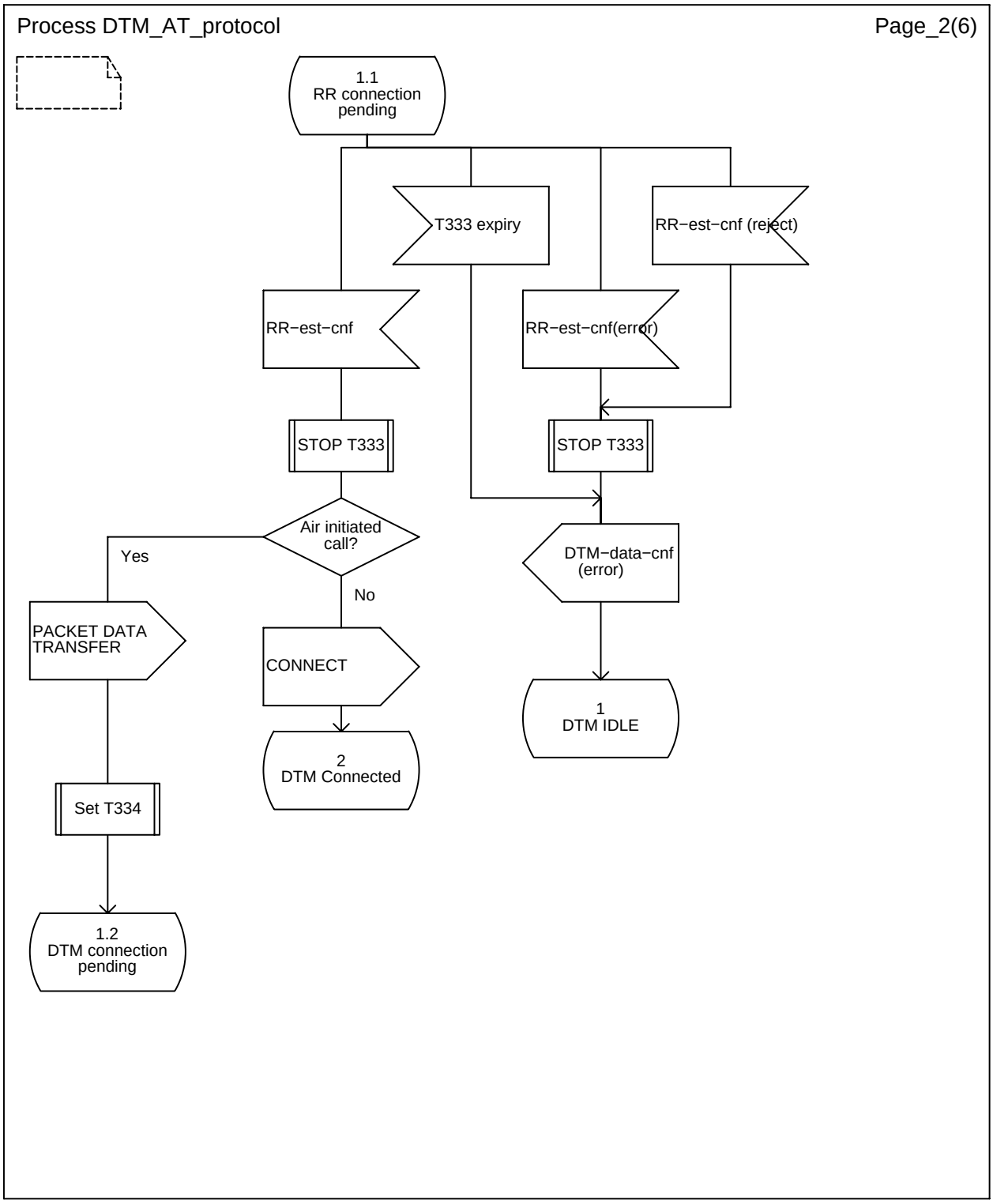

Figure C.2: (sheet 2 of 6) DTM AT protocol

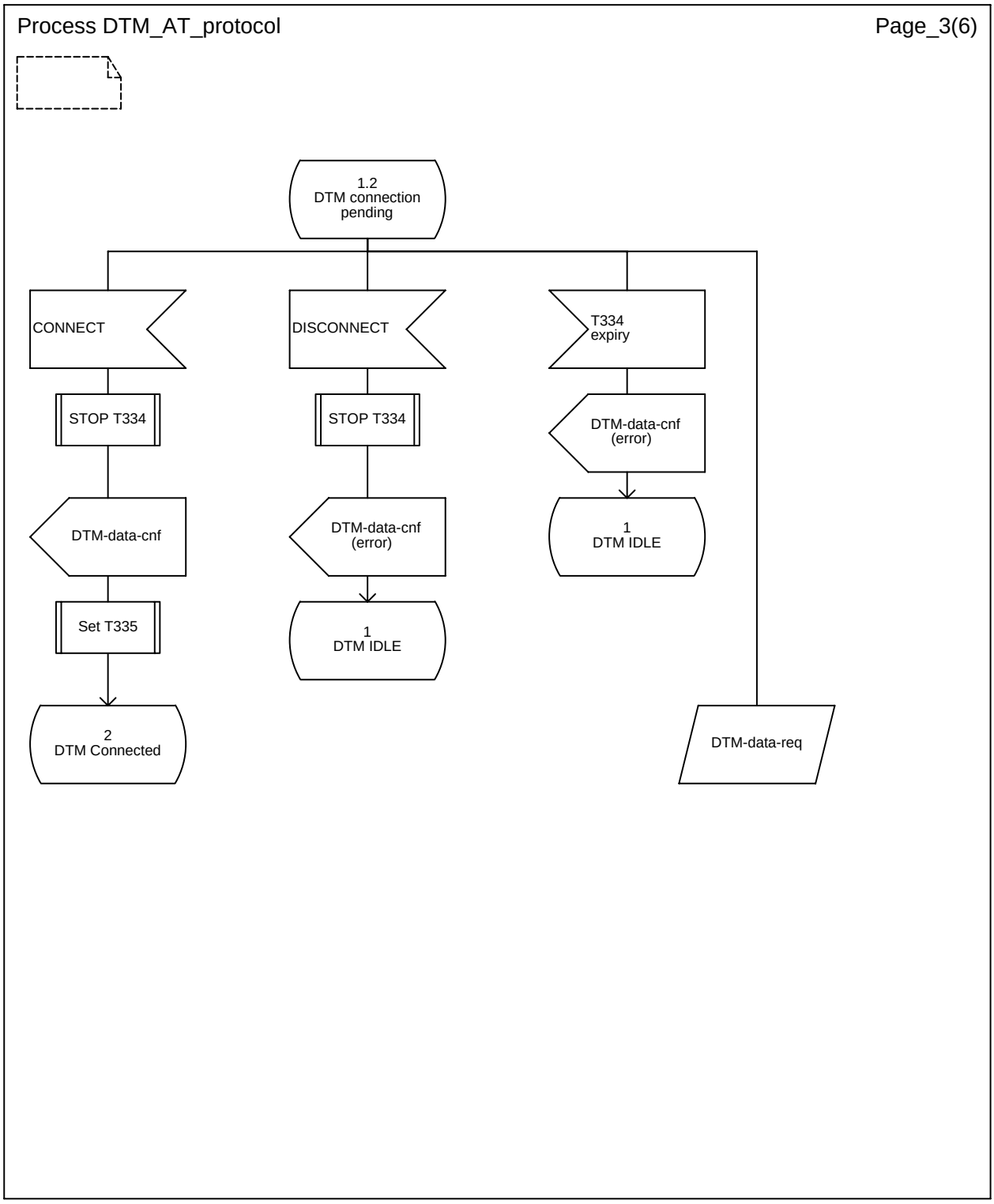

Figure C.2: (sheet 3 of 6) DTM AT protocol

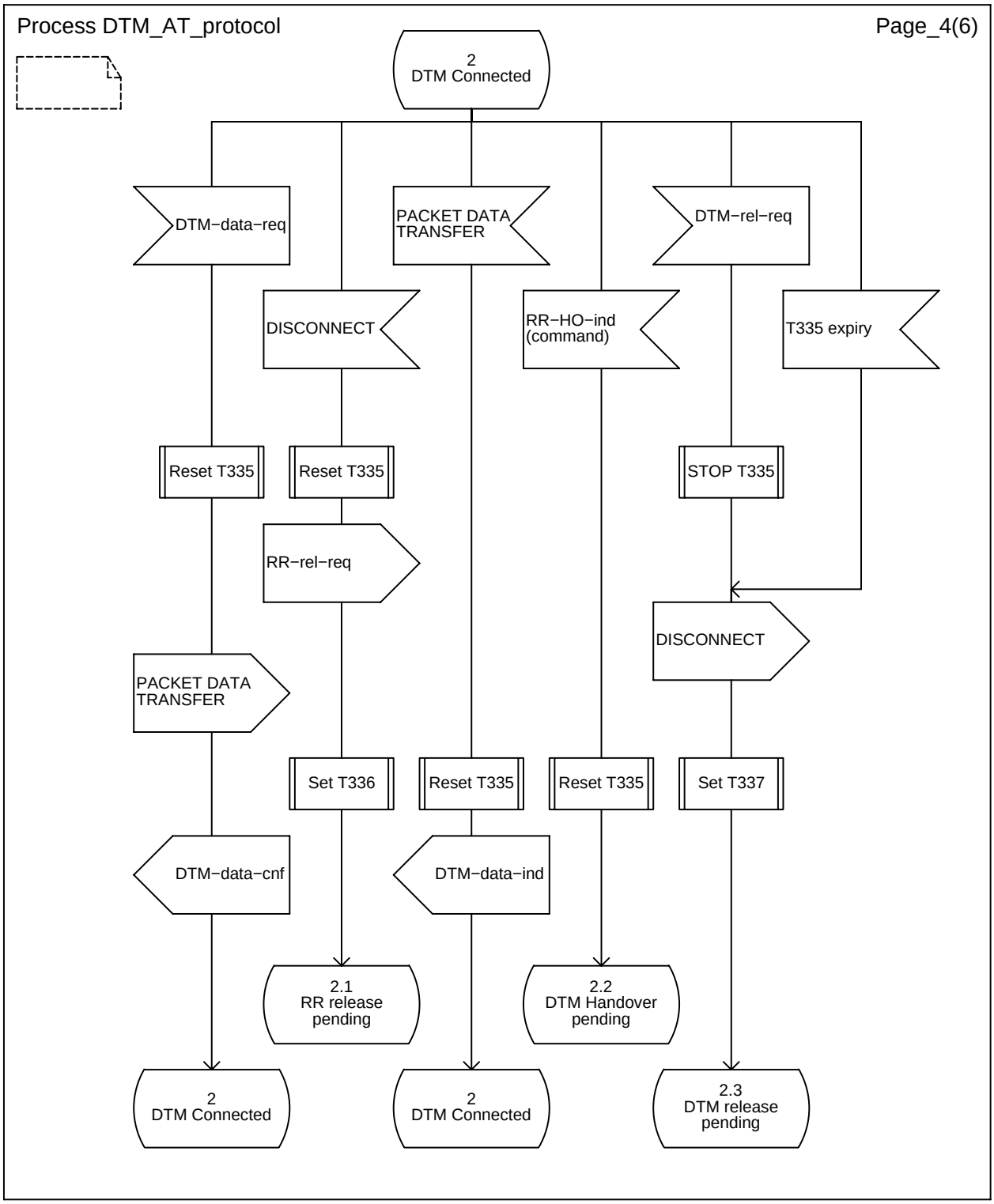

Figure C.2: (sheet 4 of 6) DTM AT protocol

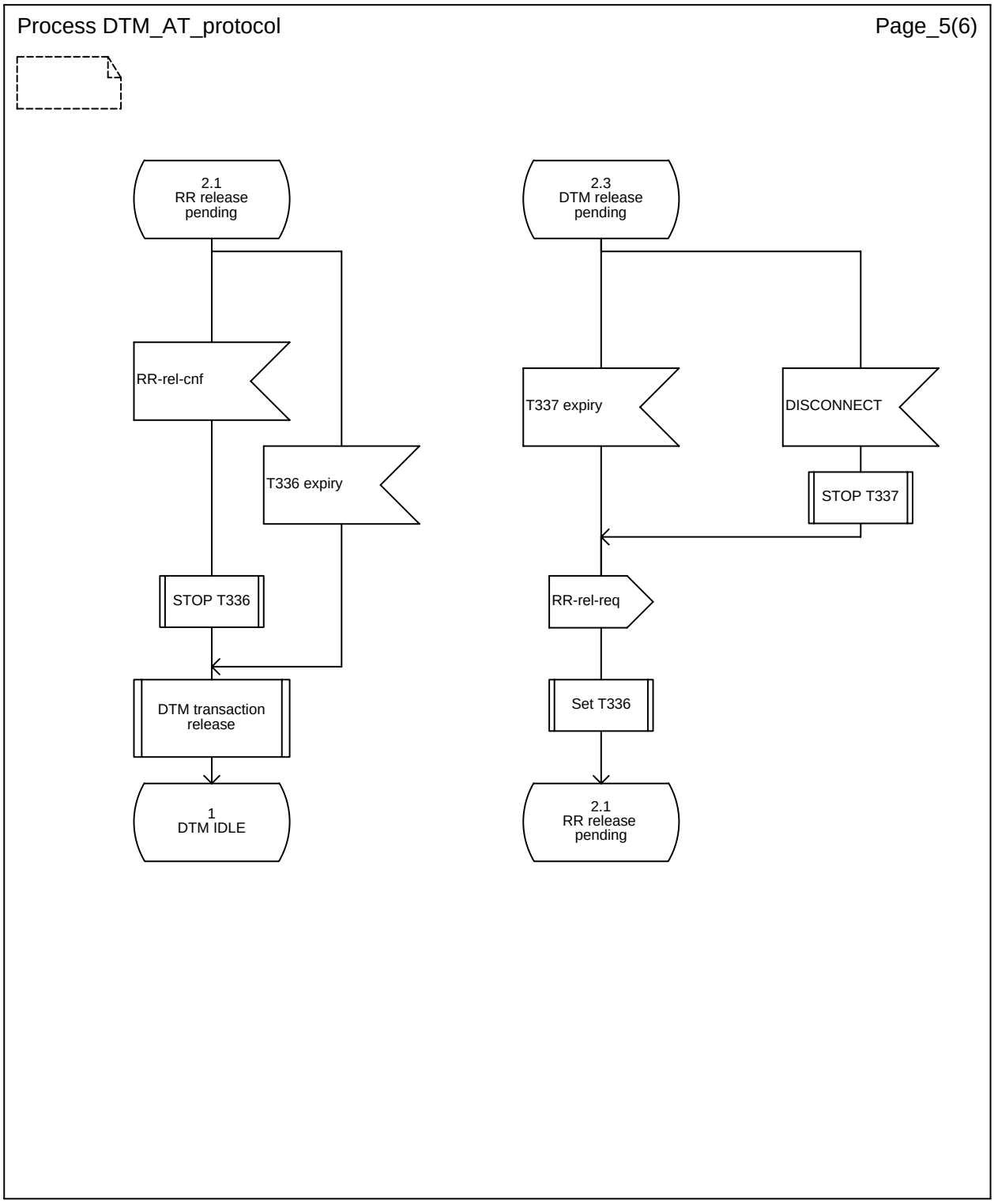

Figure C.2: (sheet 5 of 6) DTM AT protocol

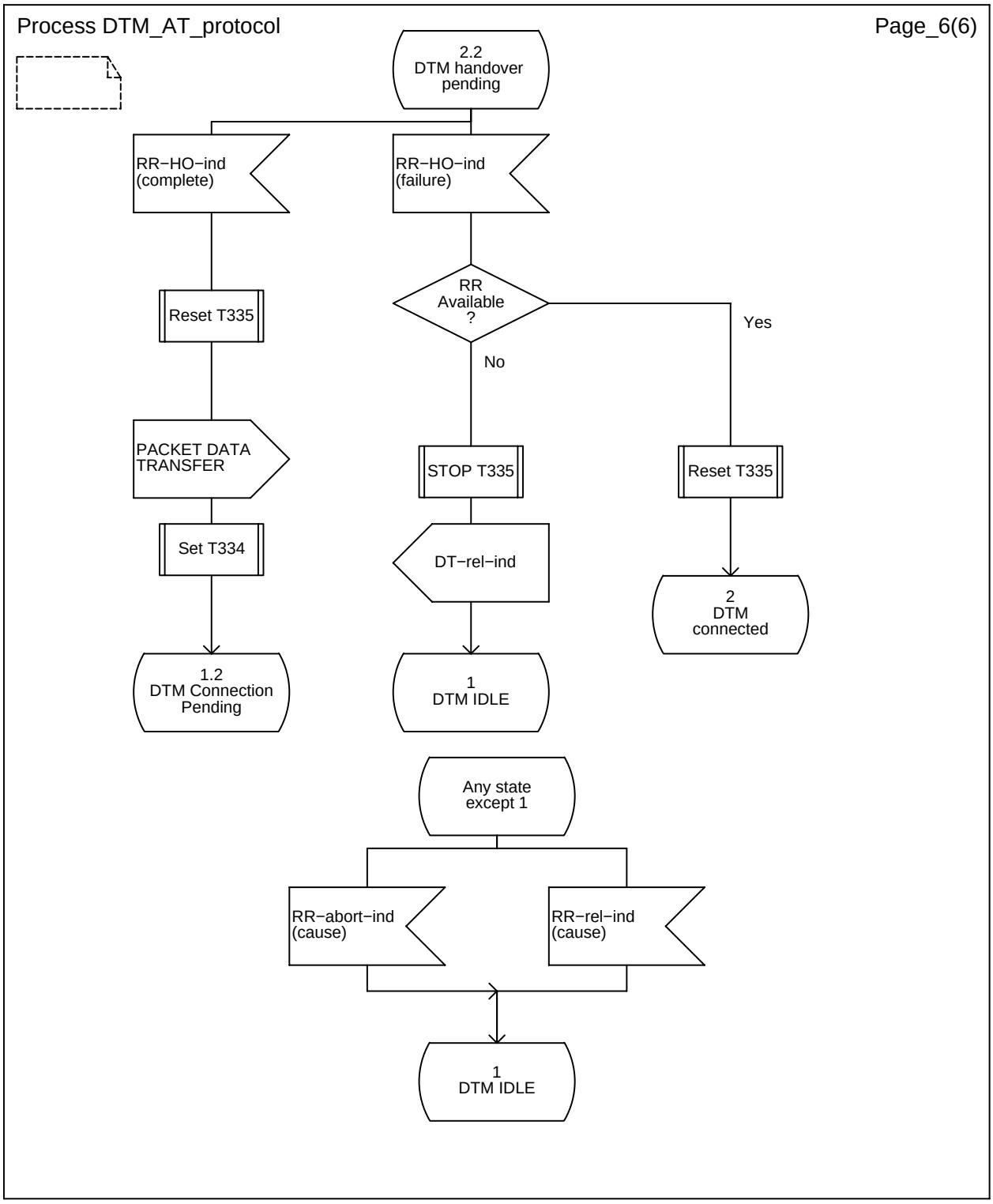

Figure C.2: (sheet 6 of 6) DTM AT protocol

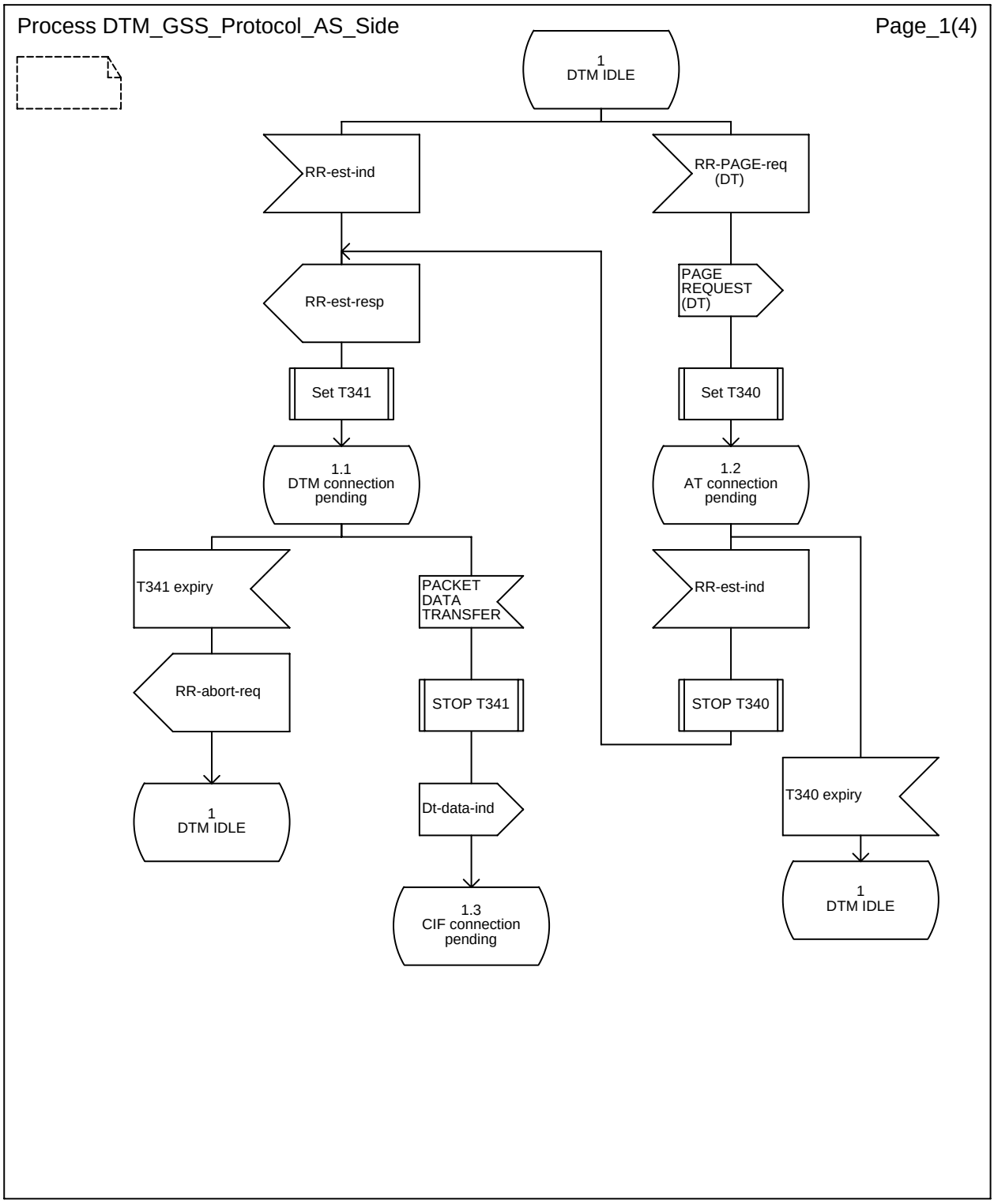

Figure C.3: (sheet 1 of 4) DTM GSS protocol - AS side

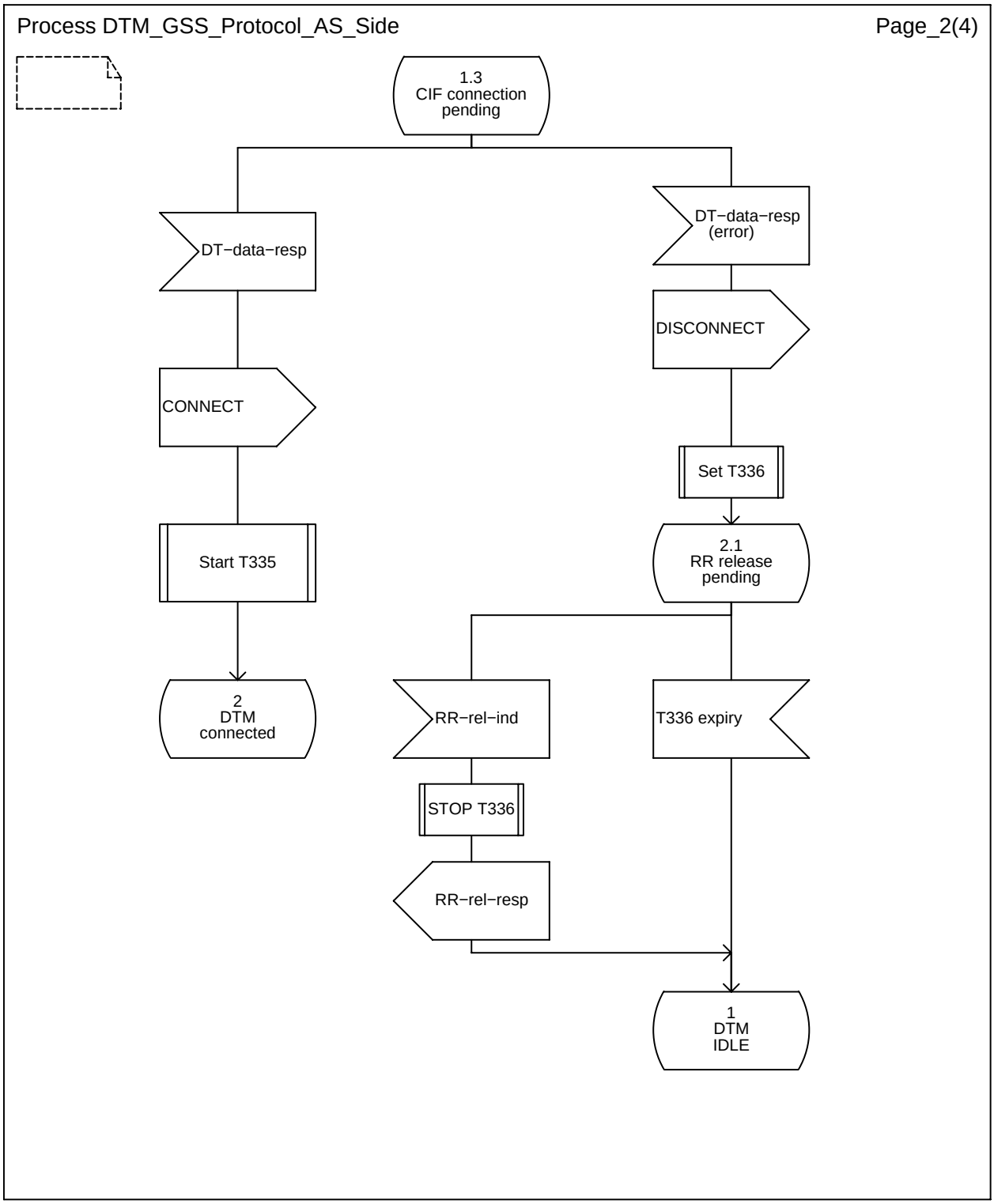

Figure C.3: (sheet 2 of 4) DTM GSS protocol - AS side

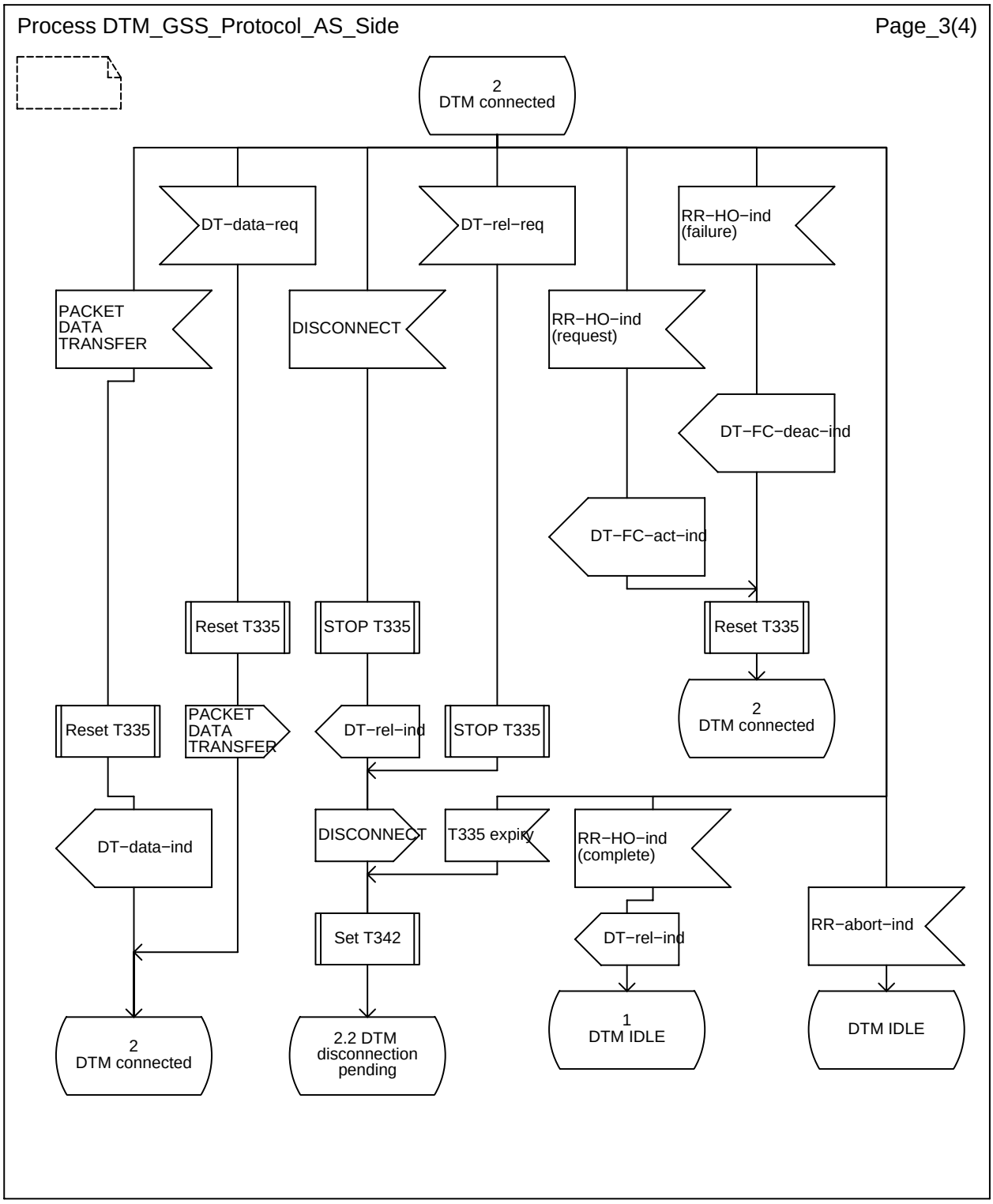

Figure C.3: (sheet 3 of 4) DTM GSS protocol - AS side

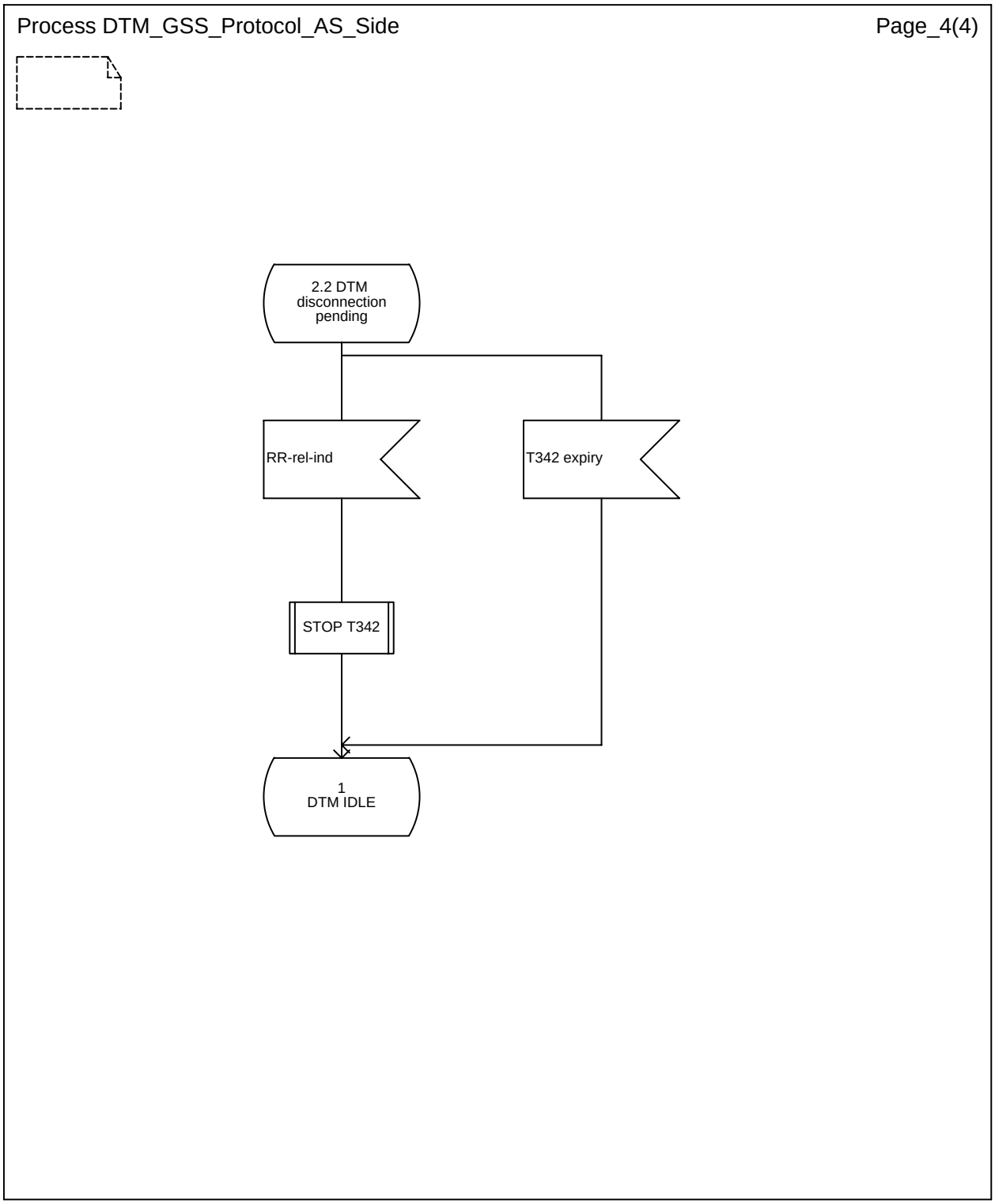

Figure C.3: (sheet 4 of 4) DTM GSS protocol - AS side

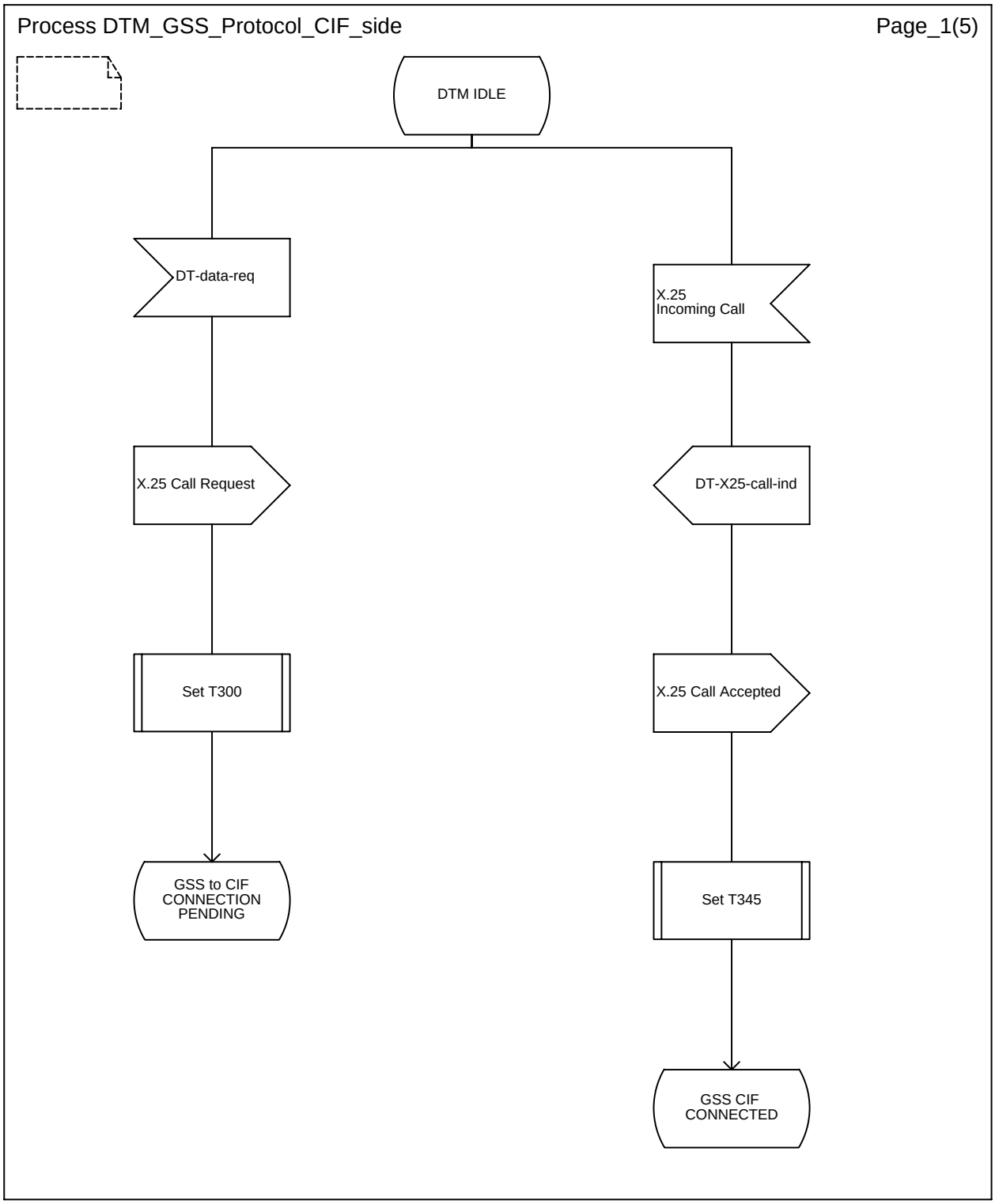

Figure C.4: (sheet 1 of 5) DTM GSS protocol CIF side

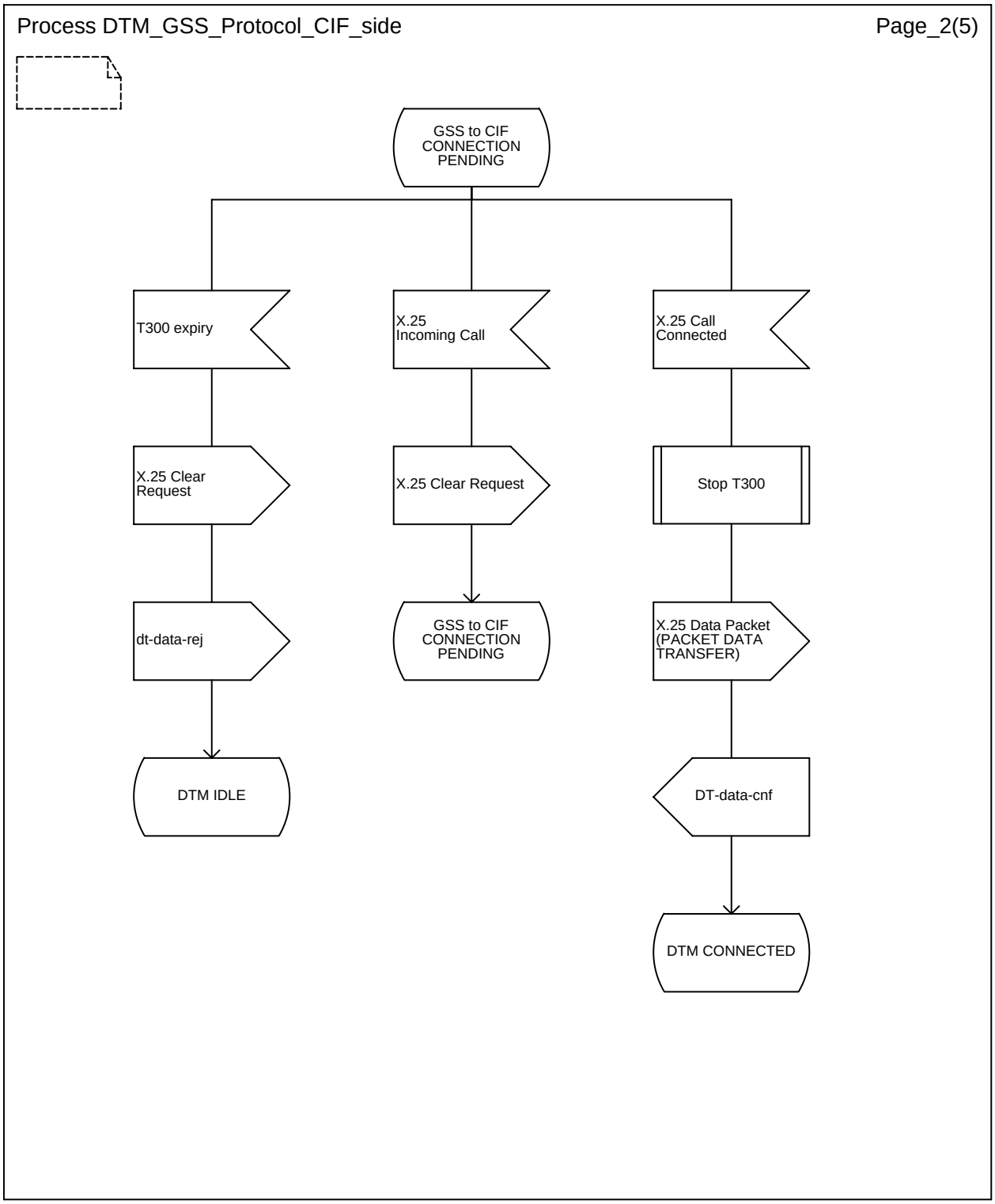

Figure C.4: (sheet 2 of 5) DTM GSS protocol CIF side

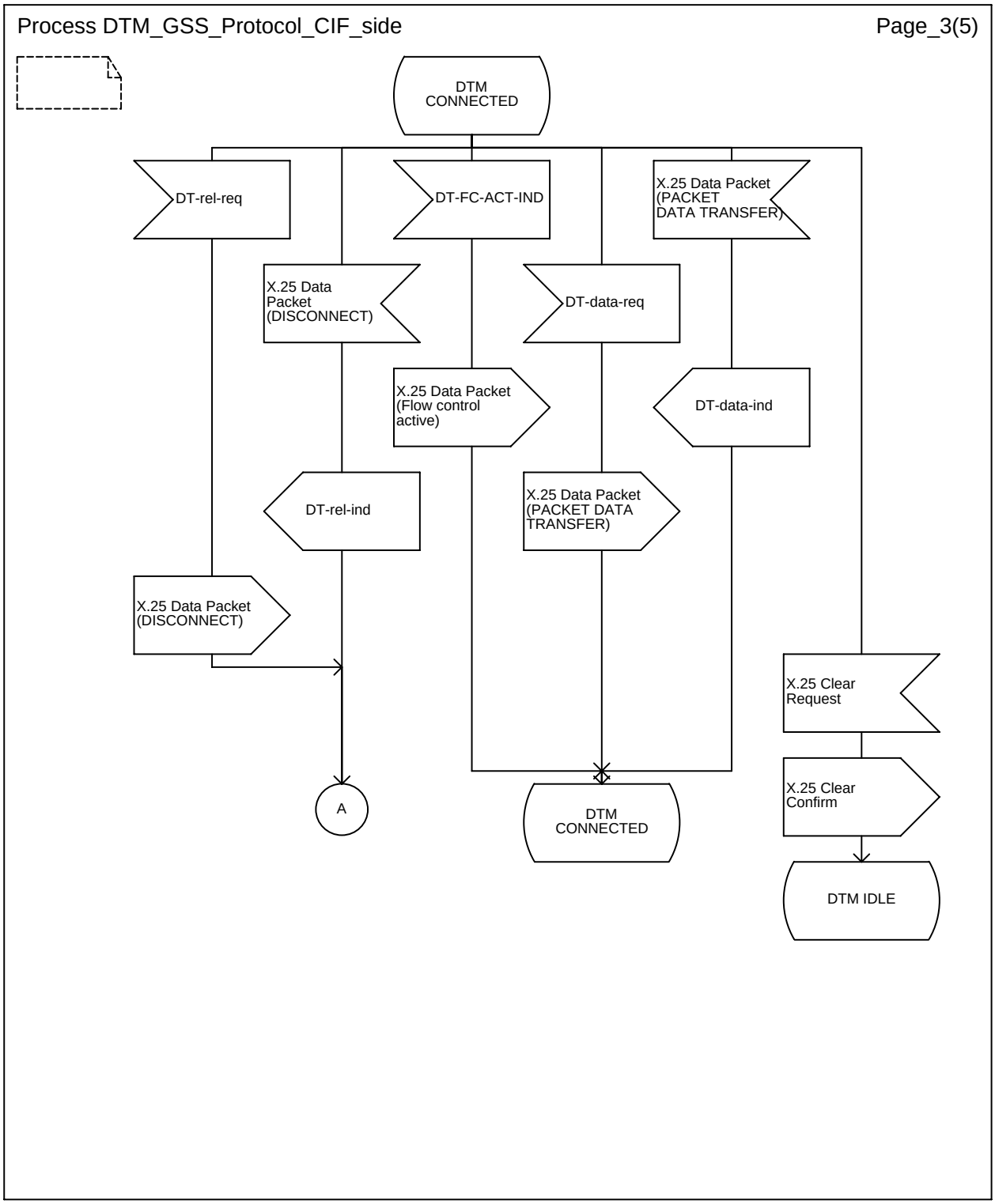

Figure C.4: (sheet 3 of 5) DTM GSS protocol CIF side

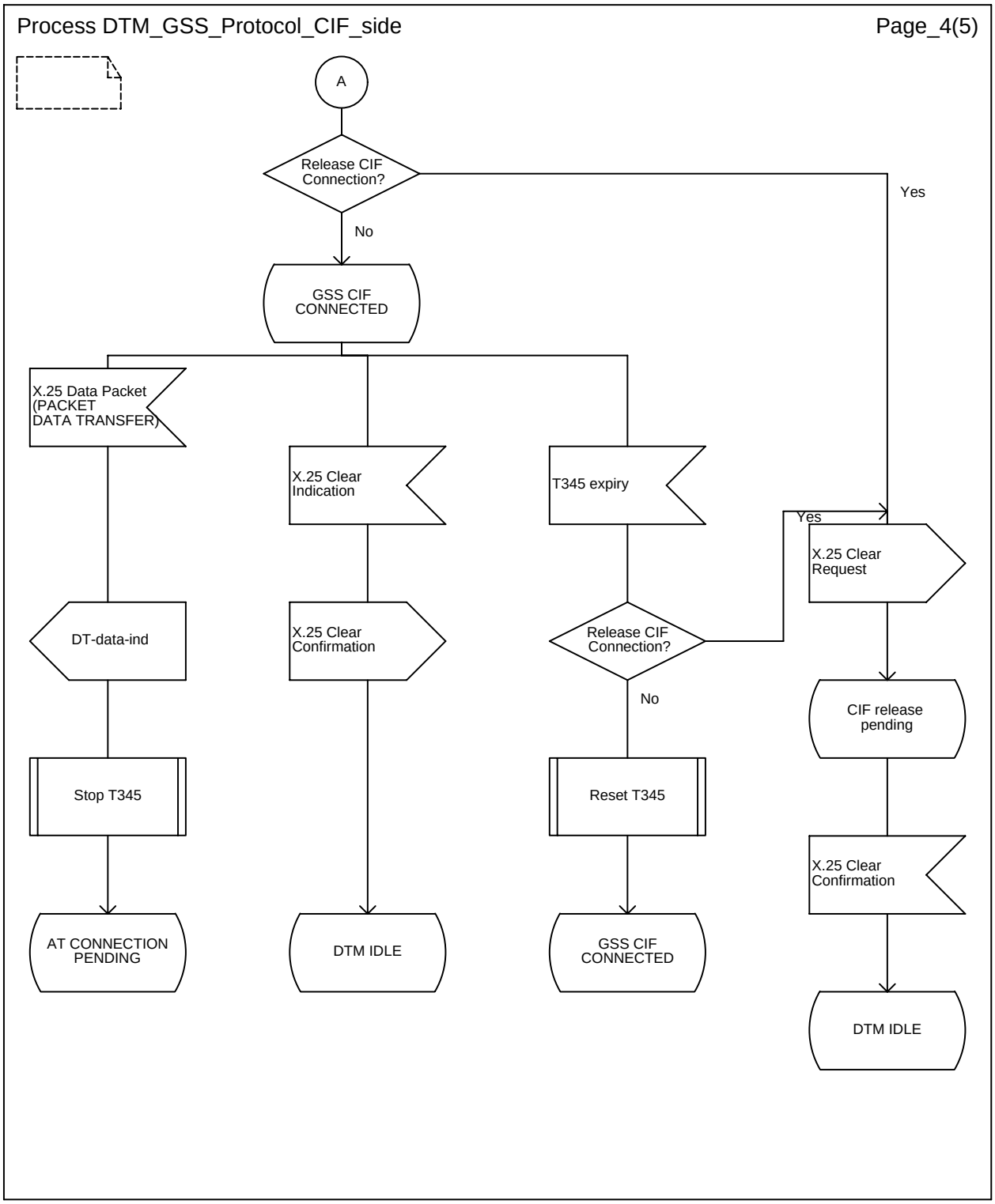

Figure C.4: (sheet 4 of 5) DTM GSS protocol CIF side

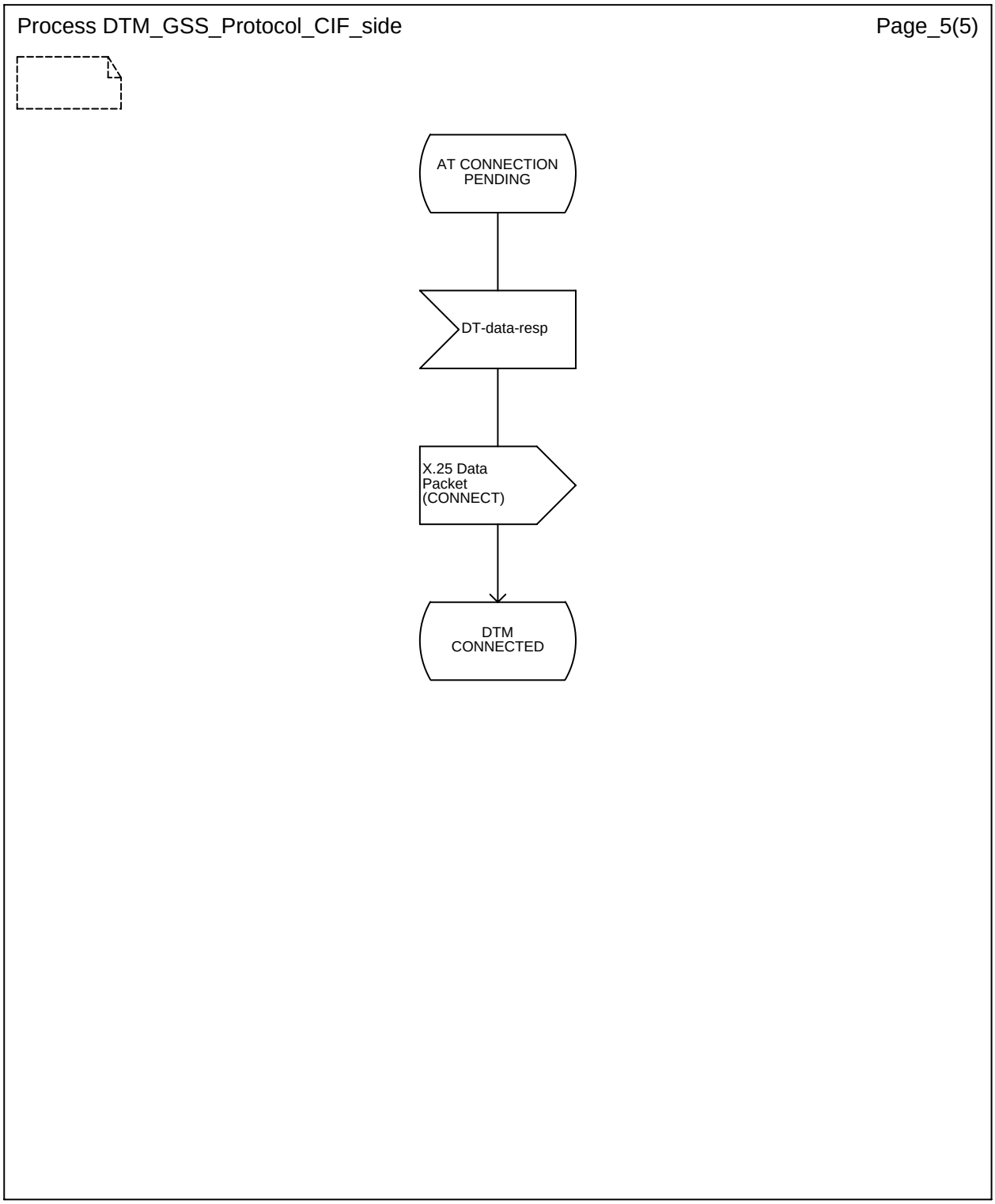

Figure C.4: (sheet 5 of 5) DTM GSS protocol CIF side

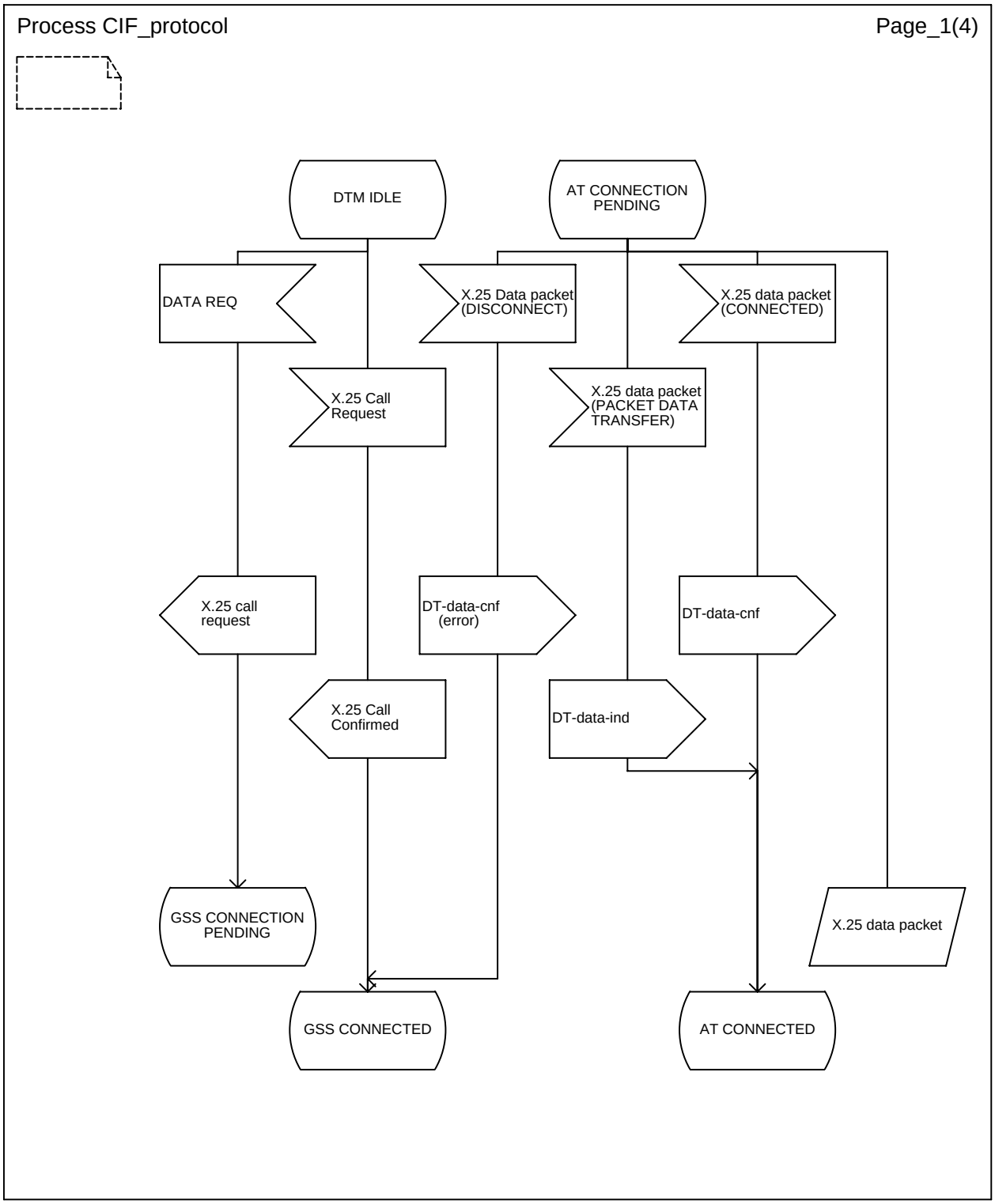

Figure C.5: (sheet 1 of 4) CIF protocol

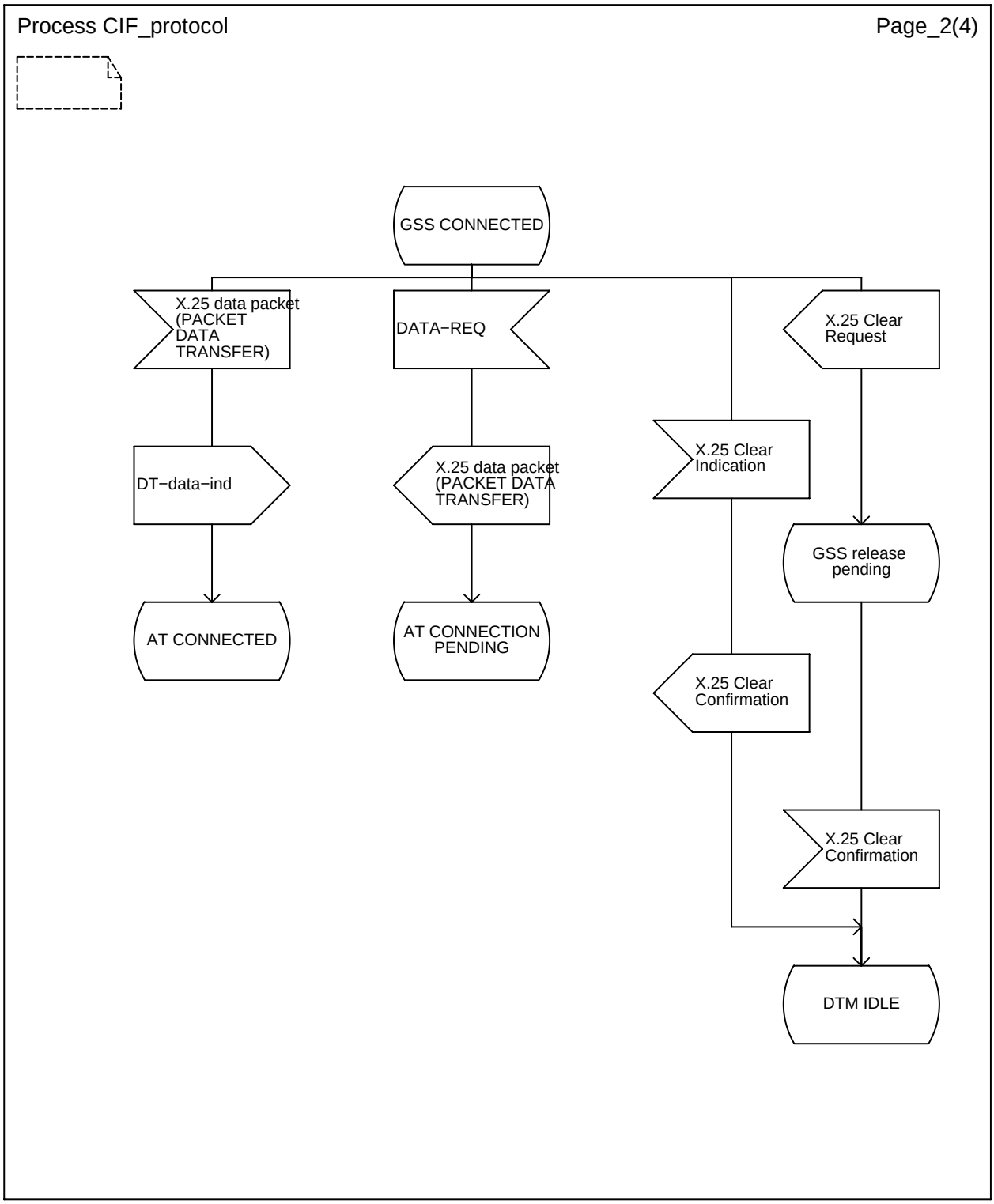

Figure C.5: (sheet 2 of 4) CIF protocol

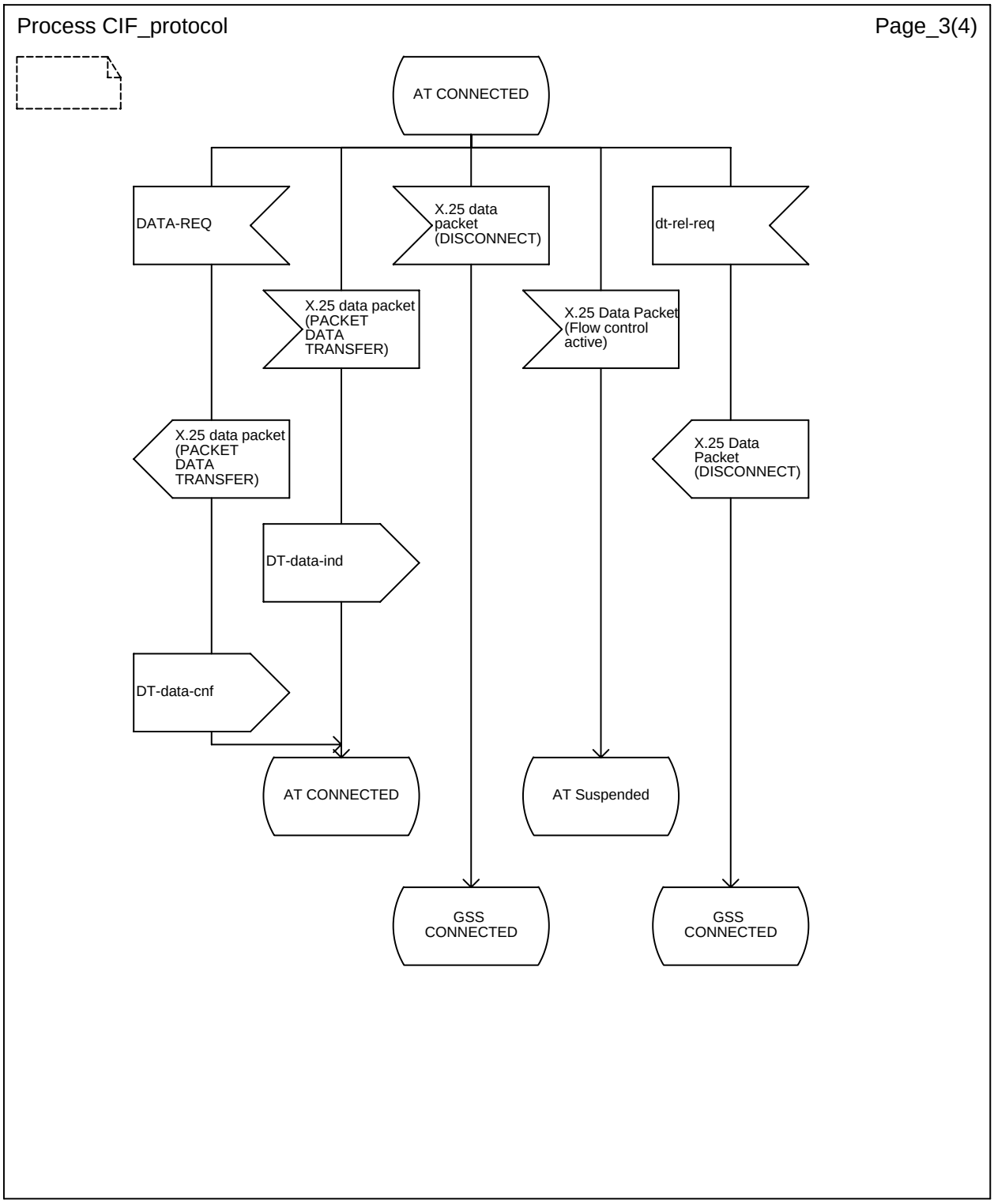

Figure C.5: (sheet 3 of 4) CIF protocol

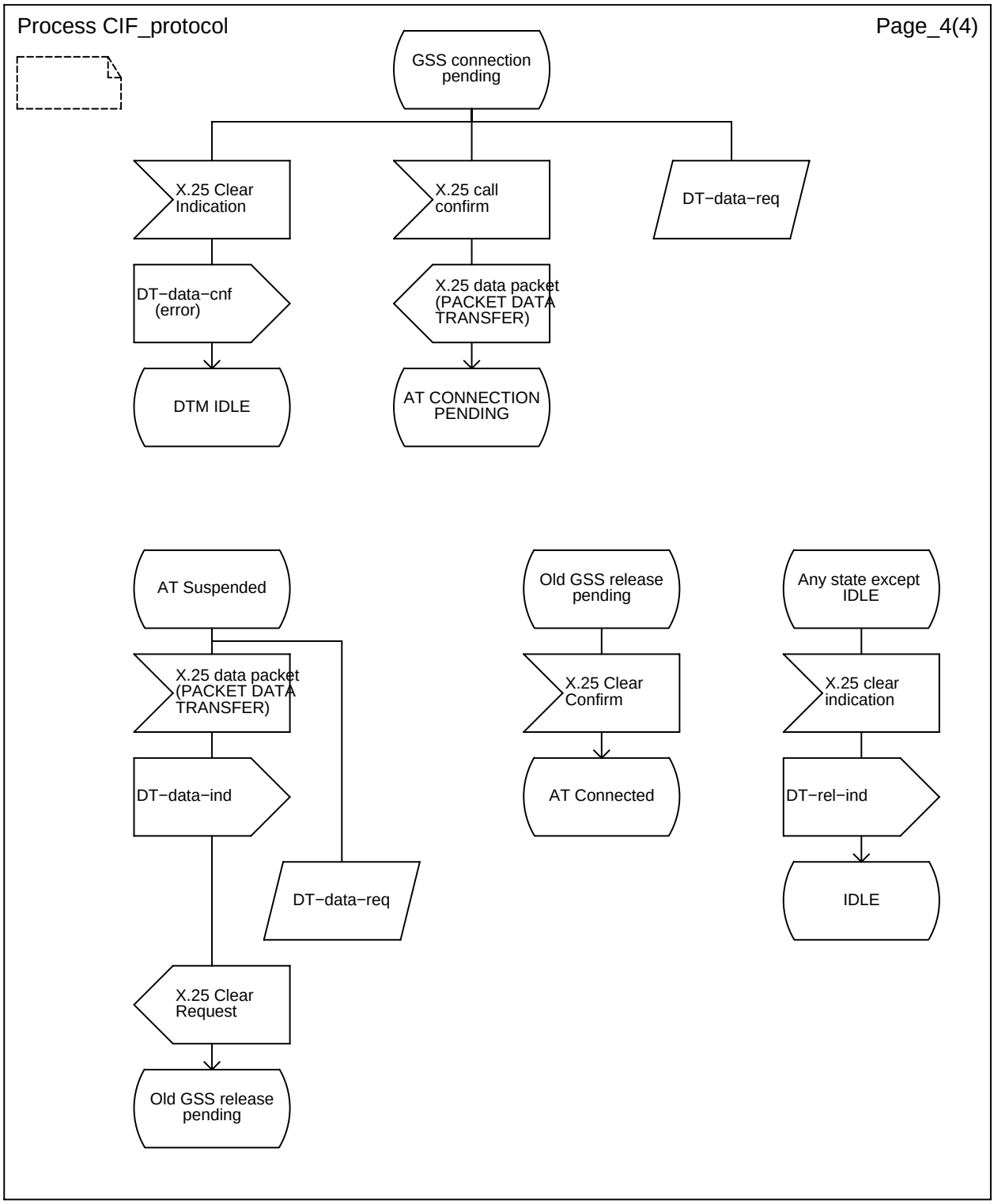

Figure C.5: (sheet 4 of 4) CIF protocol

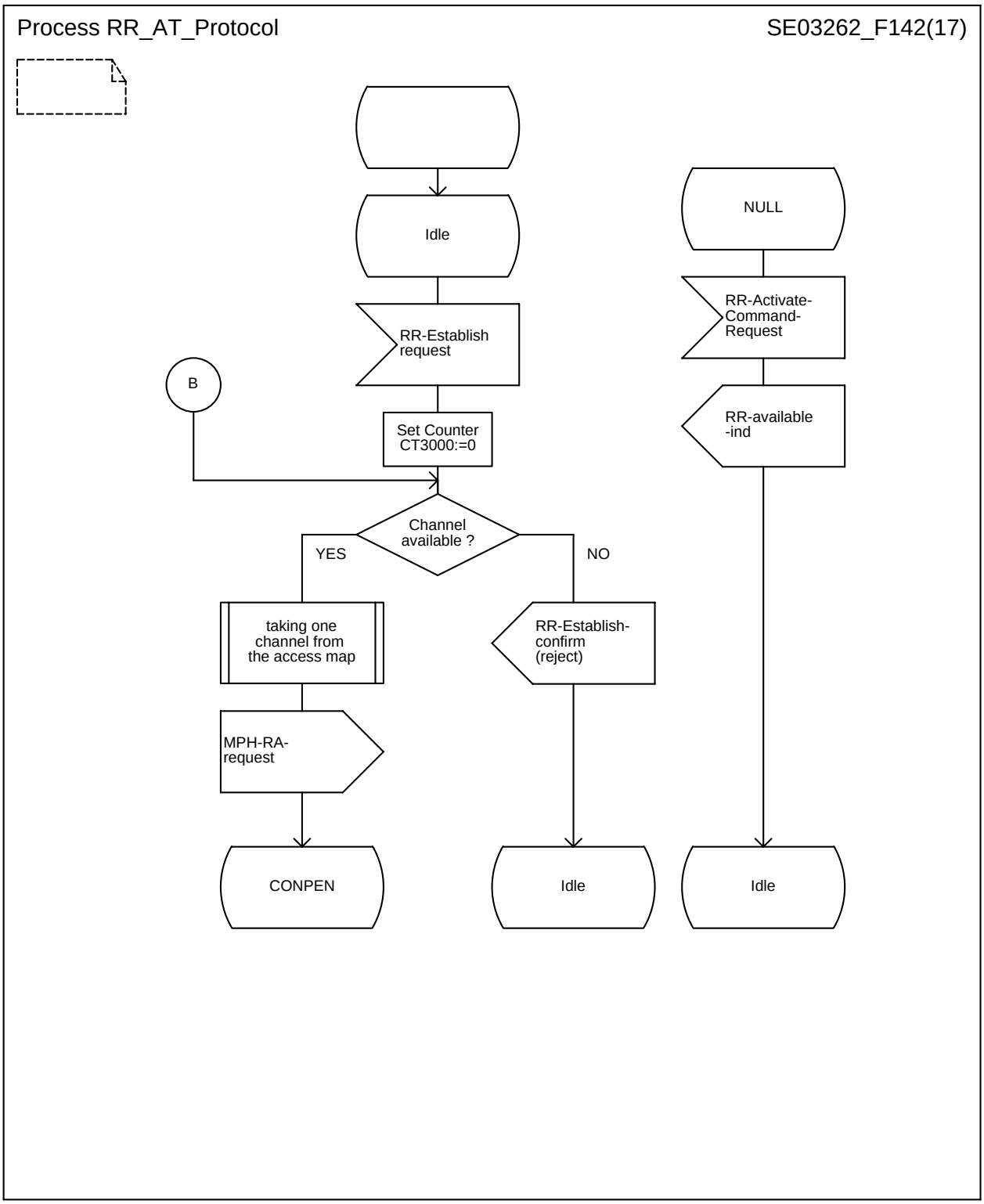

Figure C.6: (sheet 1 of 17) RR AT protocol

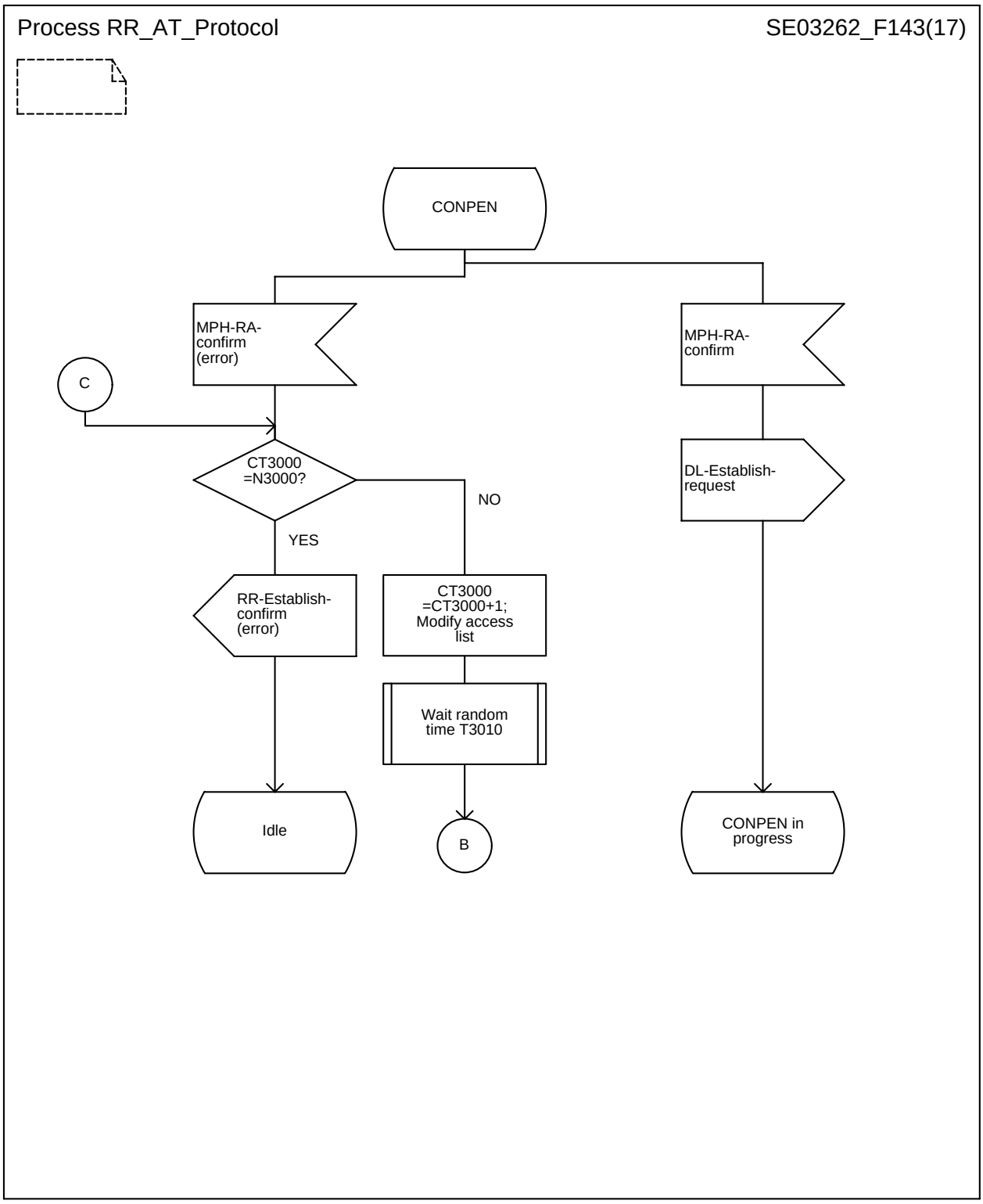

Figure C.6: (sheet 2 of 17) RR AT protocol

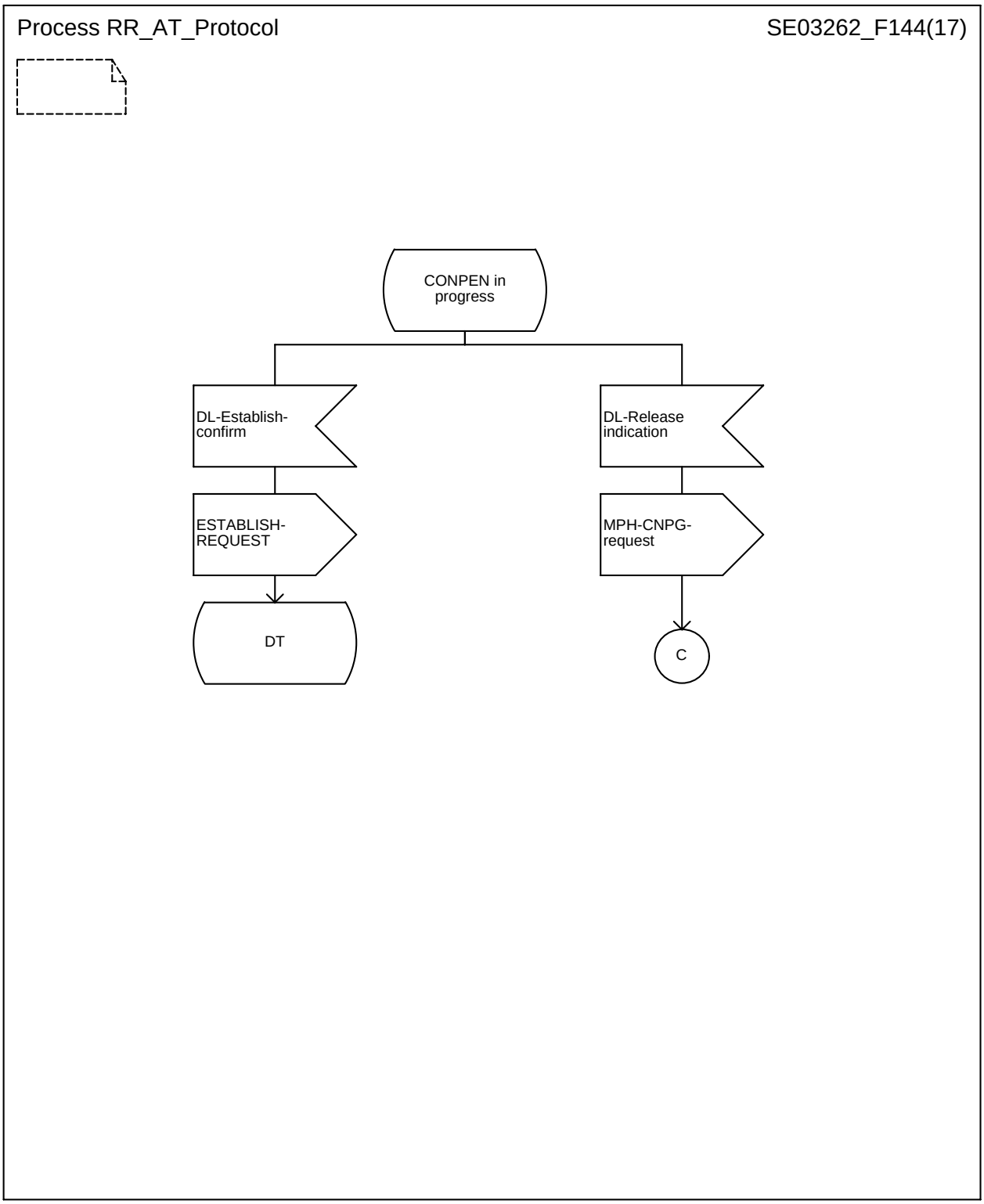

Figure C.6: (sheet 3 of 17) RR AT protocol

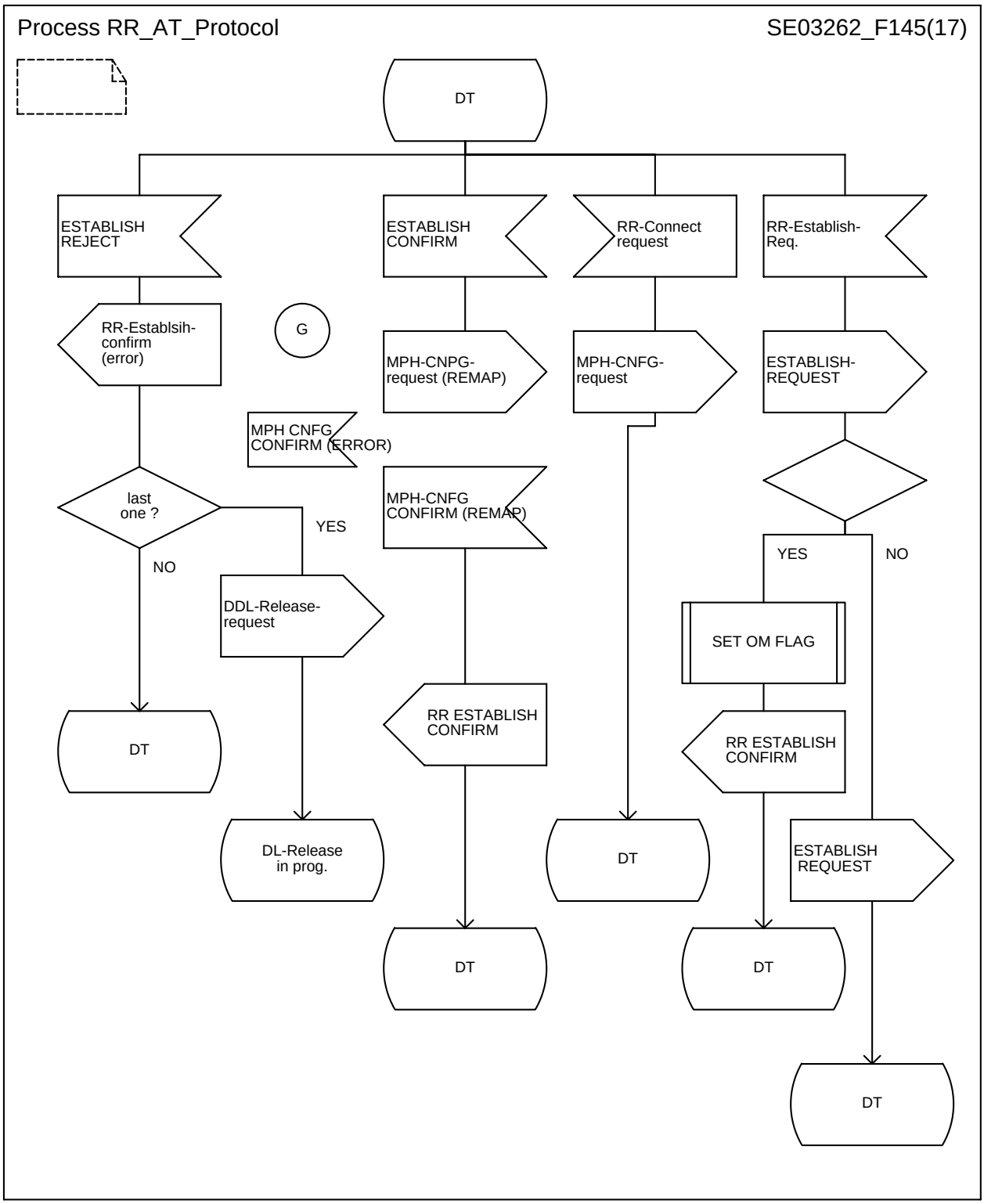

Figure C.6: (sheet 4 of 17) RR AT protocol

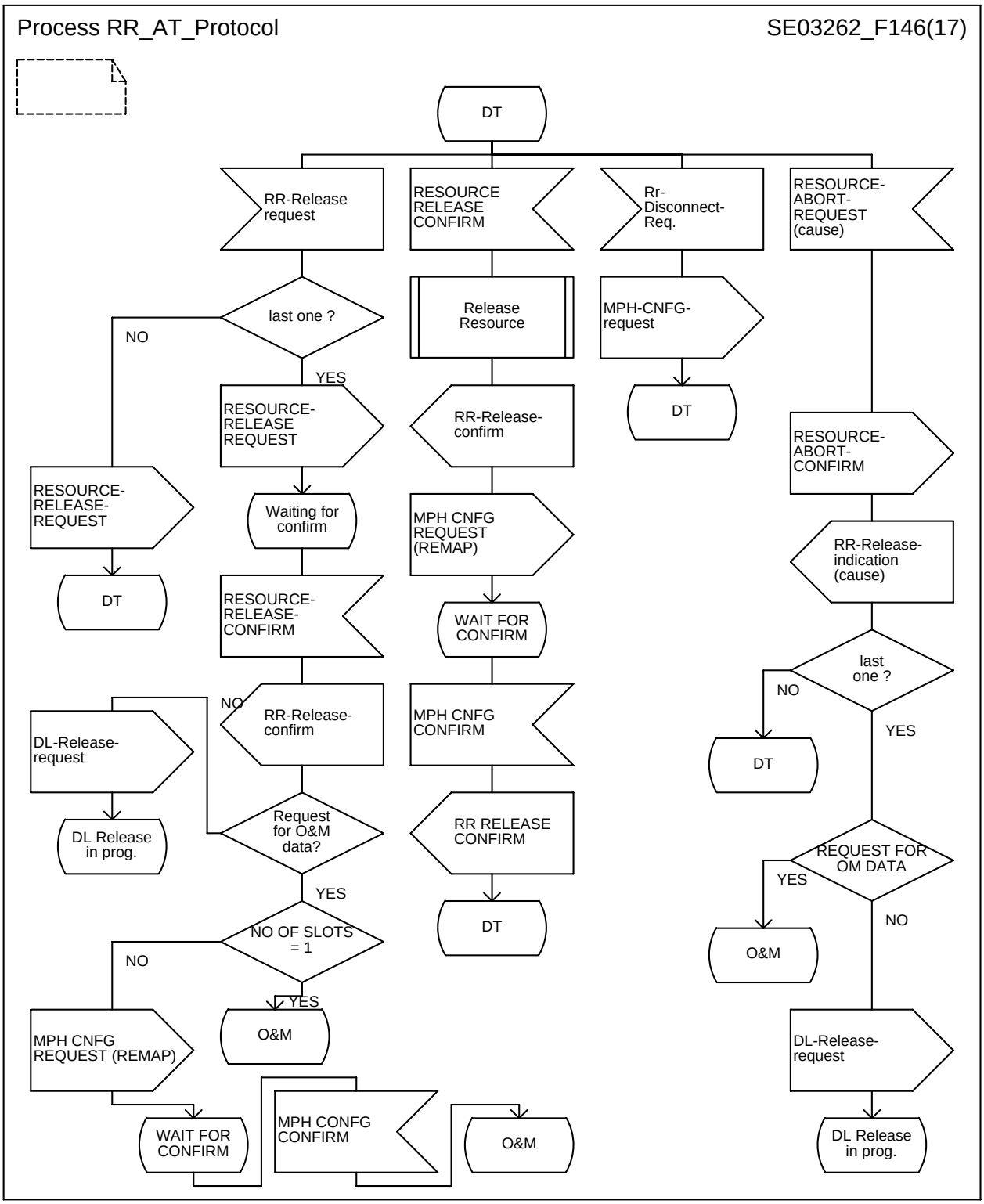

Figure C.6: (sheet 5 of 17) RR AT protocol

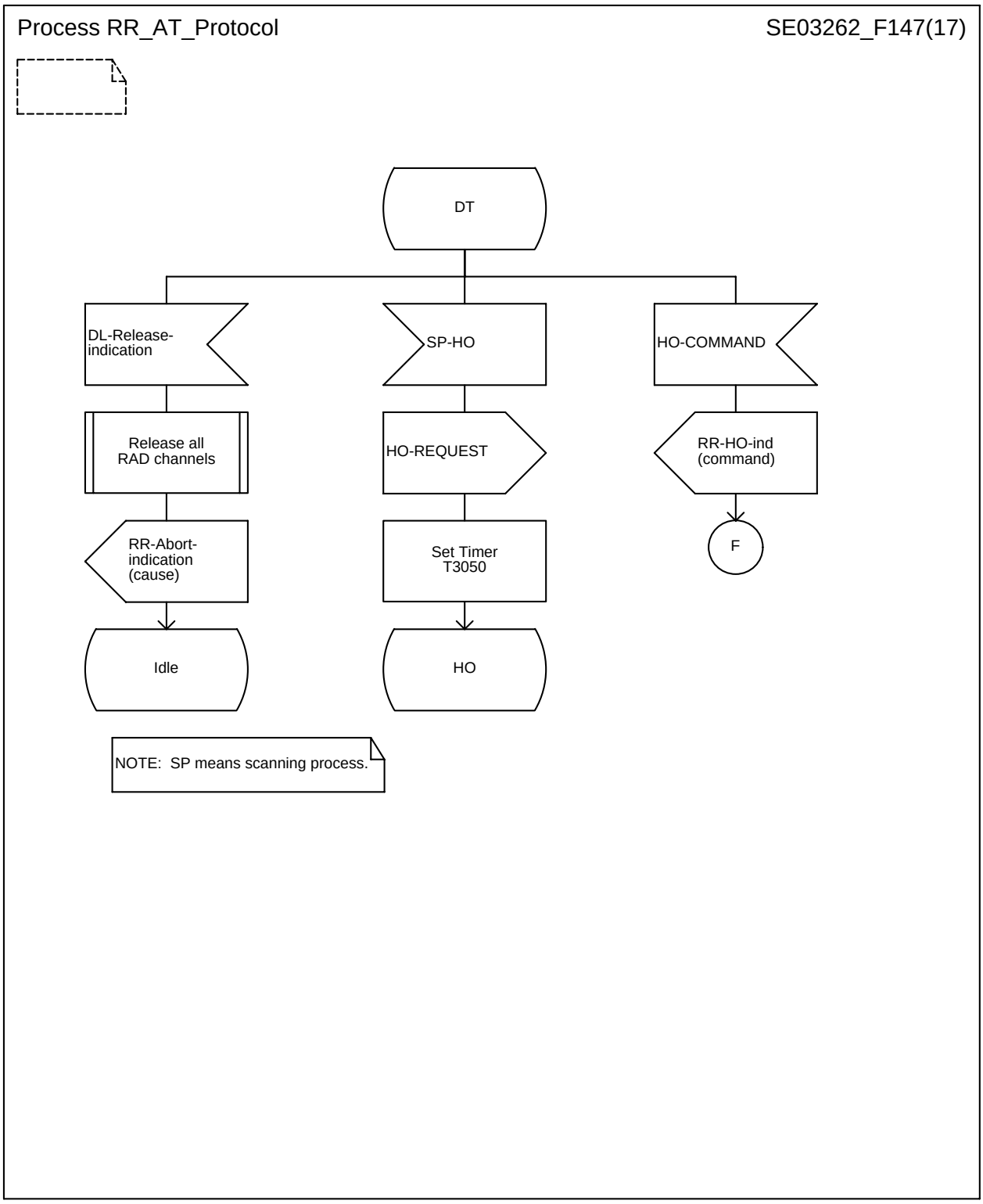

Figure C.6: (sheet 6 of 17) RR AT protocol

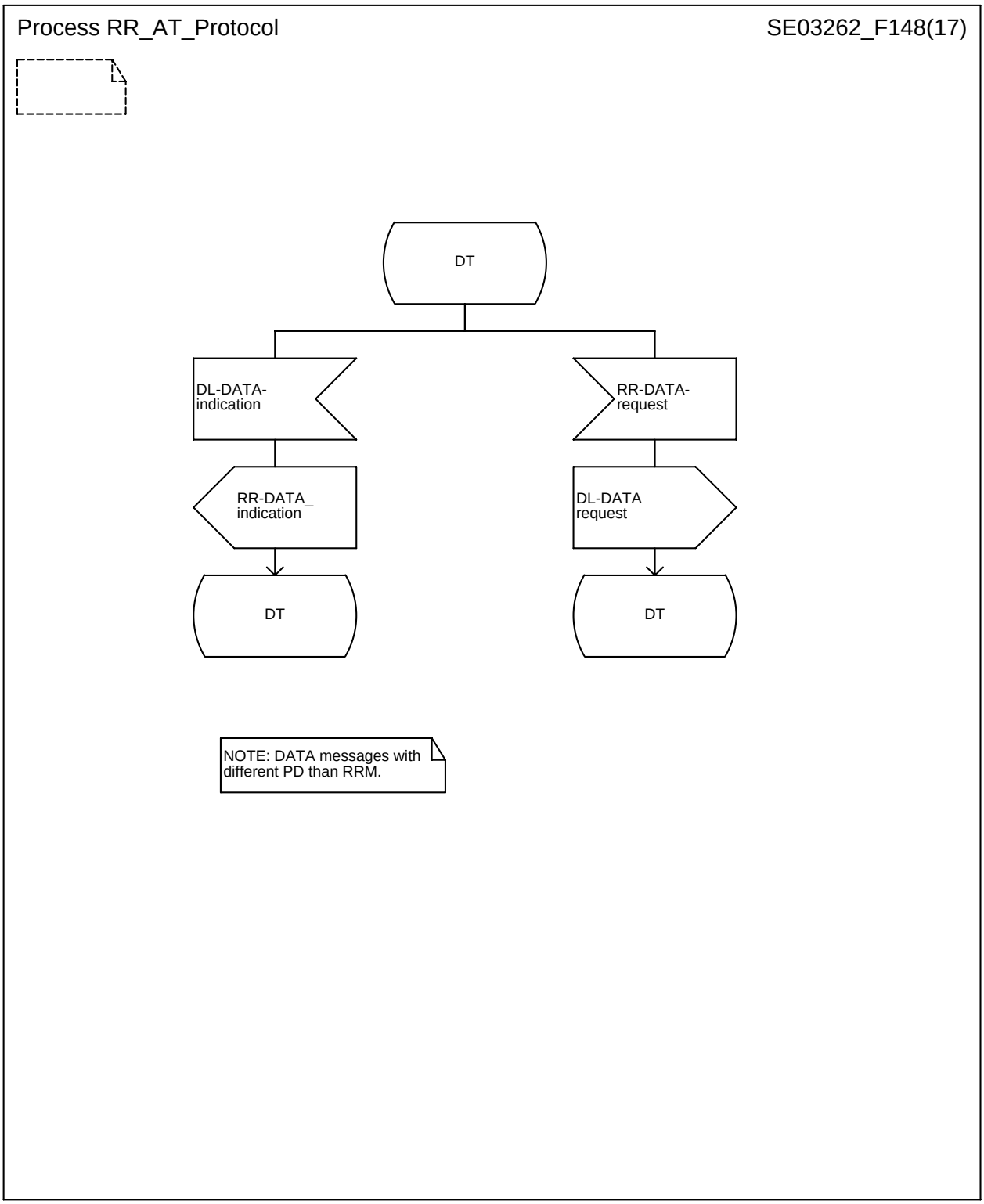

Figure C.6: (sheet 7 of 17) RR AT protocol

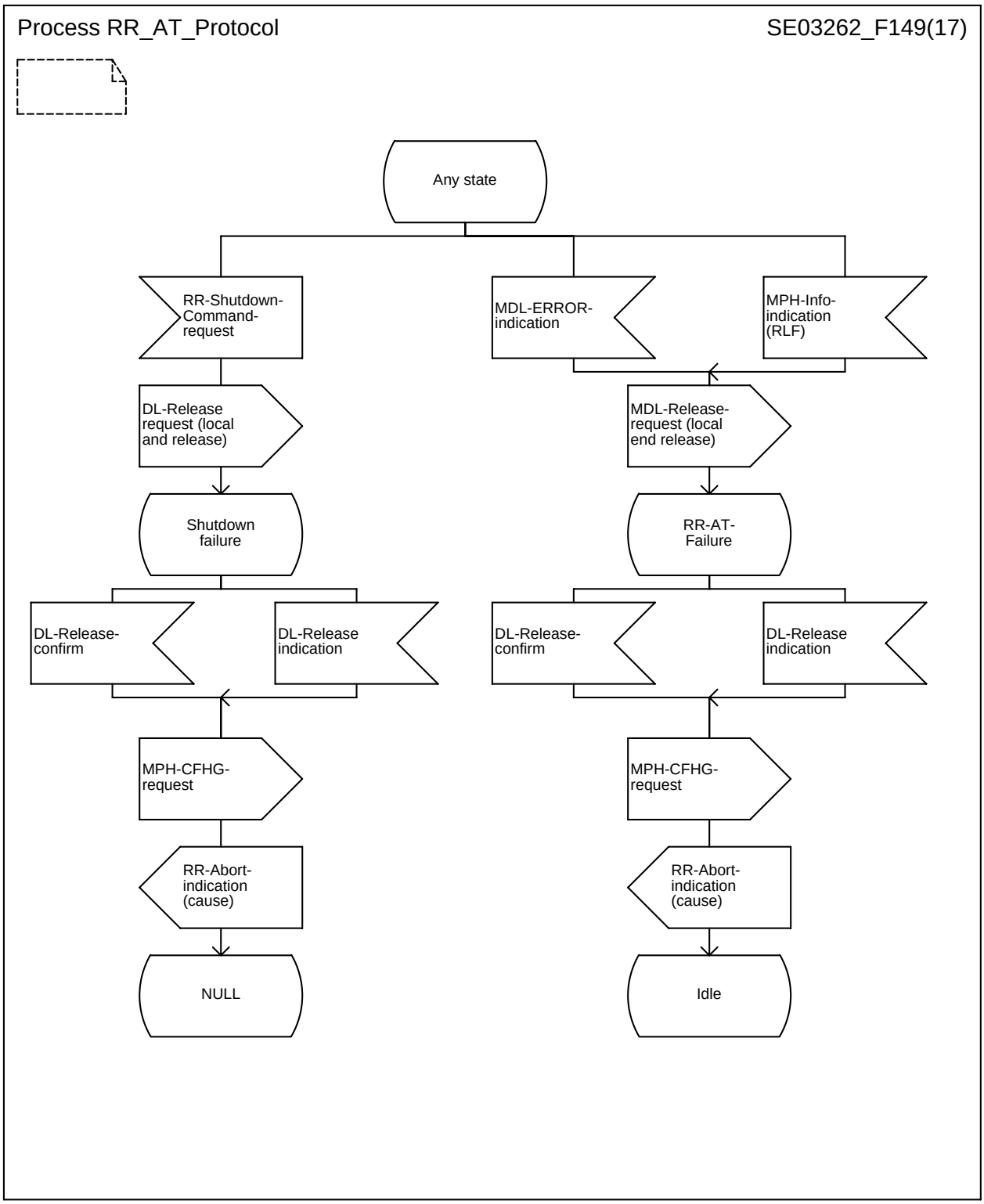

Figure C.6: (sheet 8 of 17) RR AT protocol

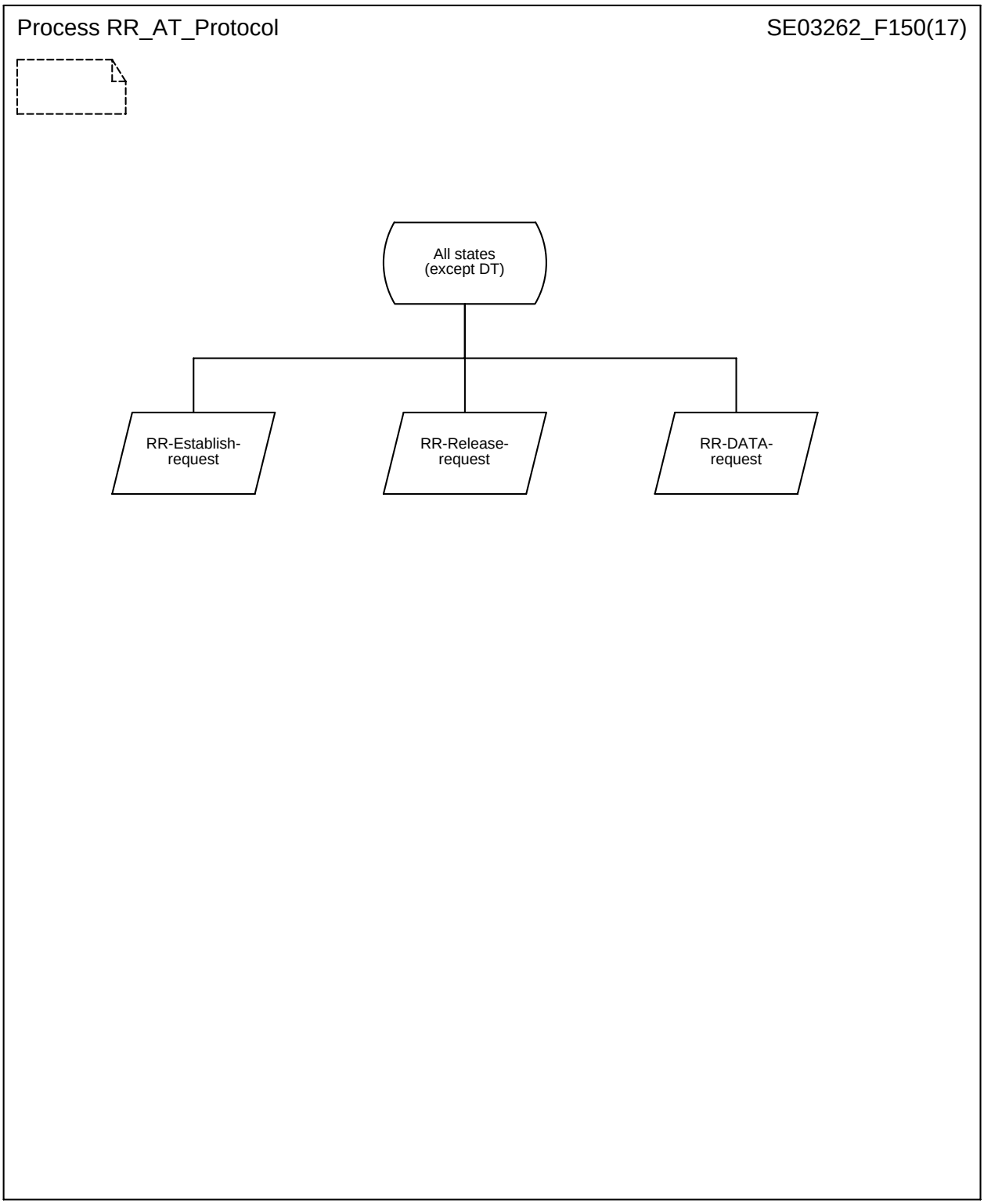

Figure C.6: (sheet 9 of 17) RR AT protocol

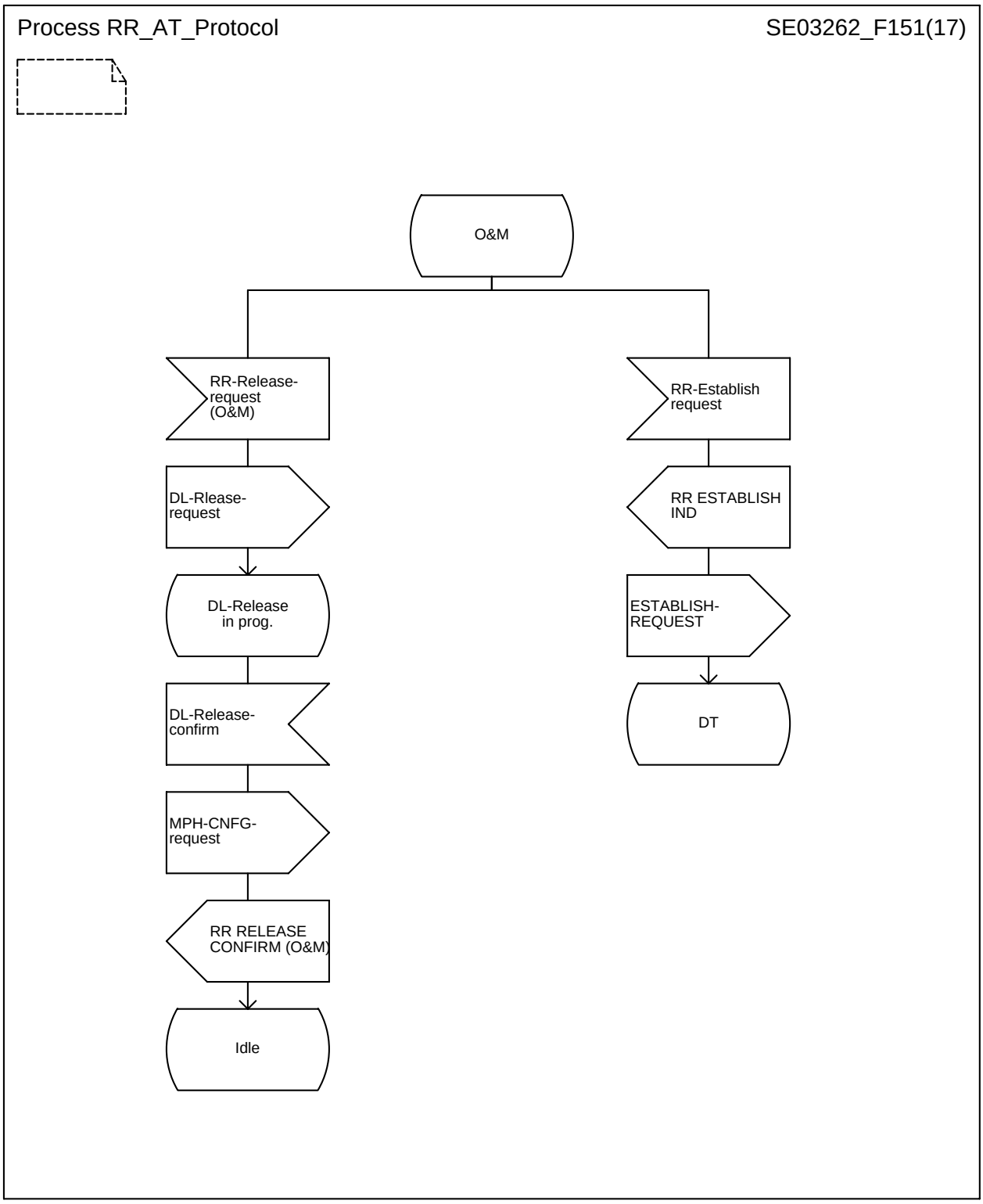

Figure C.6: (sheet 10 of 17) RR AT protocol

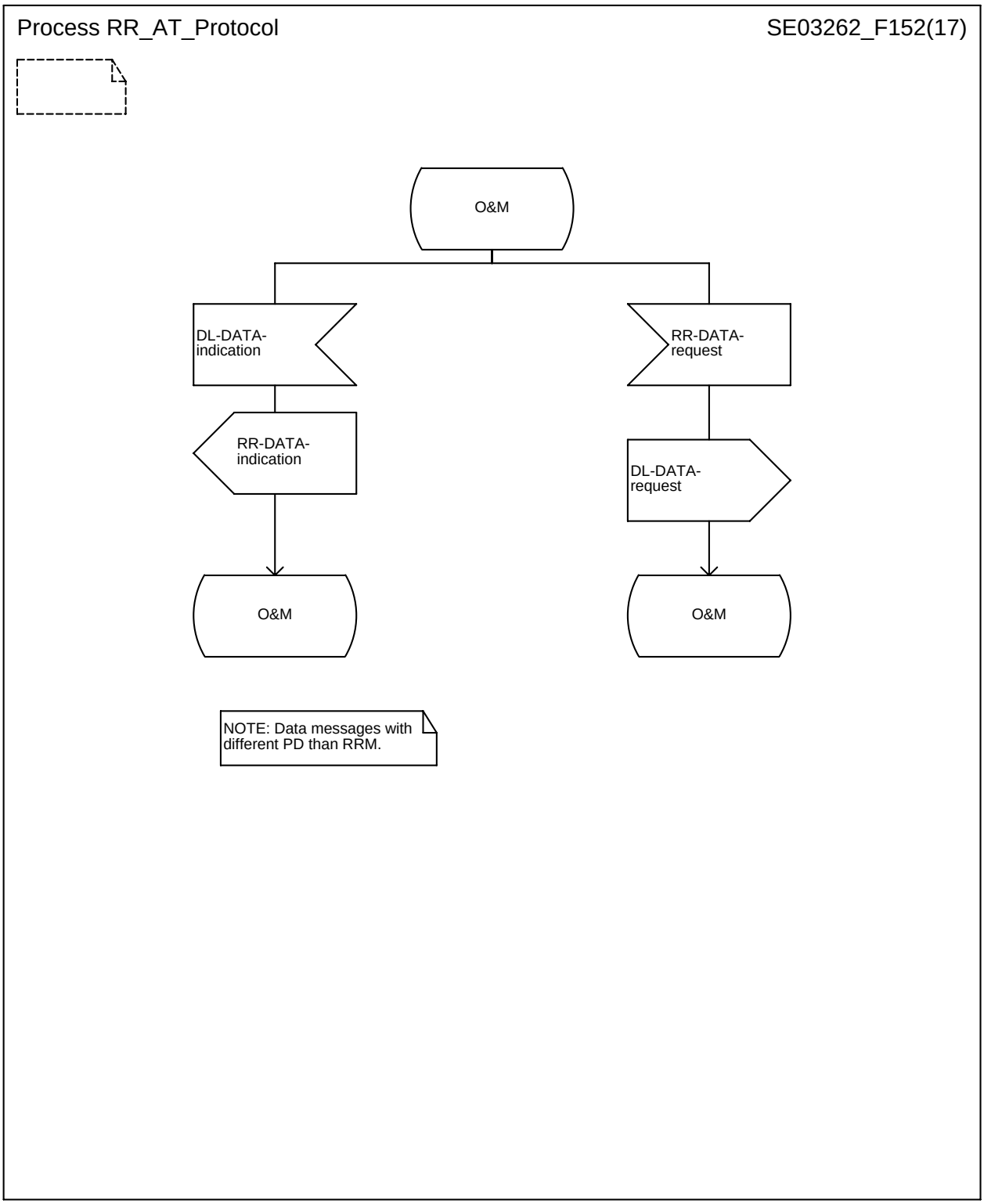

Figure C.6: (sheet 11 of 17) RR AT protocol

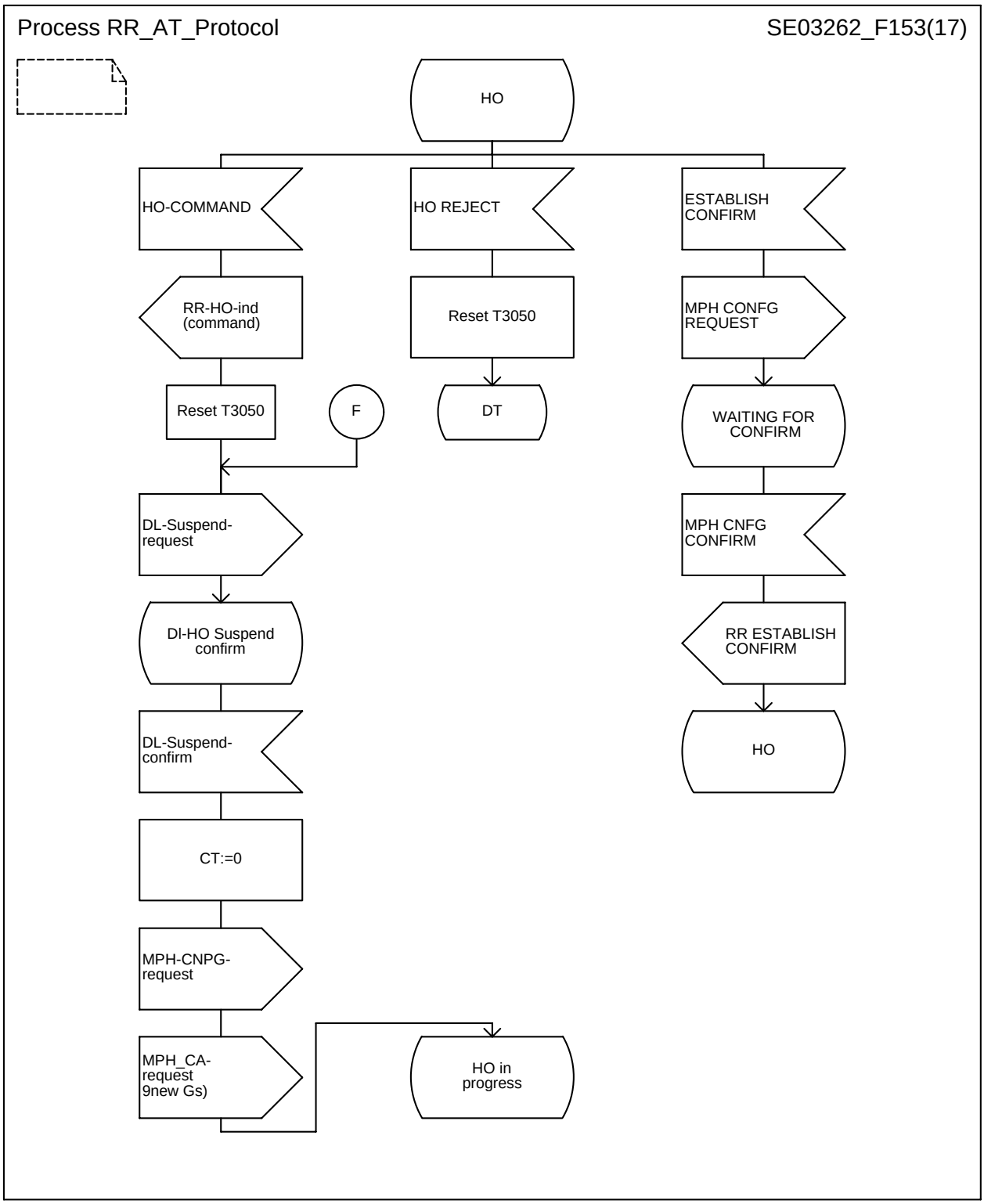

Figure C.6: (sheet 12 of 17) RR AT protocol

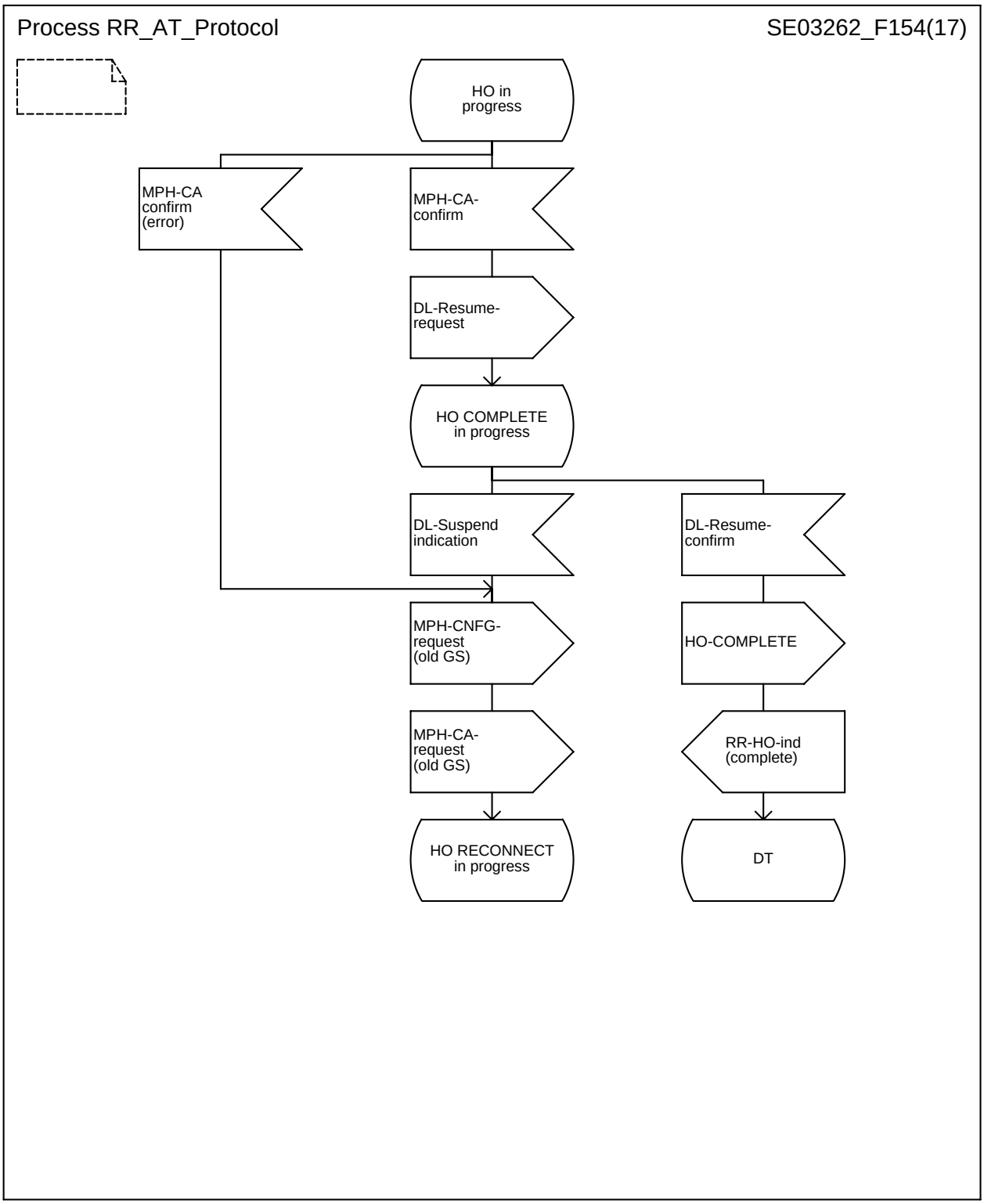

Figure C.6: (sheet 13 of 17) RR AT protocol

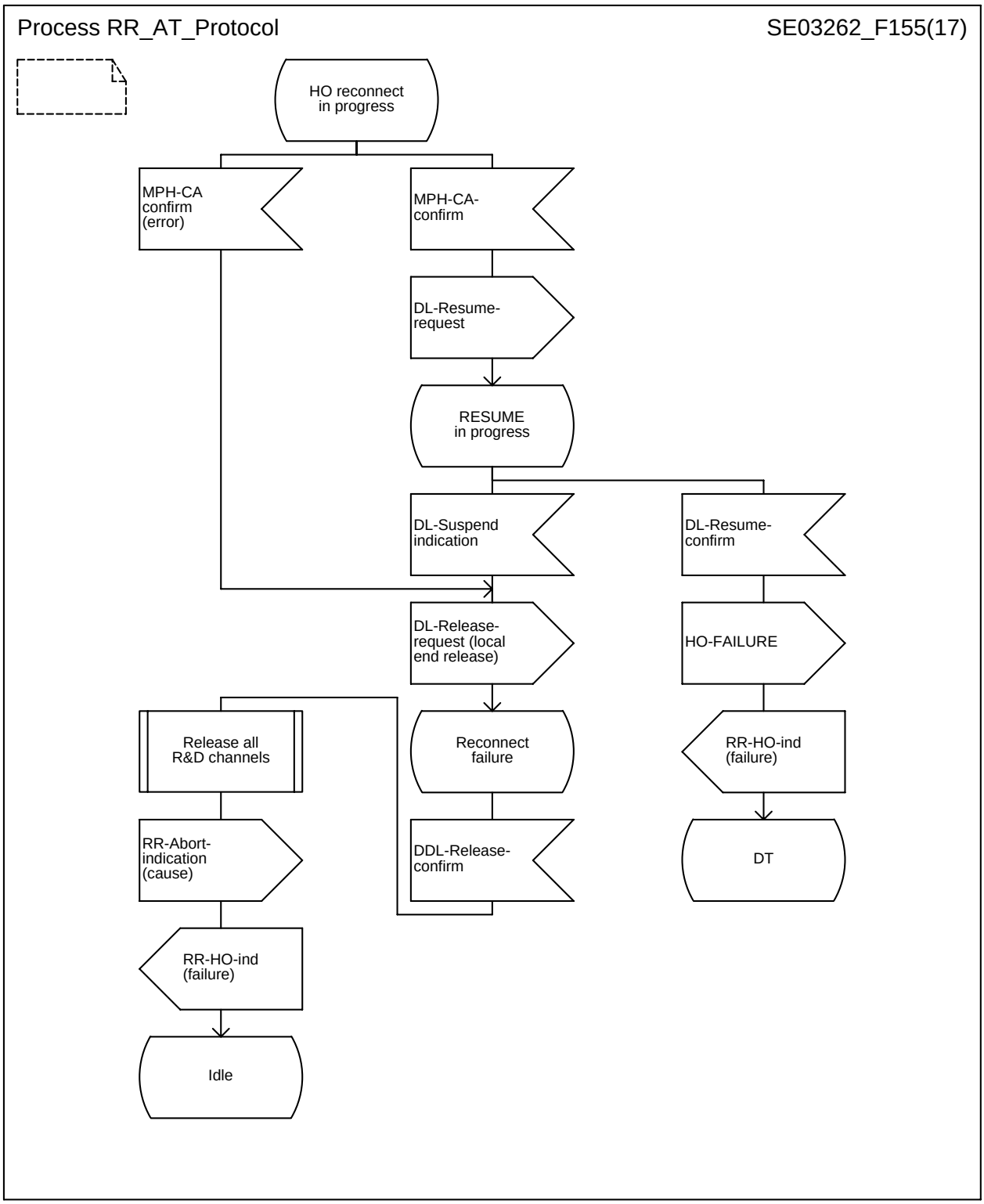

Figure C.6: (sheet 14 of 17) RR AT protocol

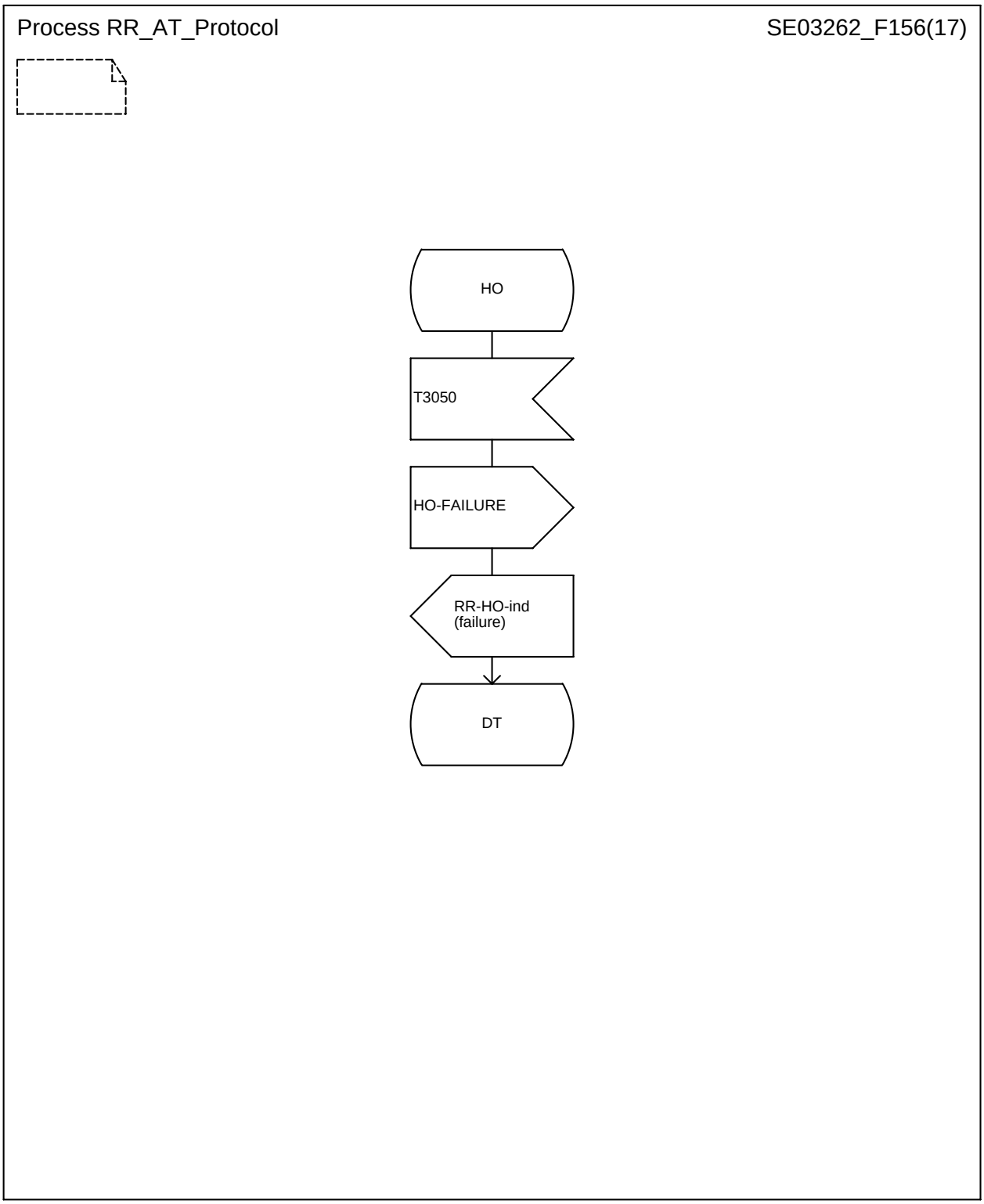

Figure C.6: (sheet 15 of 17) RR AT protocol

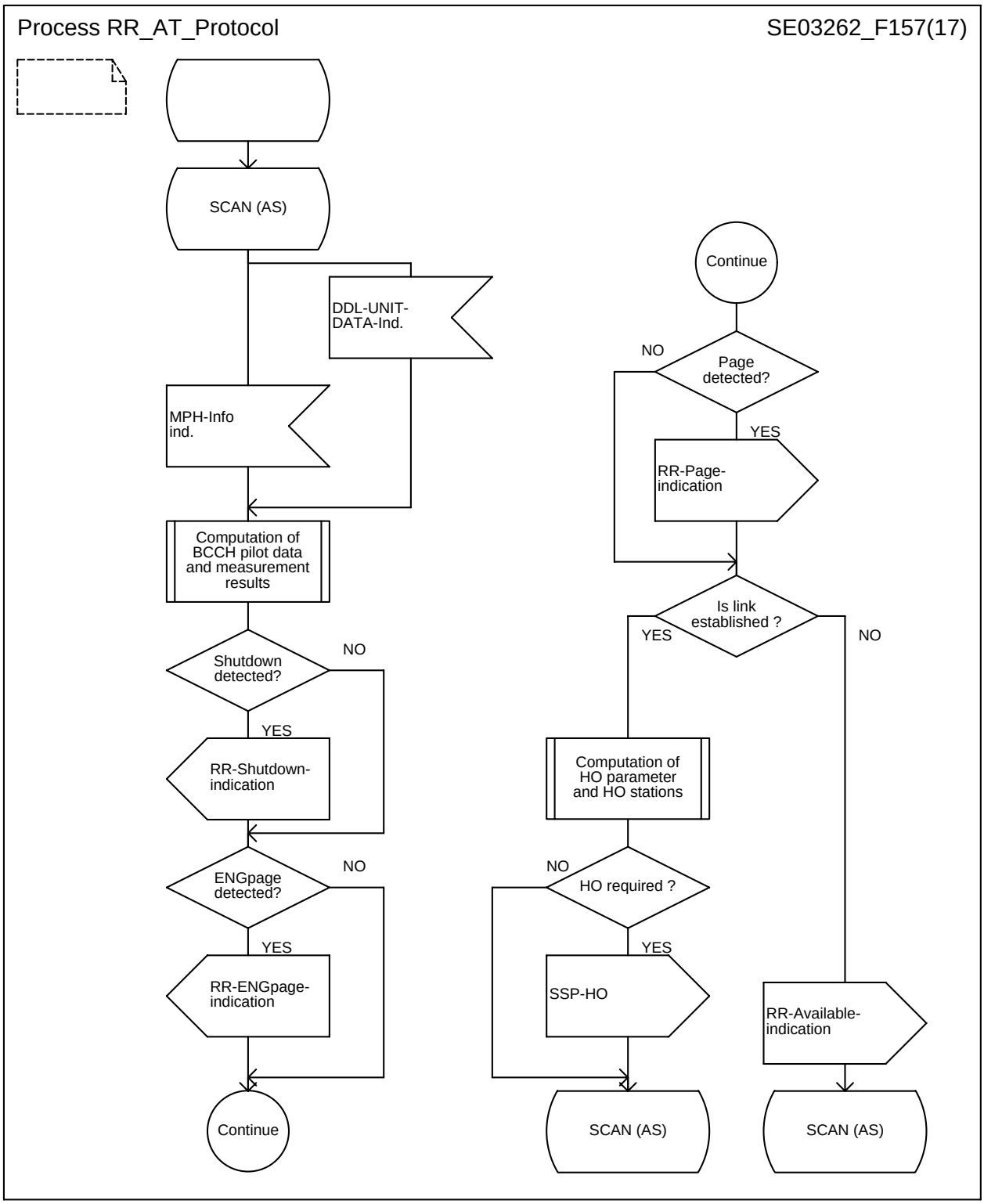

Figure C.6: (sheet 16 of 17) RR AT protocol

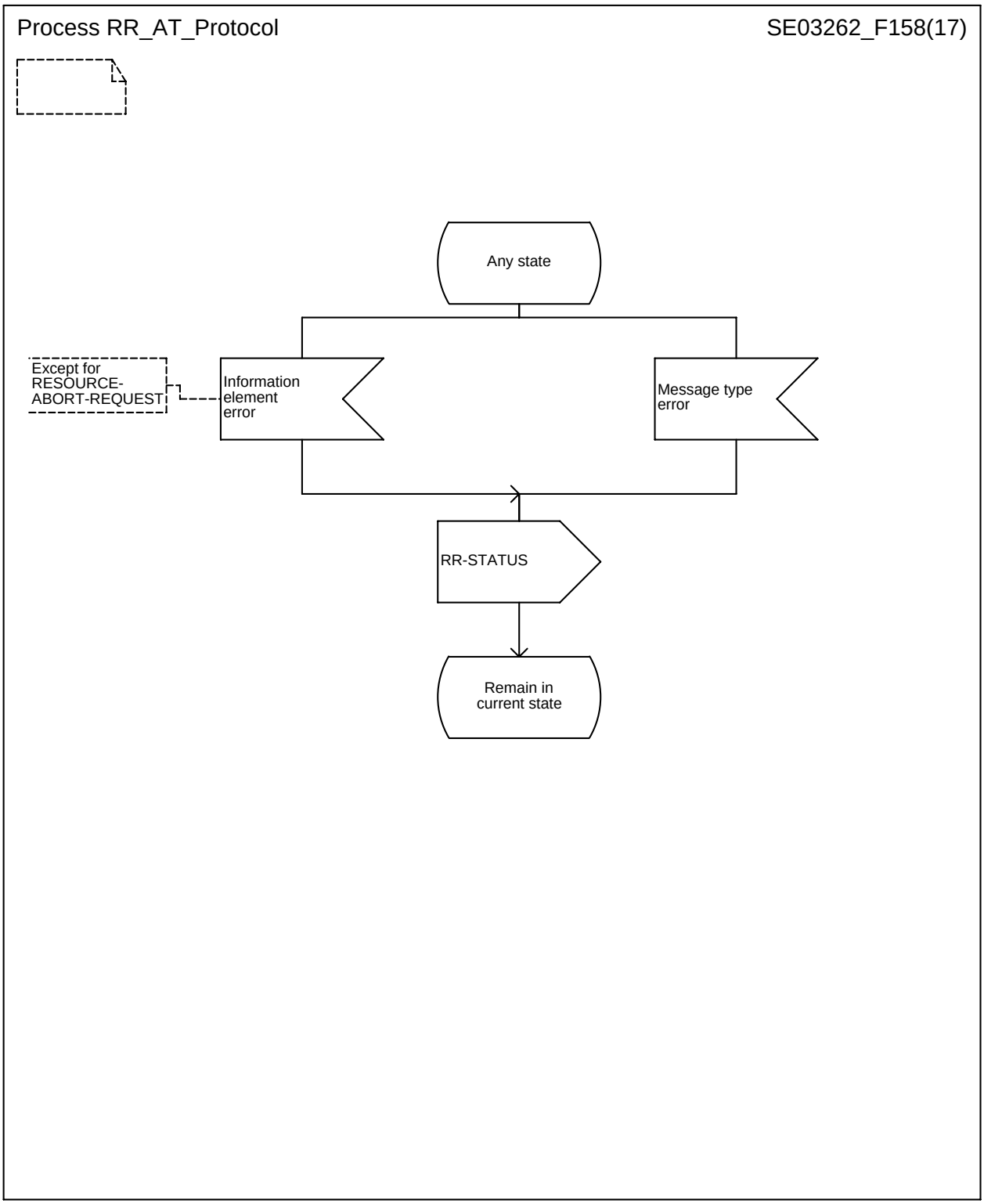

Figure C.6: (sheet 17 of 17) RR AT protocol

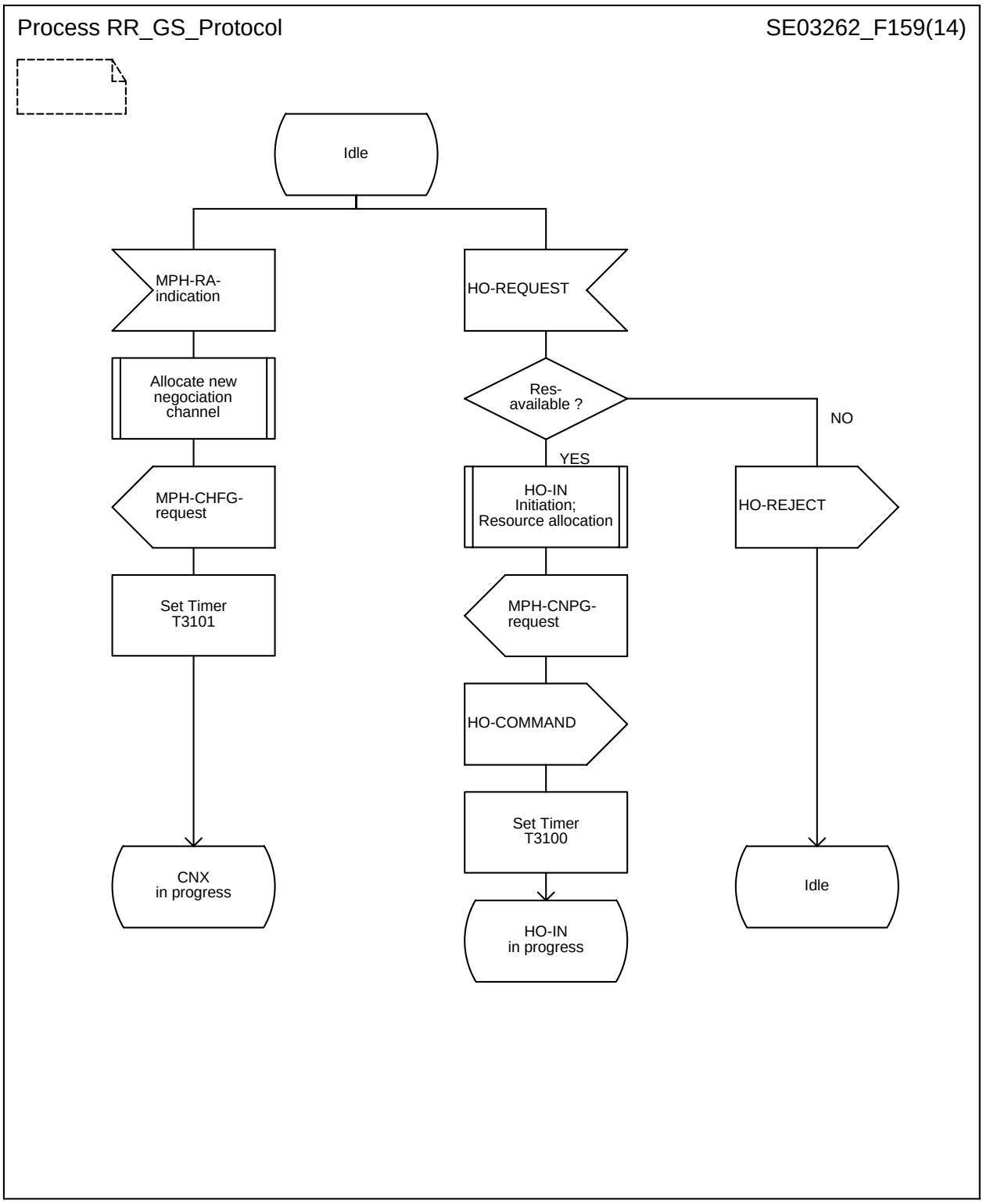

Figure C.7: (sheet 1 of 14) RR GS protocol

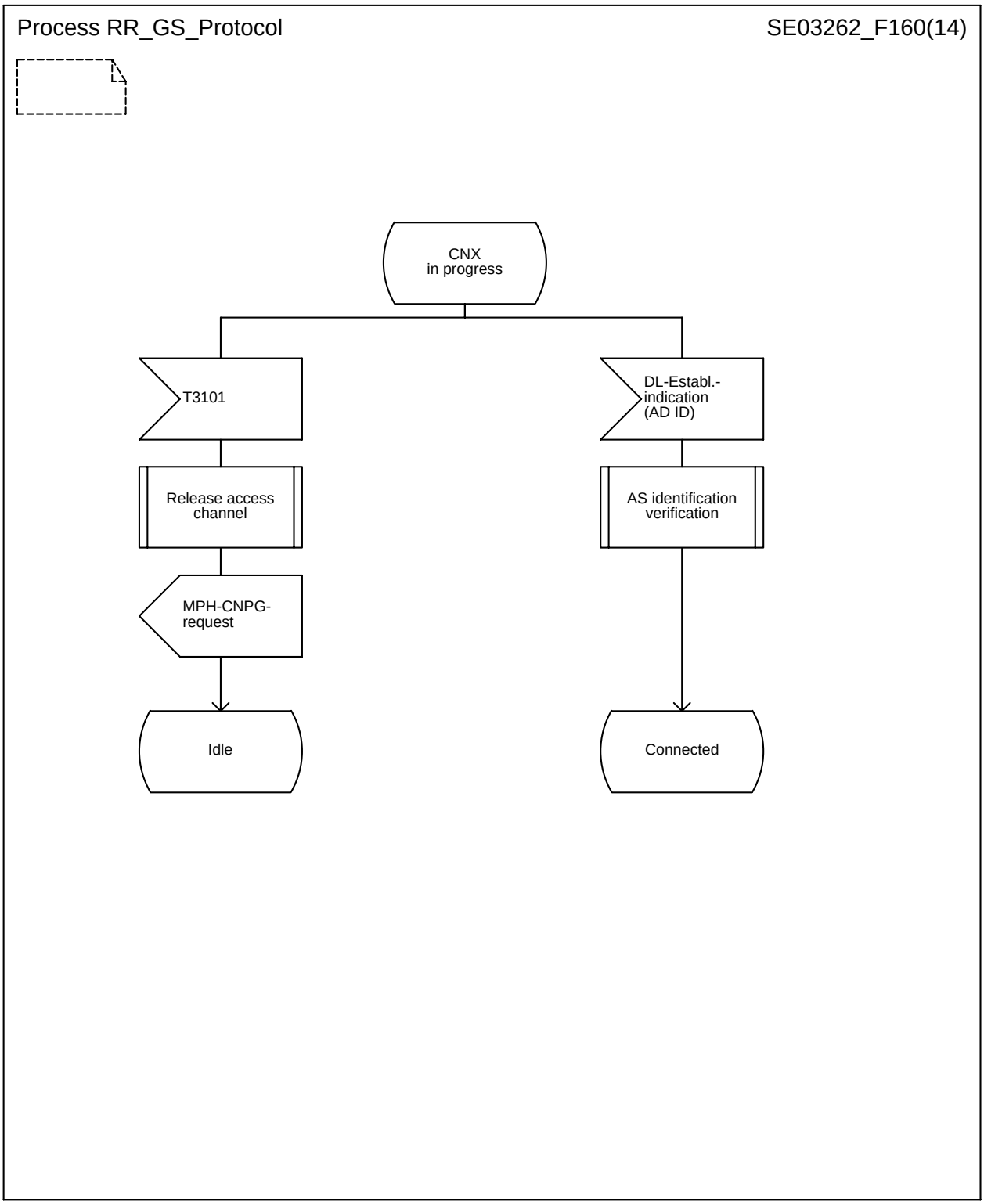

Figure C.7: (sheet 2 of 14) RR GS protocol

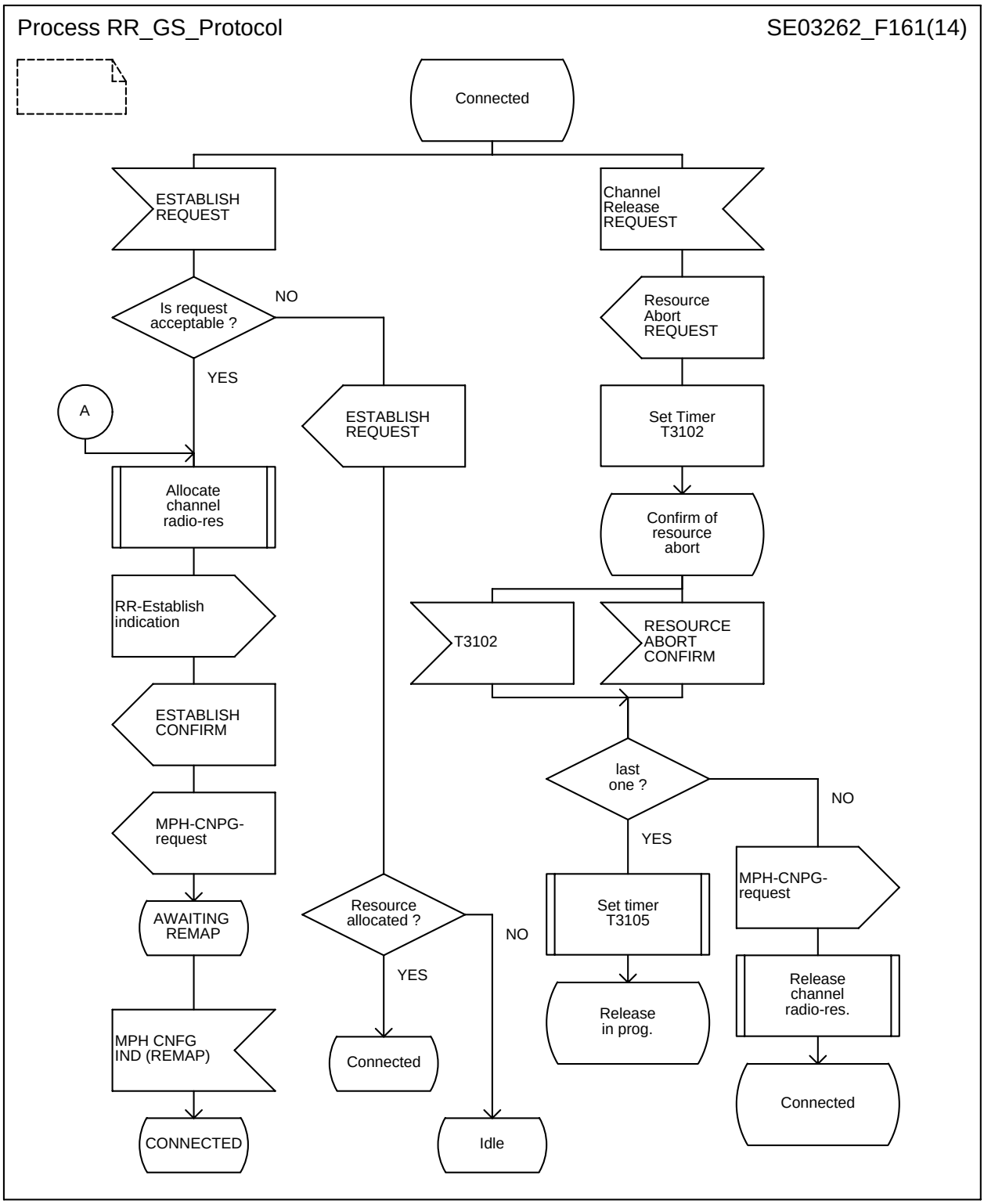

Figure C.7: (sheet 3 of 14) RR GS protocol

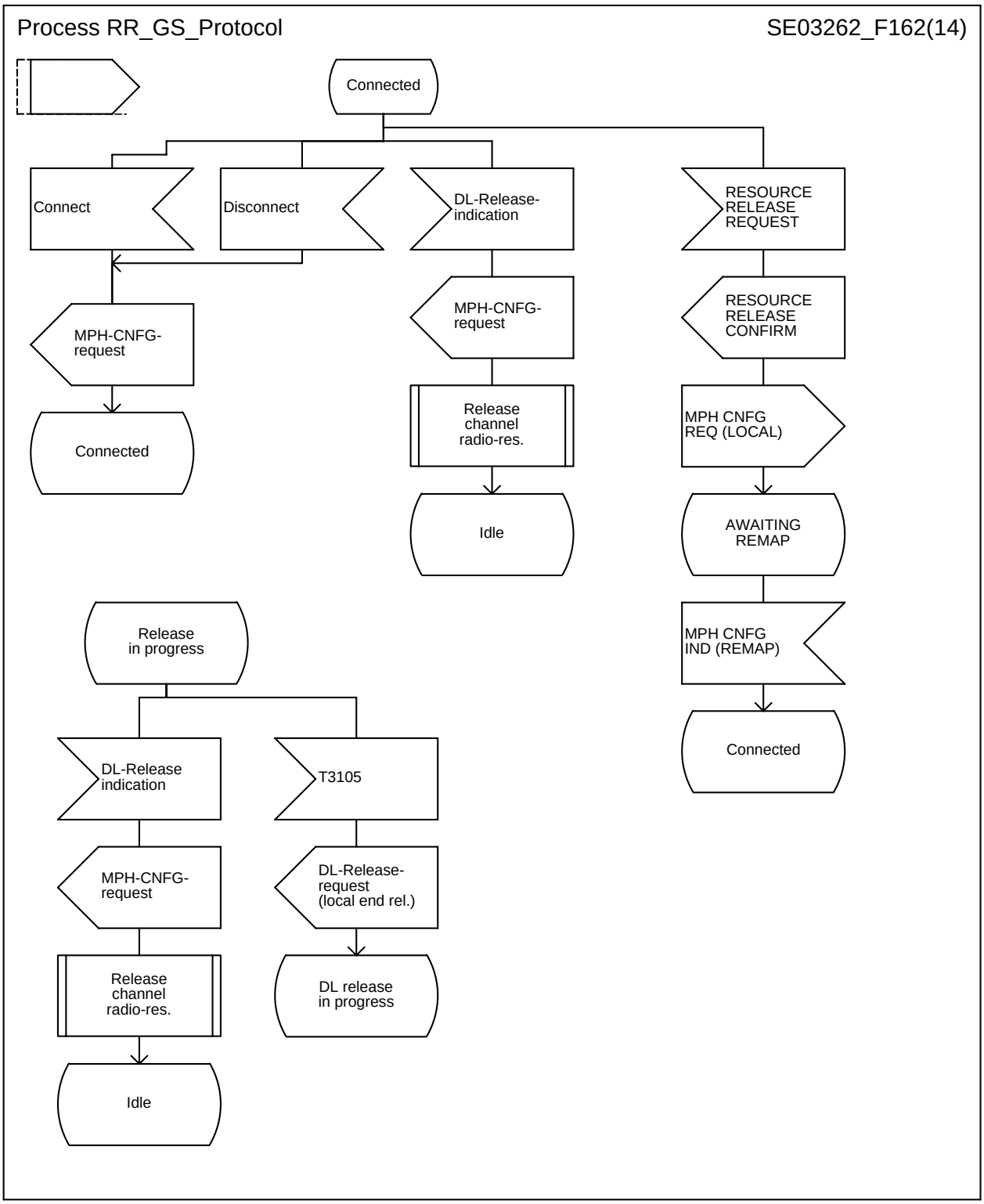

Figure C.7: (sheet 4 of 14) RR GS protocol

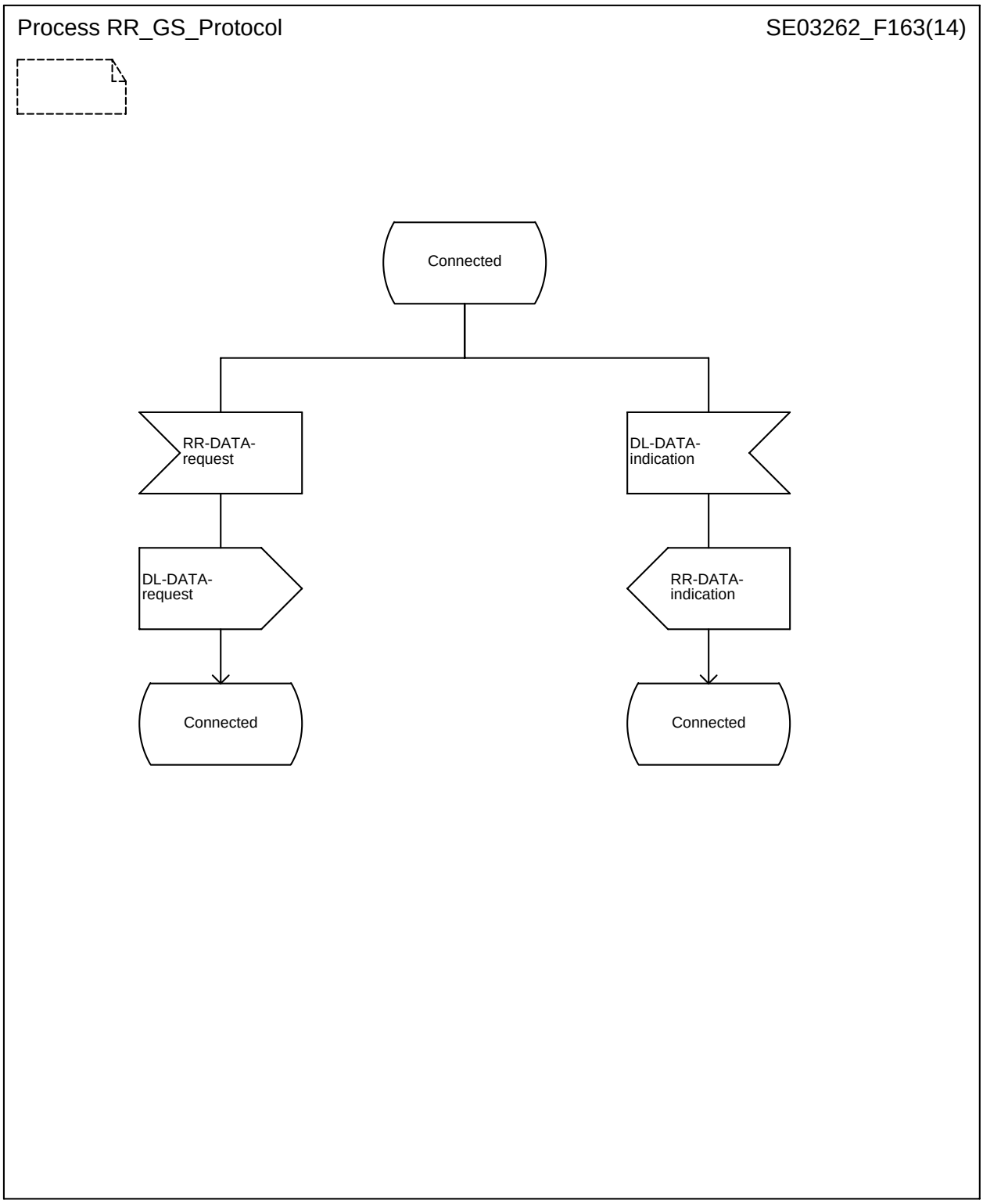

Figure C.7: (sheet 5 of 14) RR GS protocol

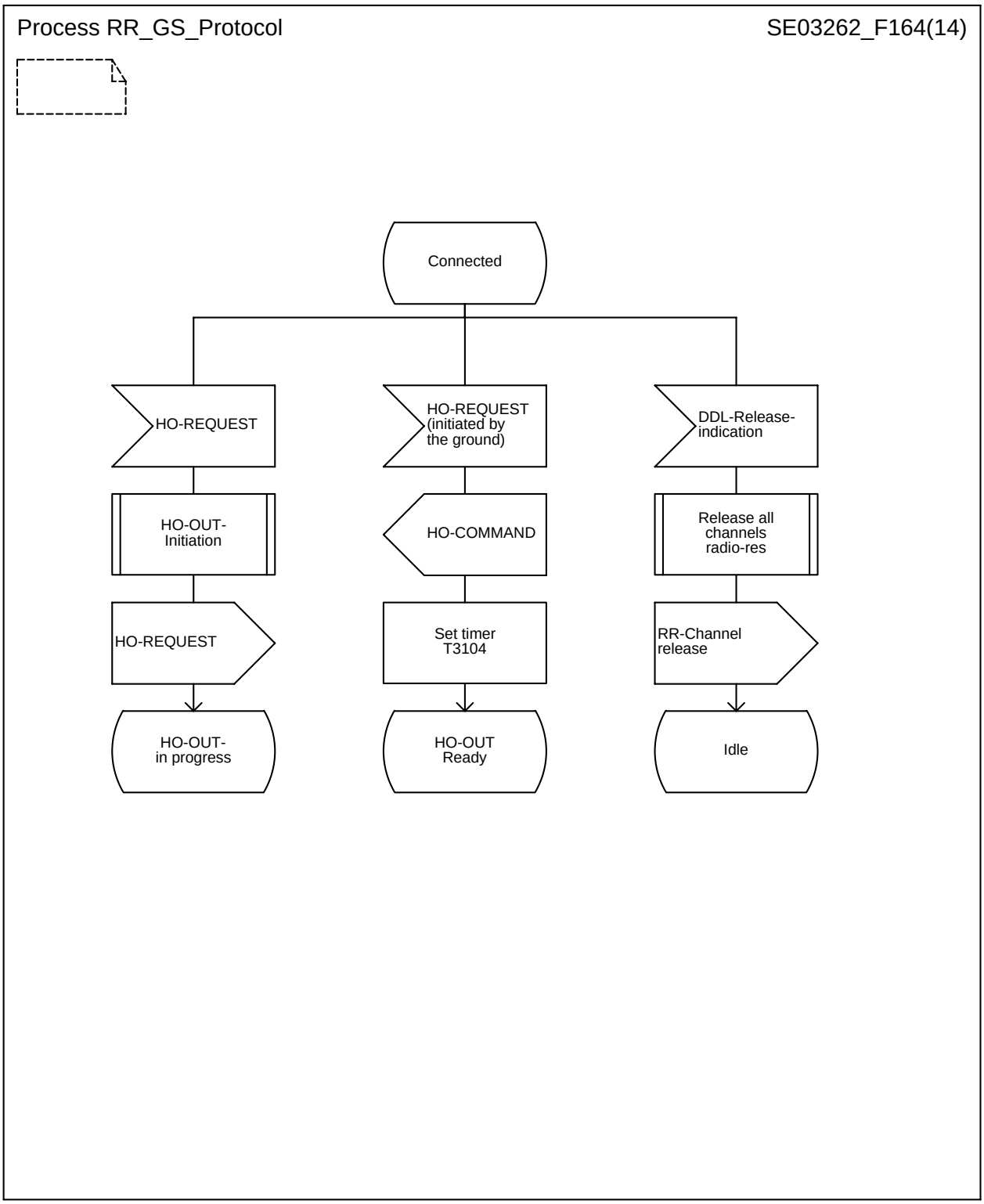

Figure C.7: (sheet 6 of 14) RR GS protocol

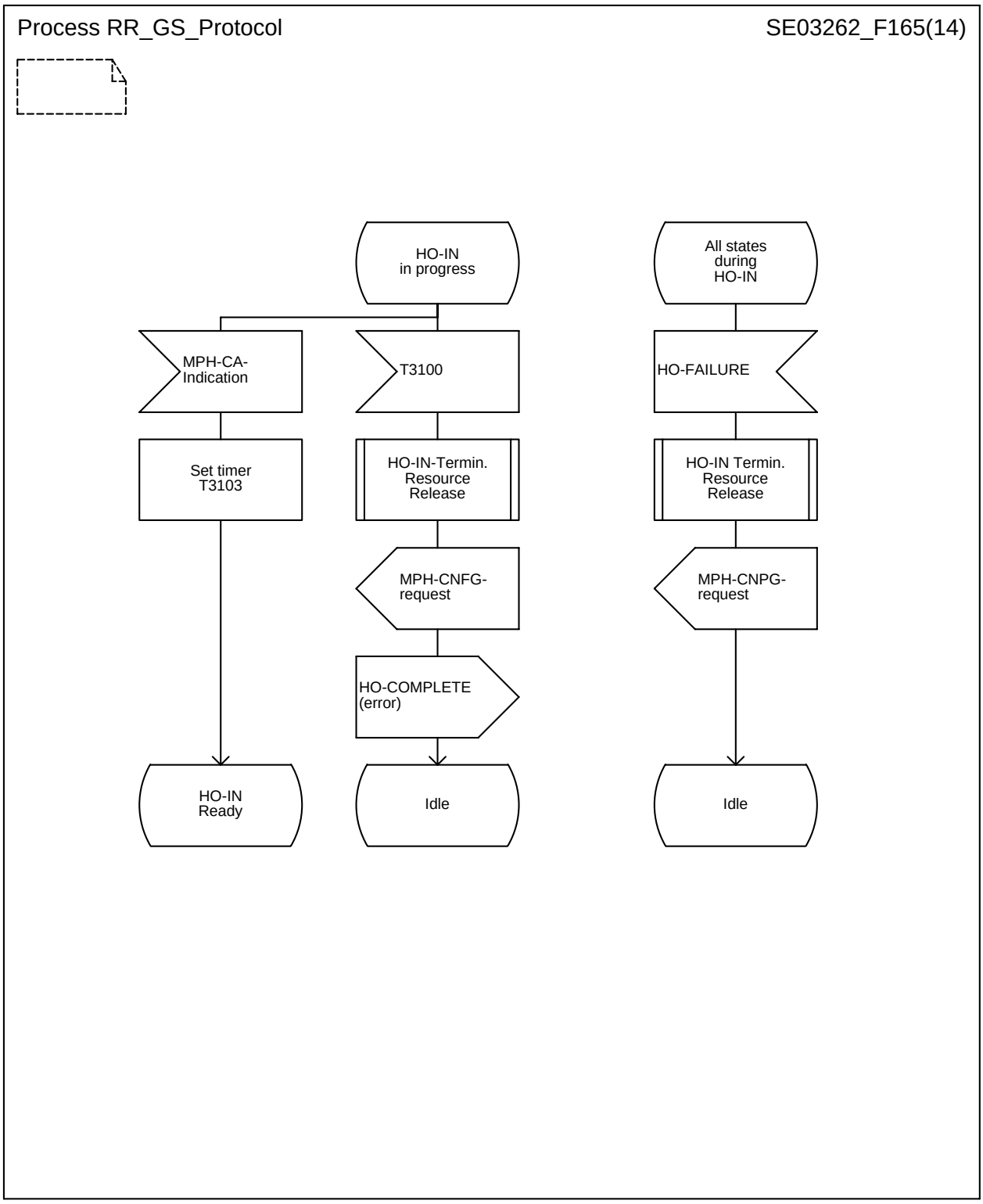

Figure C.7: (sheet 7 of 14) RR GS protocol

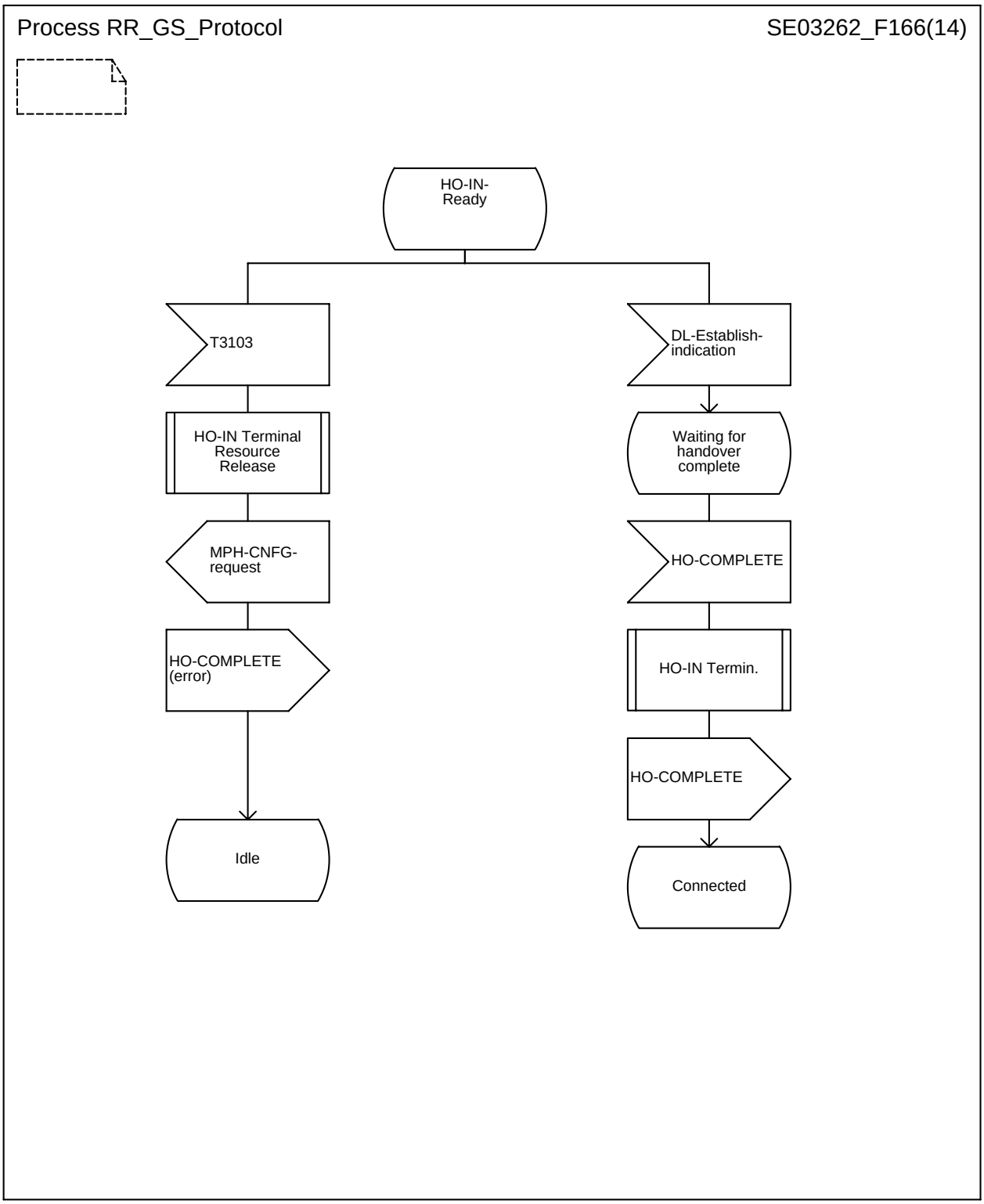

Figure C.7: (sheet 8 of 14) RR GS protocol

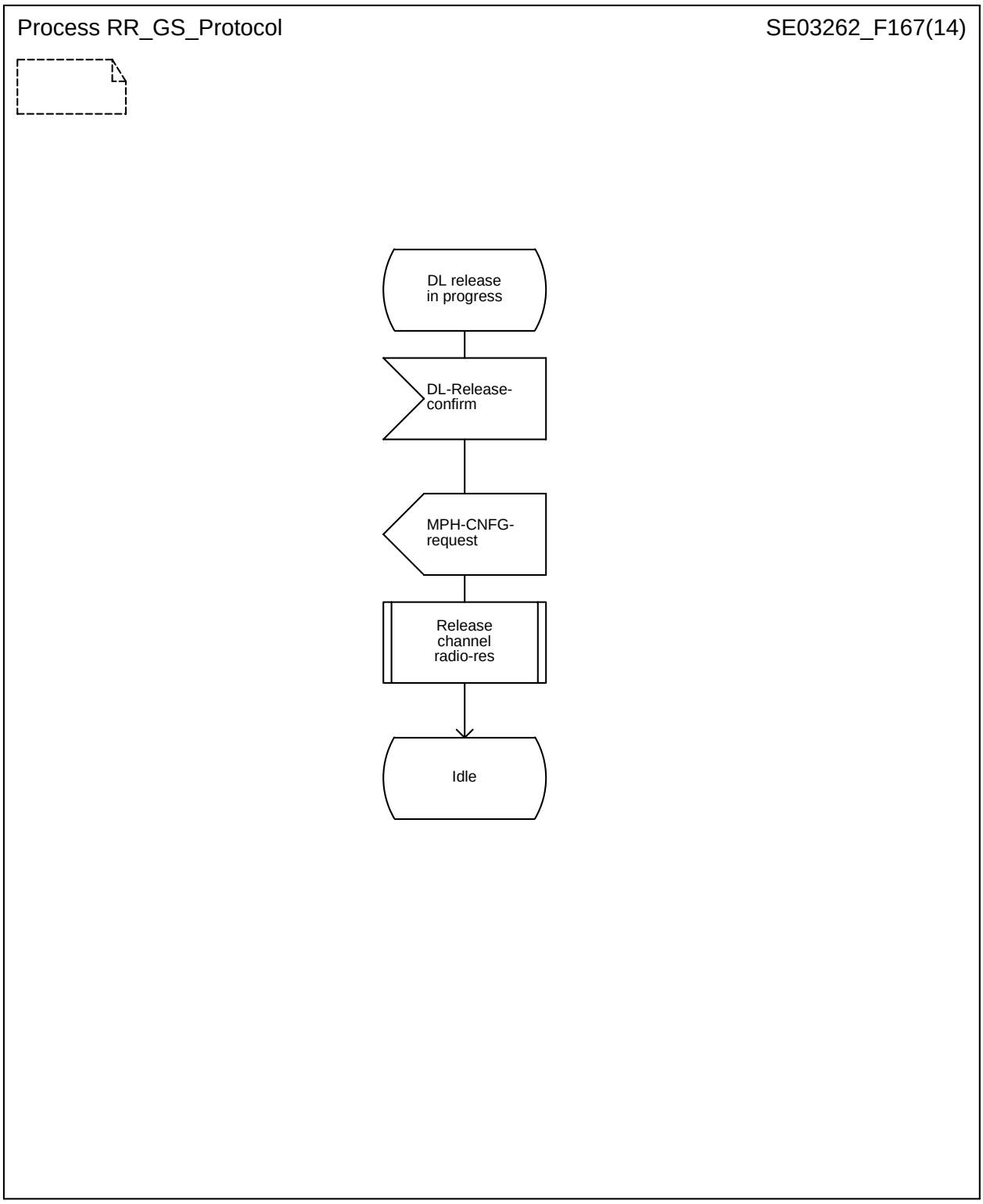

Figure C.7: (sheet 9 of 14) RR GS protocol

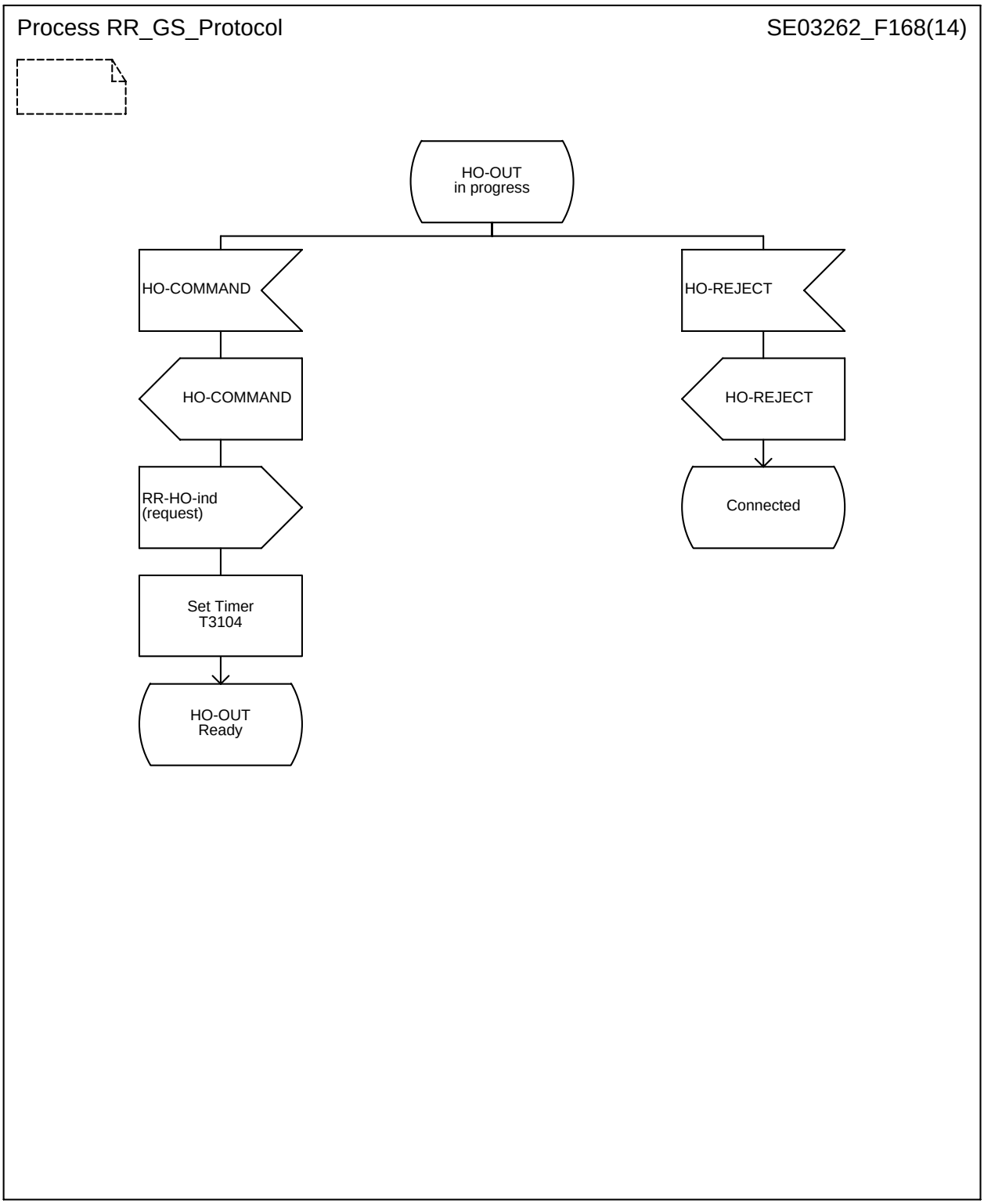

Figure C.7: (sheet 10 of 14) RR GS protocol

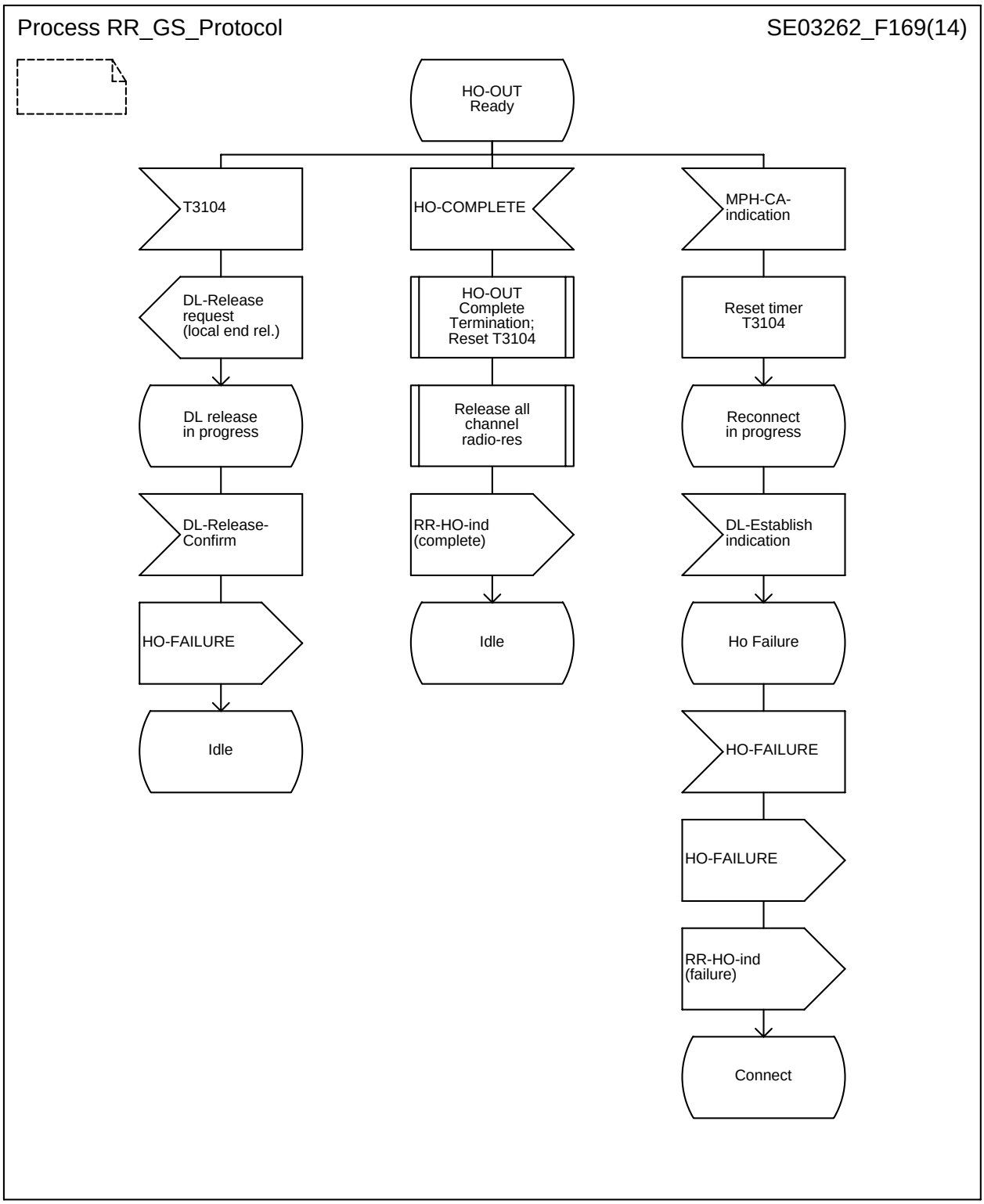

Figure C.7: (sheet 11 of 14) RR GS protocol

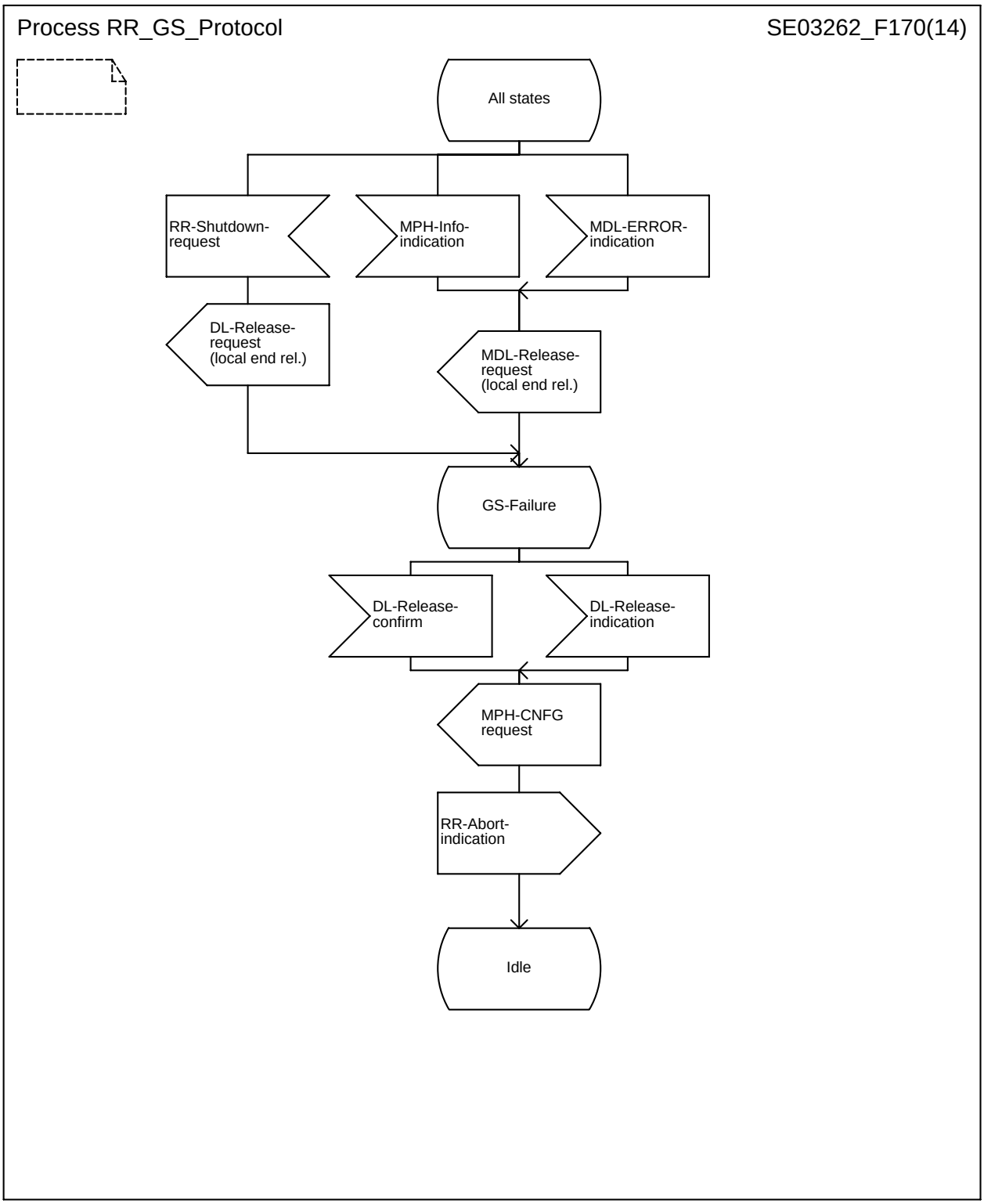

Figure C.7: (sheet 12 of 14) RR GS protocol

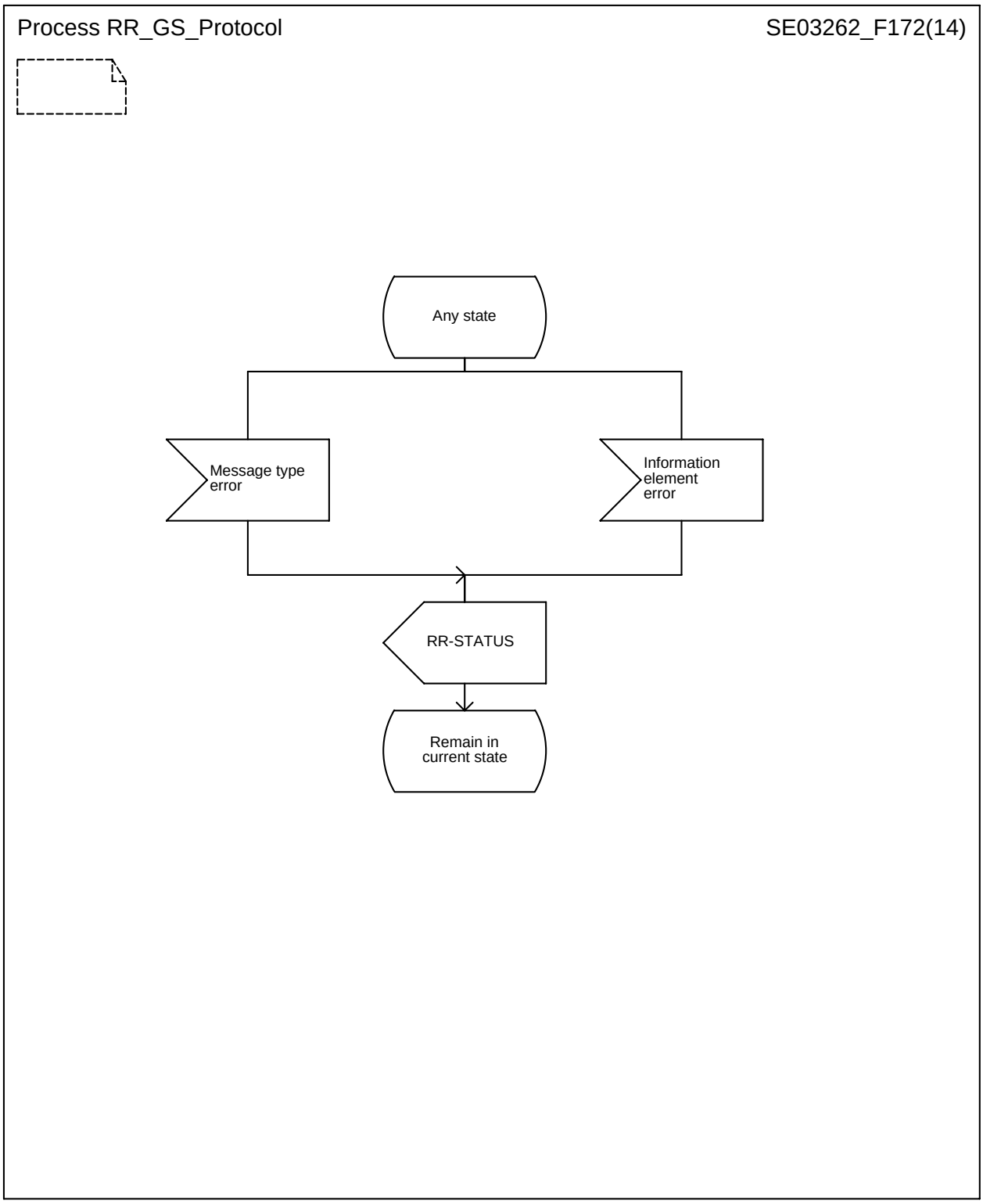

Figure C.7: (sheet 13 of 14) RR GS protocol

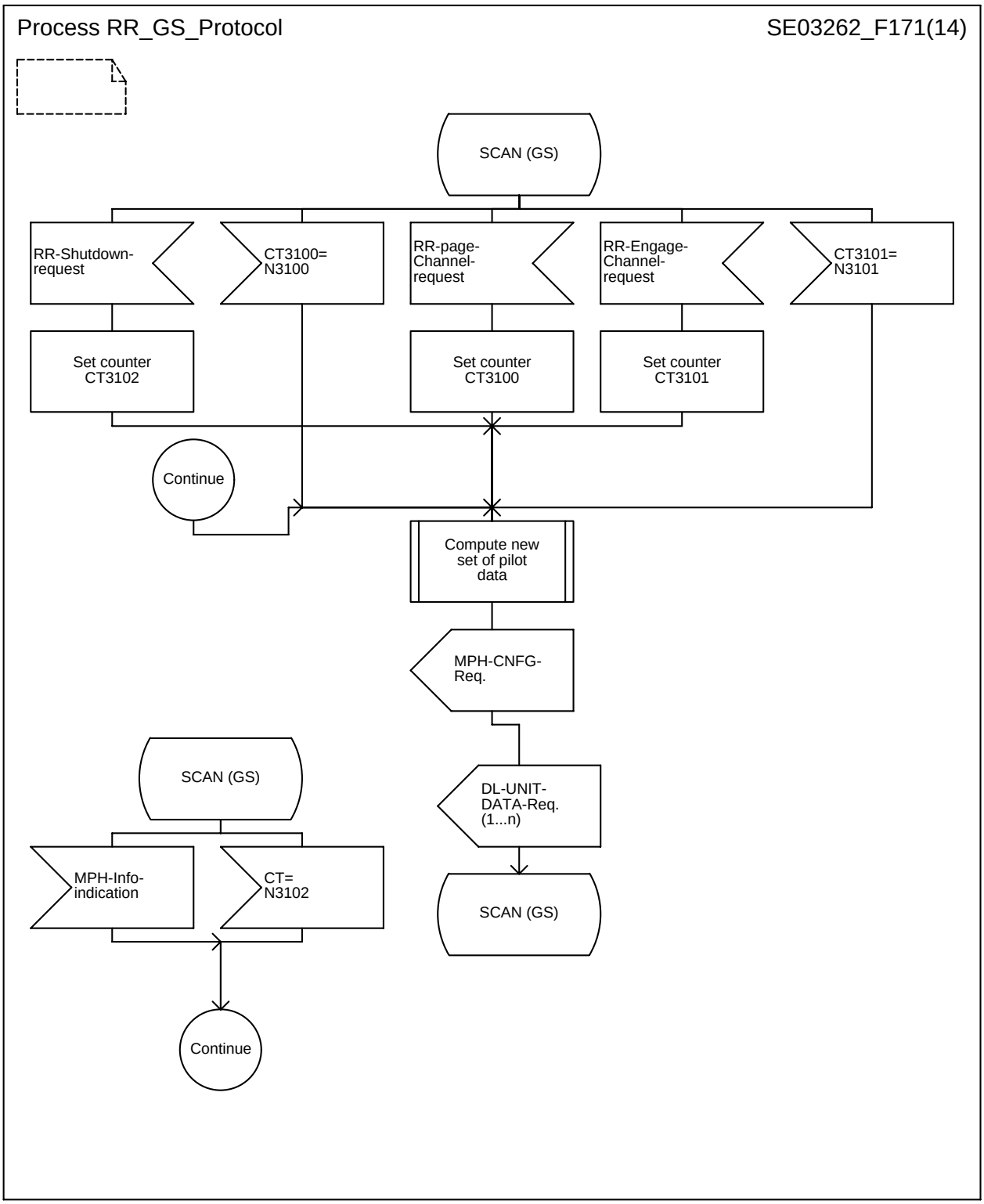

Figure C.7: (sheet 14 of 14) RR GS protocol

History

Document history			
June 1996	Public Enquiry	PE 108:	1996-06-24 to 1996-10-18
June 1997	Vote	V 9735:	1997-06-17 to 1997-08-29
September 1997	First Edition		

ISBN 2-7437-1728-9
Dépôt légal : Septembre 1997