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## Contents

Foreword .....	7
1 Scope .....	9
2 Normative references .....	9
3 Abbreviations.....	10
3.1 Definitions .....	10
3.2 Abbreviations .....	10
3.3 Symbols.....	11
4 Service definition .....	11
4.1 Packet mode services.....	11
5 Network architecture .....	11
5.1 Support of multiple network layer protocols .....	12
5.2 Data transmission .....	12
5.3 AT functionality .....	12
5.3.1 Interworking function .....	12
5.3.2 Location registration procedure .....	13
5.3.3 Dynamic resource management .....	13
5.4 GSS functionality .....	13
5.4.1 Administrative aspects .....	14
5.4.1.1 Data call phases and activities .....	14
5.4.1.2 Collection of data for call charging .....	14
5.5 CIF functionality .....	15
5.5.1 Interworking with GSSs .....	15
5.5.2 TFTS packet messages conversion.....	16
5.5.3 Address conversion.....	16
6 End to end data flow.....	16
6.1 CALL management procedures.....	16
6.1.1 AT originated call establishment .....	17
6.1.2 CIF originated call establishment .....	17
6.1.3 Data transfer.....	17
6.1.4 Handover procedures.....	17
6.1.5 Call clearing procedures.....	17
6.2 Scenarios.....	17
7 AT to GSS interface aspects .....	18
7.1 General .....	18
7.2 Layer 2 aspects.....	19
7.3 AT location registration procedure .....	19
7.4 Data transfer services provided by signalling layer 3 on the AT side .....	19
7.4.1 General.....	19
7.4.2 Service states at the AT side of the AT-GSS Interface .....	20
7.5 Data transfer services provided by signalling layer 3 on the GSS side .....	20
7.5.1 General.....	20
7.5.2 Service state diagram AT-GSS .....	20
7.6 Dynamic resource management.....	21
7.6.1 General.....	21
7.6.2 Varying throughput transmission.....	21
7.6.2.1 Aircraft-originated throughput modification.....	21
7.6.2.2 Ground initiated throughput modification.....	21
7.6.3 Decision strategy .....	22
7.6.3.1 Throughput increase.....	22
7.6.3.2 Throughput decrease .....	23

7.7	Elementary procedures for packet switched data transfer .....	23
7.7.1	General .....	23
7.7.2	DT states .....	24
7.7.2.1	Call states at the AT side of the interface .....	24
7.7.2.2	Call states at the GSS side of the interface .....	24
7.7.2.3	Packet-switched DT procedures .....	24
7.7.3	Aircraft location management .....	25
7.7.3.1	General .....	25
7.7.3.2	Location registration .....	25
7.7.3.2.1	General .....	25
7.7.3.2.2	Connection request .....	25
7.7.3.2.3	Connection confirmation .....	26
7.7.3.2.4	Connection rejection .....	26
7.7.3.2.5	Connection release .....	26
7.7.3.3	Location update .....	26
7.7.4	Aircraft originating call establishment procedures .....	26
7.7.4.1	General .....	26
7.7.4.2	Call request .....	26
7.7.4.3	Call connected .....	27
7.7.4.4	Call rejection .....	27
7.7.5	Ground originating call establishment procedures .....	27
7.7.5.1	General .....	27
7.7.5.2	Call connected .....	27
7.7.6	Call clearing .....	27
7.7.6.1	Exception conditions .....	27
7.7.6.2	Clearing initiated by the AT .....	28
7.7.6.3	Clearing initiated by the GSS .....	28
7.7.6.4	Completion of clearing .....	28
7.7.6.5	Clear collision .....	28
7.7.7	Miscellaneous procedures .....	29
7.7.7.1	Data transfer air-to-ground .....	29
7.7.7.2	Data transfer ground-to-air .....	29
7.7.7.3	Handover .....	29
7.7.7.3.1	AT side .....	29
7.7.7.3.2	GSS side .....	29
7.7.7.4	Resource management .....	29
7.7.7.4.1	General .....	29
7.7.7.4.2	Throughput increase .....	30
7.7.7.4.3	Throughput decrease .....	30
7.8	Handling of error conditions .....	31
7.8.1	General treatment of error conditions .....	31
7.8.2	Message type error .....	31
7.8.3	Mandatory information element error .....	31
7.9	Message functional definitions and contents .....	32
7.9.1	DTM messages .....	33
7.9.1.1	Connect .....	33
7.9.1.2	Disconnect .....	33
7.9.1.3	Packet data transfer (PD1) .....	33
7.9.1.4	Packet data transfer (PD2) .....	34
7.9.2	Supplementary RRM messages .....	34
7.9.2.1	Throughput modification request .....	34
7.9.2.2	Throughput modification command .....	35
7.9.2.3	Throughput modification reject .....	35
7.10	General message format and information elements coding .....	35
7.10.1	Overview .....	35
7.10.2	Protocol discriminator .....	36
7.10.3	Transaction identifier .....	36
7.10.4	Message type .....	36
7.10.5	Capacity request .....	37
7.10.6	Slot allocation .....	37
7.10.7	DT-cause .....	37
7.10.8	Data information .....	38
7.11	List of system parameters .....	38

7.11.1	Timers for data transfer on the AT side .....	38
7.11.2	Timers for data transfer on the GSS side.....	38
7.12	Definition of primitive parameters .....	39
7.12.1	Primitive parameters for DT .....	39
7.12.2	Additional primitive parameters for the RR service .....	39
8	Interworking at the GSS .....	40
8.1	General .....	40
8.2	Relay function description.....	40
8.3	DT states at the GSS side of the AT-GSS and GSS-CIF interfaces .....	40
9	GSS to CIF interface aspects.....	41
9.1	General .....	41
9.2	Data transfer services provided by signalling layer 3 on GSS side .....	41
9.2.1	General GSS .....	41
9.2.2	Service state diagram GSS.....	41
9.3	Data transfer services provided by signalling layer 3 on the CIF side .....	42
9.3.1	General.....	42
9.3.2	Service state diagram CIF.....	42
9.4	Elementary procedures for packet switched DT .....	43
9.4.1	Overview.....	43
9.4.1.1	General .....	43
9.4.2	DT states.....	43
9.4.2.1	Call states at the GSS side of the interface.....	43
9.4.2.2	Call states at the CIF side of the interface.....	43
9.4.2.3	Packet-switched DT procedures.....	44
9.4.3	GSS originating call establishment procedures.....	44
9.4.3.1	Call request.....	44
9.4.3.2	Call connected .....	44
9.4.4	CIF originating call establishment procedures .....	45
9.4.4.1	Call request.....	45
9.4.4.2	Call connected .....	45
9.4.5	Call clearing.....	45
9.4.5.1	Clearing initiated by the CIF.....	45
9.4.5.2	Clearing initiated by the GSS.....	46
9.4.5.3	Completion of clearing.....	46
9.4.6	Miscellaneous procedures.....	46
9.4.6.1	Data transfer GSS-to-CIF .....	46
9.4.6.2	Data transfer ground to air.....	46
9.4.6.3	Handover .....	46
9.4.6.3.1	GSS side.....	46
9.4.6.3.2	CIF side.....	46
9.5	Handling of error conditions.....	47
9.5.1	General treatment of error conditions .....	47
9.5.2	Message type error .....	47
9.5.3	Mandatory information element error .....	47
9.6	Message functional definitions and contents .....	47
9.6.1	X.25 layer 3 sub-layer.....	47
9.6.2	Data transfer management sub-layer.....	48
9.6.2.1	Packet data transfer (PD1).....	48
9.6.2.2	Packet data transfer (PD2) .....	48
9.6.2.3	Connect .....	49
9.6.2.4	Disconnect.....	49
9.7	General message format and information elements coding.....	49
9.7.1	Service provider indicator.....	49
9.7.2	DT cause .....	49
9.7.3	Data information .....	50
9.8	List of system parameters.....	50
9.8.1	Timers for data transfer on the AT side .....	50
9.8.2	Timers for data transfer on the GSS side .....	51
9.8.3	Timers for data transfer on the CIF side.....	51
9.9	Definition of primitive parameters .....	51

Annex A (informative):	Information on expected usage of data service.....	52
A.1	Status update information.....	52
A.2	File transfer.....	52
A.3	Information update.....	52
A.4	Interactive services.....	52
Annex B (informative):	Scenarios .....	53
Annex C (informative):	SDL of TFTP layer 3 DTM processes.....	68
History .....		108

## Foreword

This draft European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

<b>Proposed transposition dates</b>	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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## 1 Scope

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

The TFTS packet data transport 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: "Radio Equipment and Systems (RES); Terrestrial Flight Telephone System (TFTS); Part 1: Speech services, facilities and requirements".
- [2] ETS 300 326 (1996): "Radio Equipment and Systems (RES); Terrestrial Flight Telephone System (TFTS); Part 2: Speech services, radio interface".
- [3] ETS 300 326: "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.31: "Support of packet mode terminal equipment by an ISDN".
- [6] ITU-T Recommendation X.121: "International numbering plan for public data networks".
- [7] ITU-T Recommendation Z.100: "CCITT Specification and description language (SDL)".
- [8] ARINC 746-3: "Cabin communication systems (CCS)"
- [9] ARINC 752: "Terrestrial Flight Telephone System (TFTS) Airborne radio subsystem"
- [10] ISO 9577: "Information technology - Telecommunications and information exchange between systems - Protocol identification in the network layer".
- [11] ISO 8208: "Information technology - Data communications - X.25 Packet Layer Protocol for Data Terminal Equipment".
- [12] ITU-T Recommendation Q.931: "Digital subscriber Signalling System No. 1 (DSS 1) - ISDN user-network interface layer 3 specification for basic call control".

### 3 Abbreviations

#### 3.1 Definitions

**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.

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

**La channel:** a channel with a gross data rate of 2,4 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 AT and the GSS (ETS 300 326 Part 2 [2]).

#### 3.2 Abbreviations

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

ACARS	
AS	Aircraft Station
AT	Avionic Termination
ATEI	Air Termination Equipment Identifier
BCCH(D)	Broadcast Control CHannel (Data)
CIF	Centralised Interworking Function
DCCH	Dedicated Control Channel
DT	Data Transmission
DTM	Data Transmission Management
DT-SAP	Data Transport 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 Fixed
MN-SAP	Mobile Network Service Access Point
MV	Mandatory Variable
OV	Optional with Variable length
RNR	Receiver Not Ready
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 Telephone System
TFTS Forum	An informal organisation of telecommunications operators collaborating to operate TFTS
TI	Transaction Identifier
VC	Virtual Circuit

### 3.3 Symbols

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
resp	response
req	request
trans	transport

## 4 Service definition

This ETS specifies support for the following data types:

- packet transport on TFTS radio interface.

The TFTS packet data transport 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

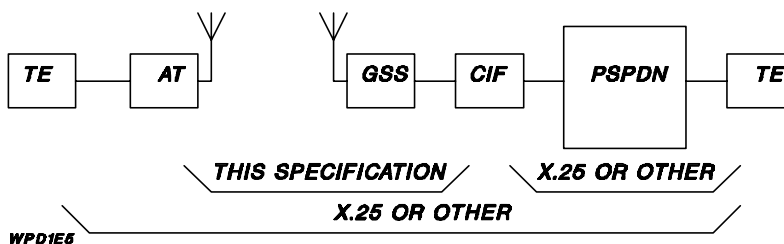
The types of packet mode services supported by the TFTS packet transport service may include the following:

- status update information;
- file transfer;
- information update;
- interactive services.

## 5 Network architecture

The TFTS packet data transport 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). 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 transport 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. 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. X.25 [4] or ARINC 746 [8].

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 functional architecture of the system.

**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 X.25 [4] and TCP/IP.

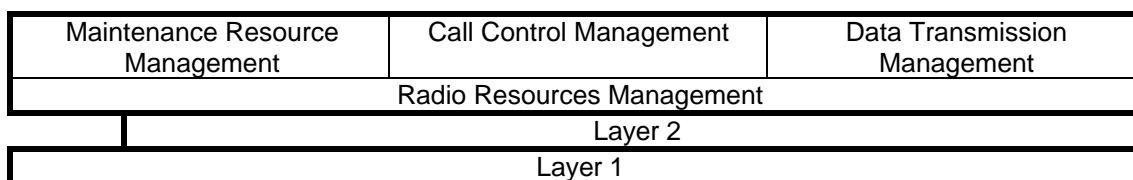
The interworking between the ground user and the TFTS network is carried out by the CIF. The first octet of the data field defined in subclause 7.9.1 shall be an Initial Protocol Identifier (IPI). IPIs can conform to ISO 9577 [10] in which case, the message shall conform to subclause 7.9.1.3 or be defined 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 side and on the Ground Station side by the Data Transmission Management (DTM) entity.

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

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



**Figure 2: Sub layer 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 (subclause 7.9.1).

### **5.3.2 Location registration procedure**

The AT shall carry out the Location Registration Procedure 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 aircraft 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.

To differentiate between Location Registration messages and other services a specific message type value is used as specified in table 11.

The content of the Location Registration message is outside the scope of this ETS.

As the use of the Location Registration Procedure is optional, it shall be implemented so that it can be enabled or disabled in service. No equipment shall be implemented so as to preclude the use of location registration.

### **5.3.3 Dynamic resource management**

The AT shall dynamically manage radio resources 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 (subclause 7.9.1.3 or subclause 7.9.1.4), the GSS function shall extract the user data transferred and encapsulate it in the corresponding PACKET DATA TRANSFER message 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 Virtual Circuit (VC).

The VC shall be established on the 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.

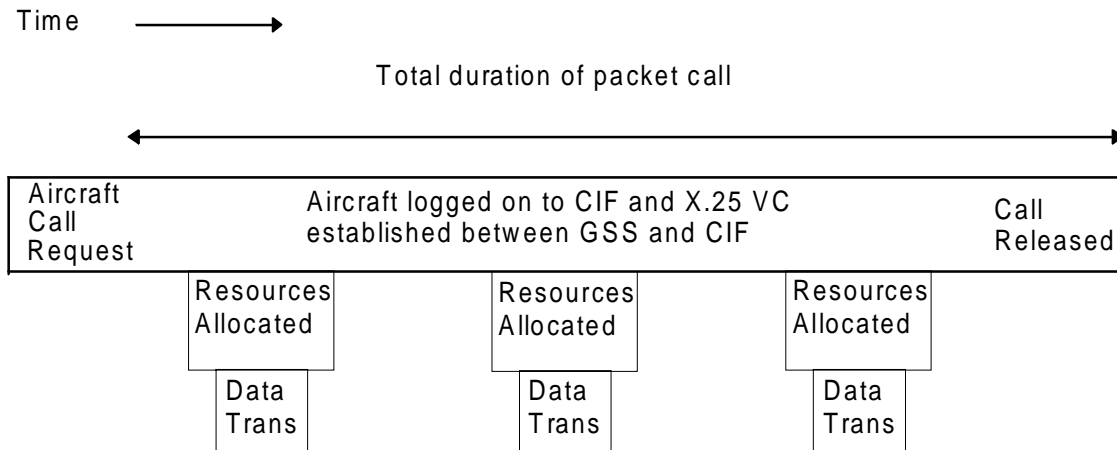
For ground-to-air transfer, additional functionality is required if no radio resources are available. The GSS shall buffer the first message whilst it sends a PAGE REQUEST message to the AT alerting it that it has data for it. The AT shall then request that a Dedicated Control Channel (DCCH) be established. Once a DCCH is established the GSS shall forward the PACKET DATA TRANSFER message to the aircraft.

The GSS shall dynamically manage radio resources 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 Central Interworking Function 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 radio resources 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 X.25 virtual circuits with the CIF;
- 2) occupancy of Slow Associated Control CHannel (SACCH) channels during those phases of a call when radio resources are in use;
- 3) occupancy of Fast Associated Control CHannel (FACCH) channels during those phases of a call when radio resources 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 radio resource. Thus, a 9,6 kbps 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 well-defined networking protocol, such as ITU-T standard X.25.

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 acting as a gateway between public X.25 packet networks and the TFTS.

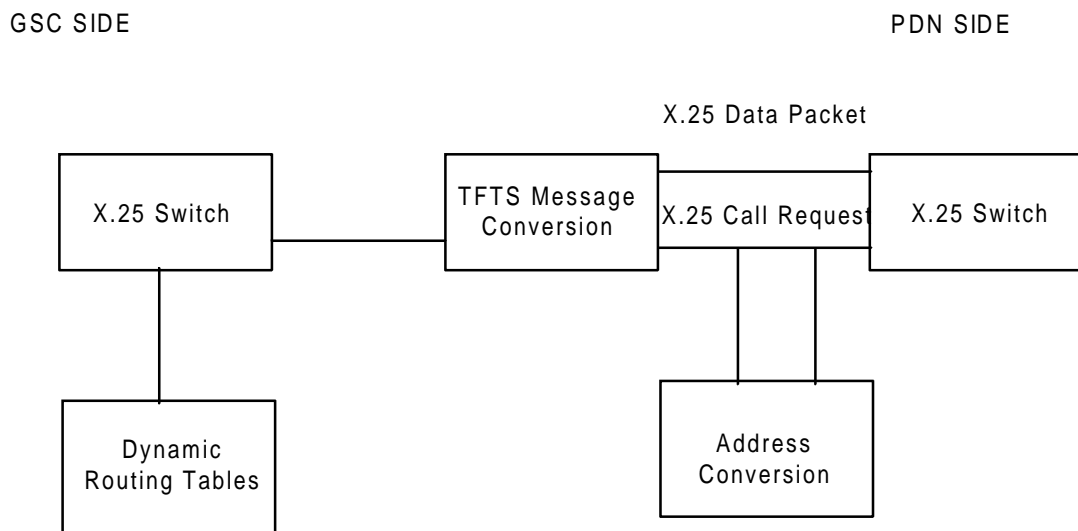


Figure 4: CIF functional overview (X.25)

### 5.5.1 Interworking with GSSs

Together with the GSSs, the CIF shall manage a set of X.25 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 be 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 transport 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 (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 (subclauses 9.6.2.1 and 9.6.2.2) message header and envelop the whole message in an X.25 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 a standard X.121 [???] address if using an X.25 public switched packet data network. 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 public 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 public 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. Figure 5 and figure 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 (subclause 7.7.4). The GSS responds with the establishment of an appropriate connection to the CIF (subclause 9.1).

### **6.1.2 CIF originated call establishment**

When the CIF receives a DT\_DATA\_REQUEST from a higher layer to send packet mode data, it shall establish an appropriate connection to the GSS (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 Transport connection exists between itself and the target AT.

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

If physical radio resources 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 and subclause 7.7.5 of this ETS.

On receipt of a DT-PAGE REQUEST for data transport the AT shall establish radio resources to the GSS by using the Data Transport 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 Central Interworking Function. These processes are illustrated in scenarios 6.7 and 6.8 in annex B. This shall be achieved by the mechanisms defined in subclauses 6.7 and 6.8 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 radio resources 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. Handover aspects specific to the packet data service on the radio interface are defined in subclause 7.7.7.3.

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 utilise the radio resources management procedures defined in clause 10 of ETS 300 326-2. Clearing of the radio resource 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.

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

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 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 sub-layers (figure 7).

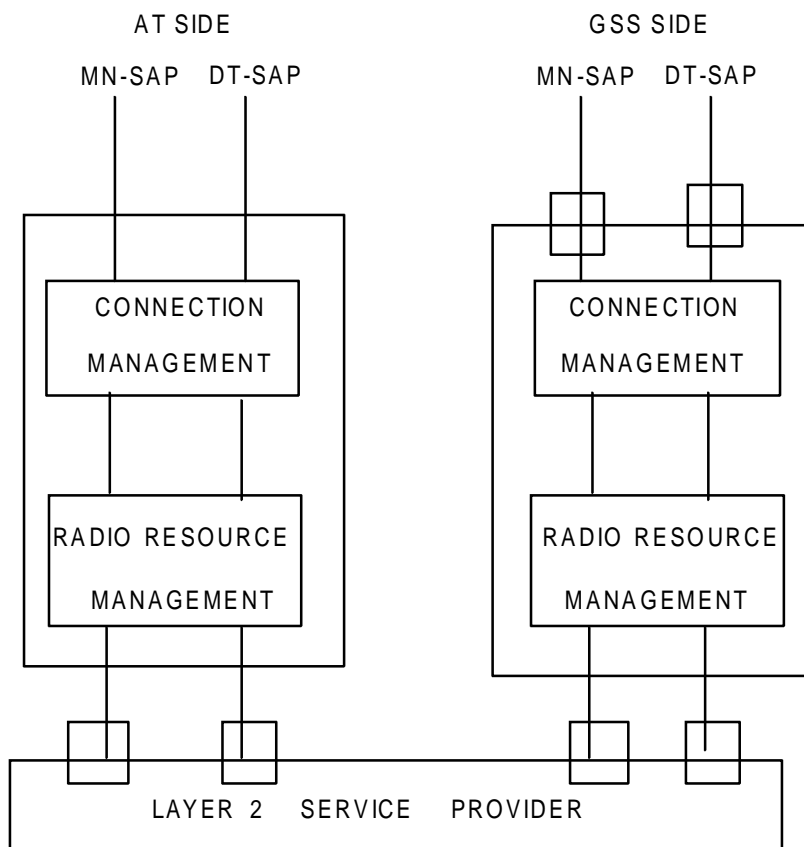
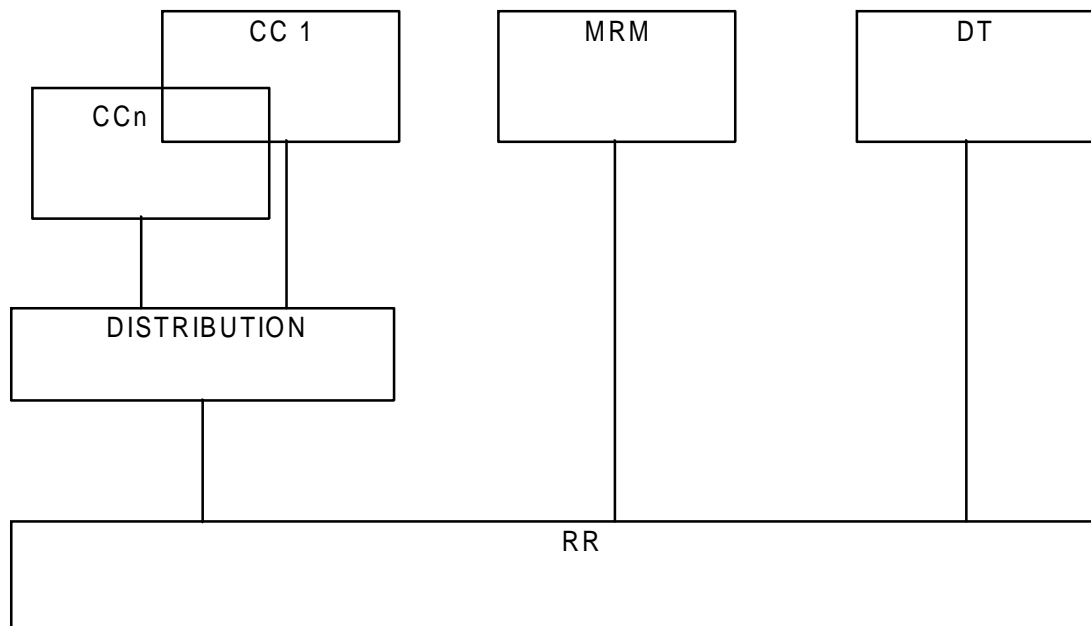


Figure 7: Protocol Architecture on Signalling Layer 3 AT-GSS



**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 (L2).

As defined in subclause 9.3.6 of ETS 300 326-2, the SAPI value already defined for call control, 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.

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 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 radio resources allocated to the AT, i.e. the AT shall perform Location Updating at each change of cell.

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

### 7.4.1 General

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

- data transport transaction establishment;
- data transport transaction maintenance;
- data transport transaction clearance.

In addition to these direct services, the DT provides management of the resources allocated to data transport 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, 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 Transport Management (DTM).

#### 7.4.2 Service states at the AT side of the AT-GSS Interface

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

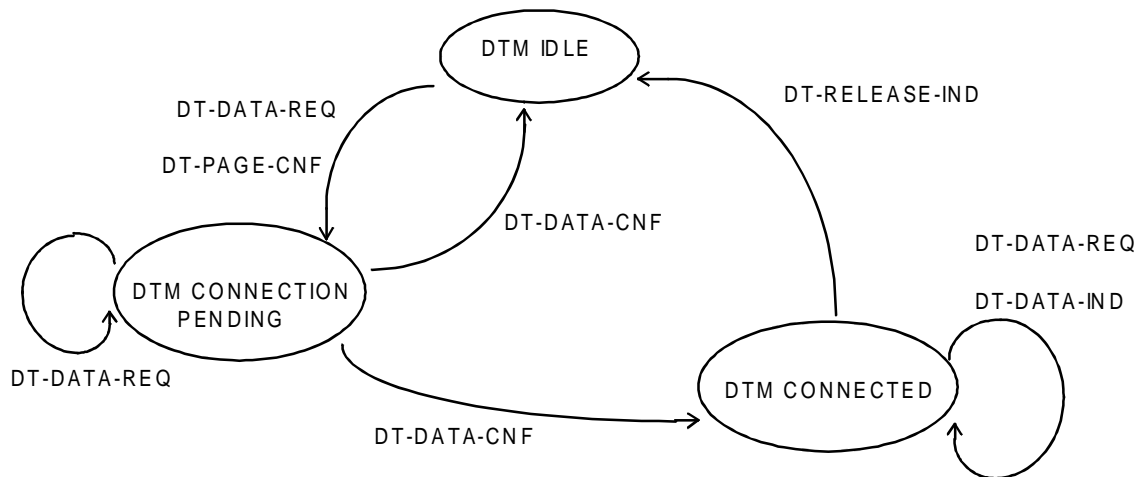


Figure 9: Overview Service State Diagram of the DT entity on the AT Side

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

##### 7.5.1 General

The DT services shall be provided at the Data Transport SAP (DT-SAP). The service class consists of the following services:

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

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

##### 7.5.2 Service state diagram AT-GSS

The DT services provided at the service access point data transport SAP (DT-SAP) are illustrated in the state diagram in figure 10.

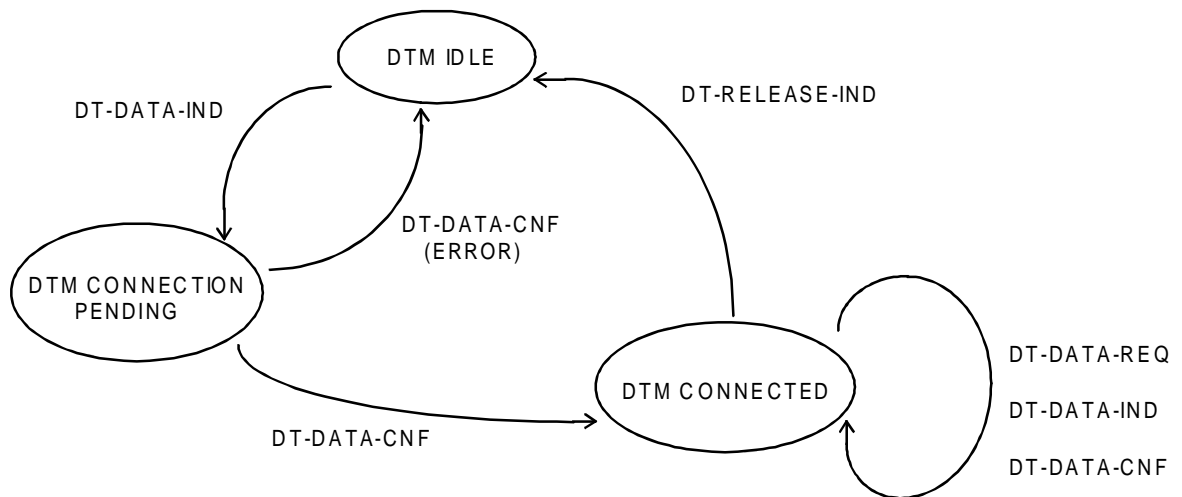


Figure 10: Overview service state diagram of the DT entity on the GSS side

## 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 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 utilisation 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 adapt itself 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.

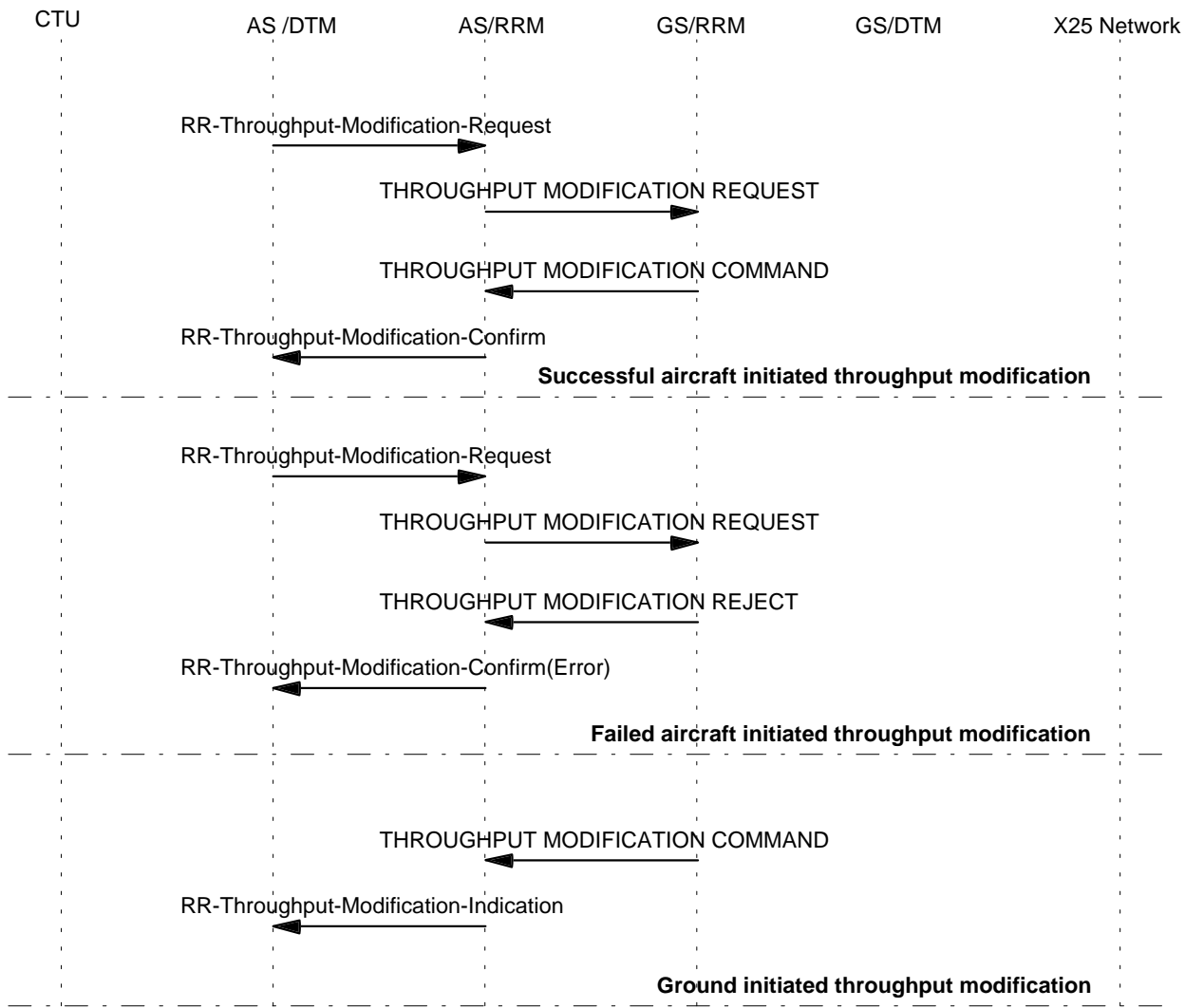


Figure 11: Message flow illustration for throughput modification

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).

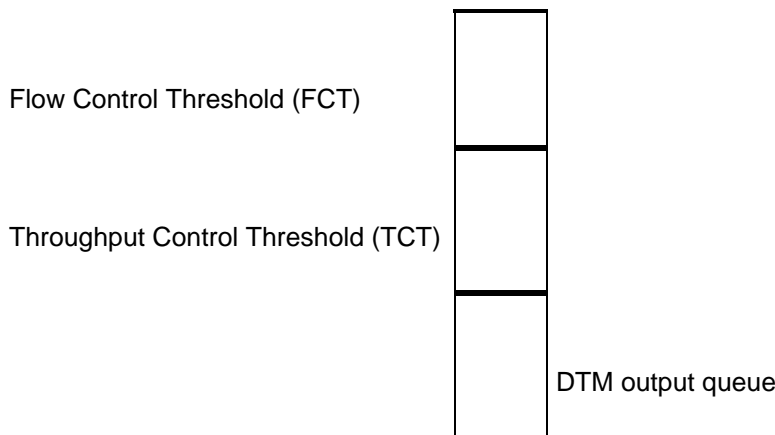
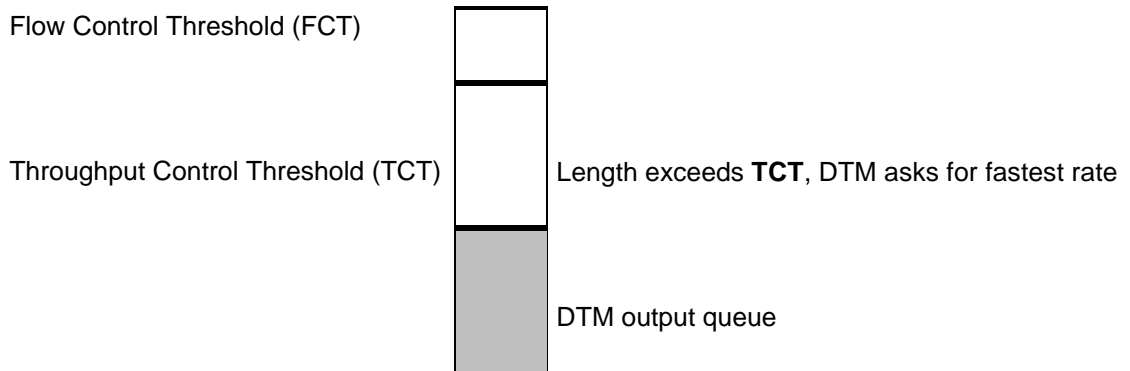


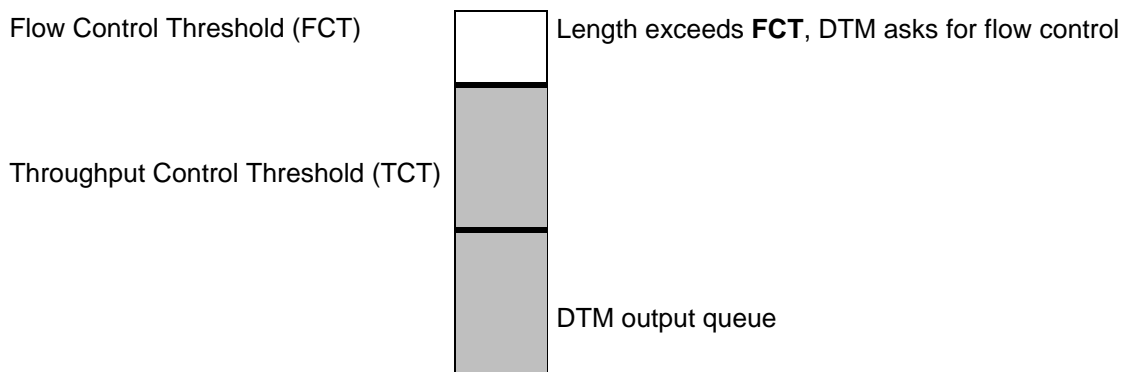
Figure 12: Throughput modification thresholds

When the length exceeds the TCT then DTM asks for faster transmission rate to its own RRM entity, which 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 under 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 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 DT 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 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 (DT) are contained in annex C of this ETS.

## 7.7.2 DT states

### 7.7.2.1 Call states at the AT side of the interface

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.

**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 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 sub-layer has indicated that a change of dedicated radio resource is taking place.

### 7.7.2.2 Call states at the GSS side of the interface

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 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.

**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 DT 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 characterised as requiring a degree of intelligent processing by the terminal in either their generation or analysis.



The procedures needed for DT 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.

NOTE: The actual content and format of the Location Registration and Location Update packets is outside the scope of this ETS.

#### **7.7.3.2 Location registration**

##### **7.7.3.2.1 General**

When the RRM sub-layer first notifies the AT DT entity that radio resources are available the AT DTM shall request the Radio Resources (RR) sub-layer for the establishment of indicated radio resources. Timer T333 (table 15) shall then be set and the "RR-CONNECTING PENDING" state entered.

When indicated radio resources are established, a confirmation shall be given to indicate that RR is ready for data transfer and the first DT message (PACKET DATA TRANSFER) to the GSS shall be sent.

On the GSS side, RR shall indicate that radio resources has been established on request by the peer DT entity and the "DTM connection pending" state shall be entered.

Abnormal case:

If timer T333 expires in the RR-CONNECTING PENDING state, the radio resource 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.

##### **7.7.3.2.2 Connection request**

When establishment of indicated radio resources has been confirmed, the DT entity of the AT shall initiate call establishment by transferring a PACKET DATA TRANSFER message across the radio interface. 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. This state shall be supervised by timer T334.

Abnormal case:

If timer T334 expires in the "DTM connection pending" state, the radio resource 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.

#### **7.7.3.2.3 Connection confirmation**

Upon receiving an indication that the call has been accepted, the GSS shall send a CONNECT message across the radio 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 CIF is unable to accept the call, 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 DT 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 one or more packet data connections exist between the AT and the network the AT DT 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 sub-layers in the AT and in the GSS shall be established.

The DT entity of the AT shall request the RR-sub-layer for the establishment of indicated radio resources. Timer T333 shall then be set and the "RR-CONNECTING PENDING" state entered.

When indicated radio resources are established, a confirmation shall be given to indicate that RR is ready for data transfer and the first DT message (PACKET DATA TRANSFER) to the GSS shall be sent.

On the GSS side, RR shall indicate that radio resources has been established on request by the peer DT entity and the "DTM connection pending" state shall be entered.

Abnormal case:

If timer T333 expires in the RR-CONNECTING PENDING state, the radio resource 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 radio resources has been confirmed, the DT entity of the AT shall initiate call establishment by transferring a PACKET DATA TRANSFER message across the radio interface. 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. This state shall be supervised by timer T334.

Abnormal case:

If timer T334 expires in the "DTM connection pending" state, the radio resource 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 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.

#### **7.7.4.4 Call rejection**

Upon receiving an indication that the CIF is unable to accept the call, 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 DT-PAGE REQUEST message identifying the target aircraft and indicating "packet service" utilising the procedures of subclause 10.11.5.2.2 of ETS 300 326-2. On sending this DT-PAGE REQUEST message the GSS shall start timer T340 and enter the "AT connection pending" state.

On receipt of the DT-PAGE REQUEST message, the AT shall select a Transaction Identifier (subclause 7.10.3), request RRM to establish radio resources, 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 radio resources has been confirmed, the DT 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 sub-layer that radio resources 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 exceptions 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;
- request the release of used radio resources; 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, set timer T336 and enter the "RR release pending" state.

#### **7.7.6.3 Clearing initiated by the GSS**

Apart from the exception conditions 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 sub-layer of the release of radio resources, the AT shall stop timer T336, release the DTM transaction identifier and enter the "DTM IDLE" state.

Following the release of radio resources (by the AT), the GSS shall:

- stop timer T342; and
- enter the "DTM IDLE" state.

Abnormal cases:

If confirmation of release of radio resources 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 radio resources 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 (user) 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 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 (user).

### **7.7.7.3 Handover**

#### **7.7.7.3.1 AT side**

On receipt of an indication from the RRM sub-layer 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 sub-layer 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 section 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 sub-layer that handover has failed, the AT DTM shall determine from the RRM whether dedicated radio resources 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 (user) that the packet data connection has been released and enter the "DTM IDLE" state.

#### **7.7.7.3.2 GSS side**

On receipt of an indication from the RRM sub-layer that a handover is pending the GSS DTM shall request the higher layer (CIF) to suspend sending data, reset timer T335 and remain in the "DTM connected" state.

On receipt of an indication from the RRM sub-layer 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 sub-layer 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.

### **7.7.7.4 Resource management**

#### **7.7.7.4.1 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 radio

resources 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.

#### **7.7.7.4.2 Throughput increase**

##### **7.7.7.4.2.1 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) and timer T332 is not running, 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. The AT DTM shall on receipt of this primitive start timer T332 and remain in the "DTM CONNECTED" state.

##### **7.7.7.4.2.2 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), timer T332 is not running 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. The GSS DTM shall on receipt of this primitive start timer T332 and remain in the "DTM CONNECTED" state.

#### **7.7.7.4.3 Throughput decrease**

##### **7.7.7.4.3.1 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) and timer T332 is not running, the AT 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 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. The AT DTM shall on receipt of this primitive start timer T332 and remain in the "DTM CONNECTED" state.

#### **7.7.7.4.3.2 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), timer T332 is not running 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. The GSS DTM shall on receipt of this primitive start timer T332 and 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 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 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 DT-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

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 1 are required for the achievement of the Data Transfer Management process.

**Table 1: Message types for DTM**

Message type	Reference
CONNECT	7.9.1
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 DT 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 2.

Message type:	CONNECT
Significance:	Global
Direction:	Both

**Table 2: CONNECT Message Content**

Information element	Reference	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 3.

Message type:	DISCONNECT
Significance:	Global
Direction:	Both

**Table 3: DISCONNECT Message Contents**

Information element	Reference	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	
DT-Cause	7.10.7	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 that is to be passed across the interface. The message content shall be as defined in table 4.

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

**Table 4: PACKET DATA TRANSFER Message Contents**

Information element	Reference	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	7.10.8	both	MV	3-241
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 11 that is to be passed across the interface. The message content shall be as defined in table 4.

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

**Table 5: PACKET DATA TRANSFER Message Contents**

Information element	Reference	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	7.10.8	both	MV	3-241
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 6.

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

**Table 6: THROUGHPUT MODIFICATION REQUEST Message**

Information element	Reference	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	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 7.

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

**Table 7: THROUGHPUT MODIFICATION COMMAND Message**

Information element	Reference	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	7.10.6	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 8.

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

**Table 8: THROUGHPUT MODIFICATION REJECT Message**

Information element	Reference	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	7.10.7	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 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:

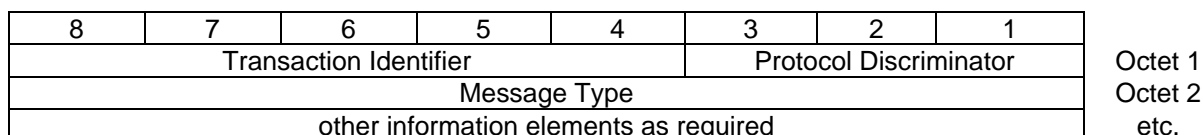
- protocol discriminator;
- transaction identifier;
- message type;
- other information elements as required.

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.



**Figure 15: General Message Organisation**

**7.10.2 Protocol discriminator**

The protocol discriminator shall conform to the requirements of ETS 300 326-2 subclause 10.11.8.2. The protocol discriminator shall be assigned the additional value defined in table 9.

**Table 9: 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 [12].

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

**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 10 and table 12.

**Table 10: 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 ISO9577 PD2 shall be used when the IPI conforms to table 11								

Table 11: 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 12: RRM Message Type Coding

8	7	6	5	4	3	2	1	
0	0	0	0	0	1	0	1	THROUGHPUT MOD REQUEST
0	0	0	0	0	1	1	0	THROUGHPUT MOD COMMAND
0	0	0	0	0	1	1	1	THROUGHPUT MOD 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 Capacity request

The capacity request Information Element (IE) shall conform to the requirements of figure 16 and table 13.

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

Figure 16: Capacity Request Information Element Format

Table 13: 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

### 7.10.6 Slot allocation

The Slot Allocation IE shall conform to the requirements of ETS 300 326-2 subclause 10.11.8.5.2.

### 7.10.7 DT-cause

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

8	7	6	5	4	3	2	1	
0	x	x	x	x	x	x	x	Octet 1
DT Cause								
DT Cause								Octet 2

Figure 17: DT Cause Information Element Format

**Table 14: DT-Cause Information Element coding**

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	Normal Clearing (AT-DT request)
0	0	0	0	0	0	1	0	Normal Clearing (CIF-DT request)
0	0	0	0	0	0	1	1	Normal Clearing (GSS request)
0	0	0	0	0	1	0	0	AT not authorised
0	0	0	0	0	1	0	1	Unknown AT
0	0	0	0	0	1	1	0	GSS-CIF temp 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

**7.10.8 Data information**

The Data Information IE shall conform generally to the requirements of ETS 300 326-2 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)								
packet data								octet 2 to 238

**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 15.

**Table 15: Timers on the AT side**

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry	At second expiry	Cross ref.
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	Note 1	Disconnect	n/a	
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	
NOTE:	There are four normal stop 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 16.

**Table 16: Timers for Data Transfer on the GSS Side**

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry	At second expiry	Cross ref.
336	20	RR-rel- pend	DISC	RR-rel-ind	clear call	n/a	
340	20	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 DT

The additional primitives required for the DT service are listed in table 17.

**Table 17: Primitives required for DT service**

Generic name and type	Appearance	Parameters
DT-DATA-REQ	Both	A request to send DATA to the peer entity
DT-DATA-IND	Both	An indication that DATA has been received from the peer entity.
DT-DATA-RESP	Both	A response to the receipt of a DT-Data-Cnf from the CIF side of the GSS DTM.
DT-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.
DT-RELEASE-REQ		A request to release resources from packet data service.
DT-RELEASE-RESP	GSS	Response acknowledging receipt of DT-REL-IND on air interface data link failure.
DT-RELEASE-CNF	Both	Confirmation that resources have been released.
DT-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

Generic name and type	Appearance	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.

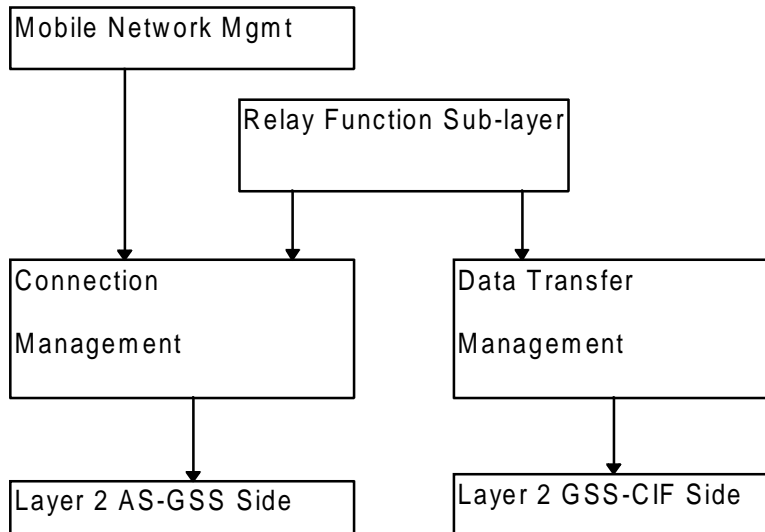


Figure 19: Location of Interworking Function within GSS Structure

### 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 DT layer in the AT and CIF sides but does not provide DT services.

The main functionality of the relay is to synchronise 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 Transport 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 DT states at the GSS side of the AT-GSS and GSS-CIF interfaces

**DT-IDLE (0):** No Data Transfer transaction exists

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

**DT-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.

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



**DT-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.

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

**DT-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.

**DT-RR-CONNECTION-AVAILABLE-CIF-ORIGINATING (20.3):** This state exists for a GSS, when radio resources 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 Transport (DT) is a function using the services provided by the layer 2 and 3 as defined in ITU-T X.25 [4] specification.

Data Transfer shall use the services of X.25 layer 3 and shall:

- provide the means for establishment, maintenance and termination of transactions for Data Transport (DT);
- comprise the group of signalling functions for Data Transport 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 Transport-SAP (DT-SAP). The DT service class consists of the following services:

- GSS originating data transport transaction establishment;
- CIF originating data transport transaction establishment;
- data transport transaction maintaining.

#### **9.2.2 Service state diagram GSS**

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

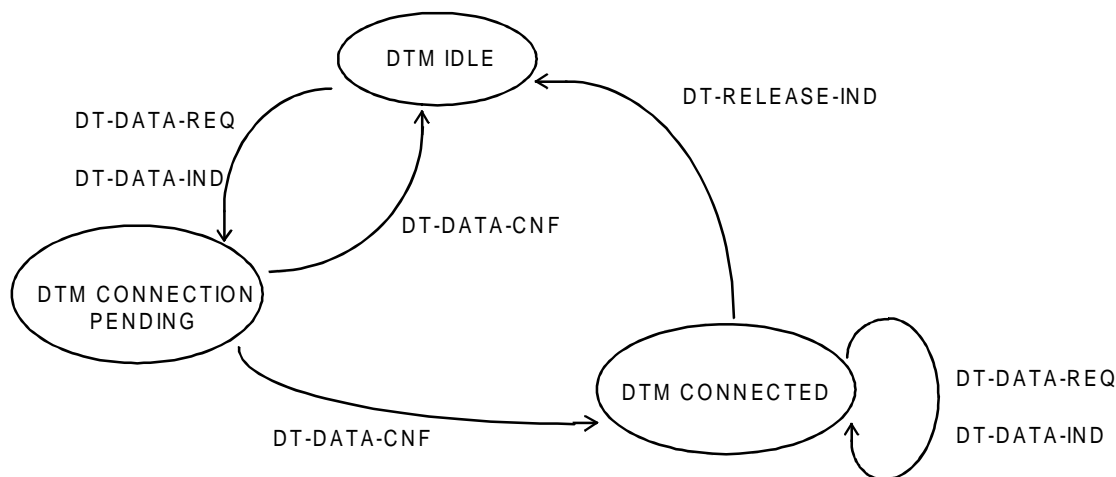


Figure 20: Overview service state diagram of DT entity on the GSS side

### 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 Transport SAP (DT-SAP). The DT service class consists of the following services:

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

#### 9.3.2 Service state diagram CIF

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

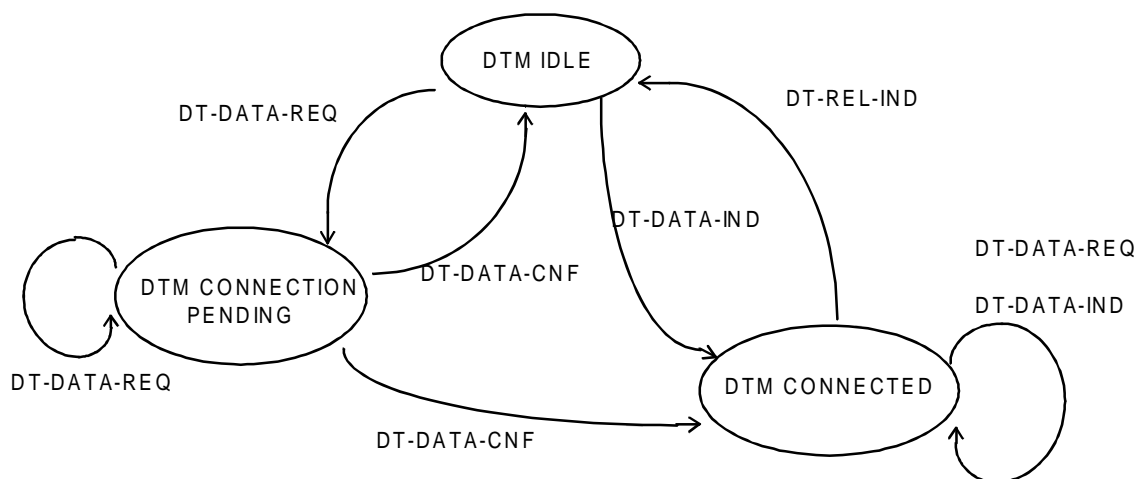


Figure 21: Overview service state diagram of DT entity on the CIF side

## 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 DT 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 (DT) are contained in annex C.

### 9.4.2 DT 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.

<b>DTM IDLE:</b>	No packet data connection exists
<b>GSS-CIF connection pending:</b>	This state exists when the AT has requested a packet data connection.
<b>CIF-GSS connection pending:</b>	This state exists when the CIF has requested a packet data connection.
<b>GSS CIF connected:</b>	This state exists when the X.25 link has been established between the GSS and the CIF.
<b>DTM connected:</b>	This state exists when a packet data connection exists between the AT and the CIF (through the GSS)..
<b>CIF release pending:</b>	This state exists when the GSS has requested release of the X.25 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.

<b>DTM IDLE:</b>	No packet data connection exists
<b>GSS connection pending:</b>	This state exists in the CIF when a request has been made to the GSS for establishment of an X.25 link and the CIF is awaiting a response.
<b>GSS connected:</b>	This state exists when an X.25 link is present between the GSS and the CIF, but no packet data connection is through connected to an AT.
<b>AT connection pending:</b>	This state exists when the CIF has sent an X.25 data packet containing a first PACKET DATA TRANSFER message for onward transmission to the AT and is awaiting establishment of a packet data connection.

<b>AT connected:</b>	This state exists when a packet data connection exists between the AT and the CIF, through-connected by the GSS.
<b>AT Suspended:</b>	This state exists in the CIF when the AT is engaged in a handover between GSS.
<b>GSS release pending:</b>	This state exists when the CIF has requested release of the X.25 link with the GSS and is awaiting a response.

### 9.4.2.3 Packet-switched DT 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 characterised as requiring a degree of intelligent processing by the terminal in either their generation or analysis:

The procedures needed for DT 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 DT entity of the GSS shall request the X.25-sub-layer for the establishment of a switched virtual circuit (VC). Timer T300 shall then be set and the "GSS to CIF CONNECTION PENDING" state entered.

On the CIF side, X.25 sub-layer 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 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 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 is ready for data transfer, T300 shall be stopped, the first DT message (PACKET DATA TRANSFER - received from the AT) to the CIF shall be sent and the "DTM CONNECTED" state shall be entered. On the CIF side when the first DT 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 (DT\_data\_req) from a higher layer (user) to establish a packet data call to a given AT, the CIF DTM shall determine whether an X.25 VC exists to the appropriate GSS (i.e. whether the CIF DT 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 DT 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 VC at the GSS side, the GSS DTM shall indicate the incoming call to the higher layer (user) with a DT-X25-call-ind primitive, confirm acceptance of the X.25 call request by initiating the sending of a X.25 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 DT message (PACKET DATA TRANSFER) to the GSS using the VC and shall enter the "AT CONNECTION PENDING" state.

On receipt of a DT 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 (user), stop T345 and enter the "AT CONNECTION PENDING" state.

Abnormal case:

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

##### **9.4.4.2 Call connected**

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

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

Abnormal case:

If the CIF DTM receives a DT message containing a DISCONNECT message (received from the AT) it shall indicate to the higher layer (user) with DT-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 (user) to release the packet data connection, the CIF DTM shall send a DT-DISCONNECT message to the GSS and enter the "GSS CONNECTED" state. If the CIF DTM is required to release the X.25 VC to the GSS, it shall initiate the release procedure by sending an X.25 Clear Request message and enter the "GSS RELEASE PENDING" state.

On receipt of the DT-DISCONNECT message the GSS shall indicate release of the packet data connection to the higher layer (user) and determine whether to release the X.25 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 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 (user) to release the packet data connection, the GSS DTM shall send a DT-DISCONNECT message to the GSS and determine whether to release the X.25 VC to the CIF.

If the GSS DTM determines that the VC is to release it shall initiate the sending of an X.25 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 DT-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 VC to the GSS, it shall initiate the release procedure by sending an X.25 Clear Request message and enter the "GSS RELEASE PENDING" state.

#### **9.4.5.3 Completion of clearing**

If release of the X.25 VC has been initiated by the CIF, the GSS shall respond to the X.25 Clear Indication message with an X.25 Clear Request 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 (user) to send a data packet, the GSS DTM shall encapsulate the received data in an X.25 Data Packet and send this to the CIF.

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

##### **9.4.6.2 Data transfer ground to air**

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

On receipt of an X.25 Data Packet, the GSS shall extract the data field from the message and pass this to the higher layer (user).

##### **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 DT shall follow the general procedure described in ETS 300 326-3 subclause 6.3.3.4.2. The GSS DTM on the CIF side shall send an X.25 Receiver Not Ready (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 7.7.7.3.2), 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 connection to the old GSS. The CIF shall take part in the location registration procedure described in subclause 7.7.7.3.1.

## **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 AT and GSS will, in general, be as described in ETS 300 326-2 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, 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 DT-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 sub-layer**

The X.25 layer 3 as defined by ITU-T offers services for the data transfer management sub-layer.

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 18: GSS Originating Connection**

Information element	Reference	Direction	Type	Length
Connection type		GSS-CIF	MF	1
Air Termination Equipment Identifier (ATEI)		GSS-CIF	MF	4
Ground Station Identity Code (GSIC)		GSS-CIF	MF	3
Reserved (security?)				11

**Table 19: CIF Originating Connection**

Information element	Reference	Direction	Type	Length
Connection type		CIF-GSS	MF	1
ATEI		CIF-GSS	MF	4
CIF Indicator		CIF-GSS	MF	1
Reserved (GSIC?)				10

The tables (connection type) represent the desired information to be included in the user data space. The actual data are to be agreed between the implementers.

**9.6.2 Data transfer management sub-layer**

**9.6.2.1 Packet data transfer (PD1)**

This message is used to transfer user packet data carrying and IPI conforming to ISO 9577 from the GSS to the CIF. The reference field relates to clauses in ETS 300 326-2. The message content is defined in table 20.

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

**Table 20: Packet Data Transfer Message Content**

Information element	Reference	Direction	Type	Length
Message type	10.11.8.3	both	MF	1
Data Information		both	MV	2-238

**9.6.2.2 Packet data transfer (PD2)**

This message is used to transfer user packet data carrying and IPI conforming to table 11 from the GSS to the CIF. The reference field relates to clauses in ETS 300 326-2. The reference field relates to clauses in ETS 300 326-2. The message content is defined in table 21.

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

**Table 21: Packet Data Transfer Message Content**

Information element	Reference	Direction	Type	Length
Message type	10.11.8.3	both	MF	1
Data Information		both	MV	3-241



9.6.2.3 Connect

message type:	CONNECT
Significance:	dual
Direction:	both

Table 22: Connect Message Content

Information element	Reference	Direction	Type	Length
Message type				
DT-Cause		both	MF	1

9.6.2.4 Disconnect

message type:	DISCONNECT
Significance:	dual
Direction:	both

Table 23: Disconnect Message Content

Information element	Reference	Direction	Type	Length
Message type		both	MF	1
DT-Cause		Both	MF	1

9.7 General message format and information elements coding

9.7.1 Service provider indicator

The Service Provider 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 24.

8	10	6	5	4	3	2	1	
0	0	0	0	1	1	0	1	Octet 1
Service Provider Indicator IEI								Octet 2
Service Provider Indicator								

Figure 22: Service Provider Indicator Information Element

Table 24: Service Provider Indicator Information Element (octet 2)

8	7	6	5	4	3	2	1	Service Provider Indicator
0	0	0	0	0	0	0	0	"Service Provider not specified"
NOTE: The allocation of other values is outside the scope of this ETS ("TFTS Forum")								

9.7.2 DT cause

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

The DT Cause information element is coded as shown in figure 23 and table 25.

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	1	0	Octet 1
DT Cause								Octet 2
DT Cause								

Figure 23: DT Cause Information Element Format

**Table 25: DT Cause Information Element coding**

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	Normal Clearing (AT-DT request)
0	0	0	0	0	0	1	0	Normal Clearing (CIF-DT request)
0	0	0	0	0	0	1	1	Normal Clearing (GSS request)
0	0	0	0	0	1	0	0	AT not authorised
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

**9.7.3 Data information**

The Data Information IE shall conform generally to the requirements of ETS 300 326-2 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 IEI								
packet data								octet 2 to 238

**Figure 24: Data Information Encoding**

**9.8 List of system parameters**

**9.8.1 Timers for data transfer on the AT side**

**Table 26: Timers for data transfer AT side**

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry
333	20	DT IDLE	RR est req	RR est cnf (error)	dtm data cnf (error)
334	20	RR conn pend	PD TRANS	CONN or DISC	DTM data cnf (error)
335	120	DTM conn pend	DTM data cnf	DTM rel req	DISC
336	20	DTM conn	RR rel req	RR rel cnf	DTM trans rel
337	20	DTM conn	DISC	DISC	RR rel req

9.8.2 Timers for data transfer on the GSS side

Table 27: Timers for data transfer GSS side

Timer number	Timer value	State of call	Cause of start	Normal stop	At first expiry
335	120	CIF conn pend	RR est resp	DISC	dtm data cnf (error)
336	20	CIF conn pend	PD TRANS	RR rel ind	DTM data cnf (error)
340	20	DTM IDLE	PAGE REQ (DT)	RR est ind	DISC
341	20	DTM IDLE	RR est resp	PACKET DATA TRANSFER	DTM trans rel
342	20	DTM conn	DISC	RR rel ind	DTM IDLE

9.8.3 Timers for data transfer on the CIF side

Table 28: 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

9.9 Definition of primitive parameters

The additional primitives required for the DT service are listed in table 29.

Table 29: Primitives required for DT service

Generic name and type	Appearance	Parameters
DT-DATA-REQ	Both	A request to send DATA to the peer entity
DT-DATA-IND	Both	An indication that DATA has been received from the peer entity.
DT-DATA-RESP	Both	A response to the receipt of a DT-Data-Cnf from the CIF side of the GSS DTM.
DT-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.
DT-RELEASE-REQ		A request to release resources from packet data service.
DT-RELEASE-RESP	GSS	Response acknowledging receipt of DT-REL-IND on air interface data link failure.
DT-RELEASE-CNF	Both	Confirmation that resources have been released.
DT-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 characterised 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

# MSC TFTS\_DTM\_Scenario\_1

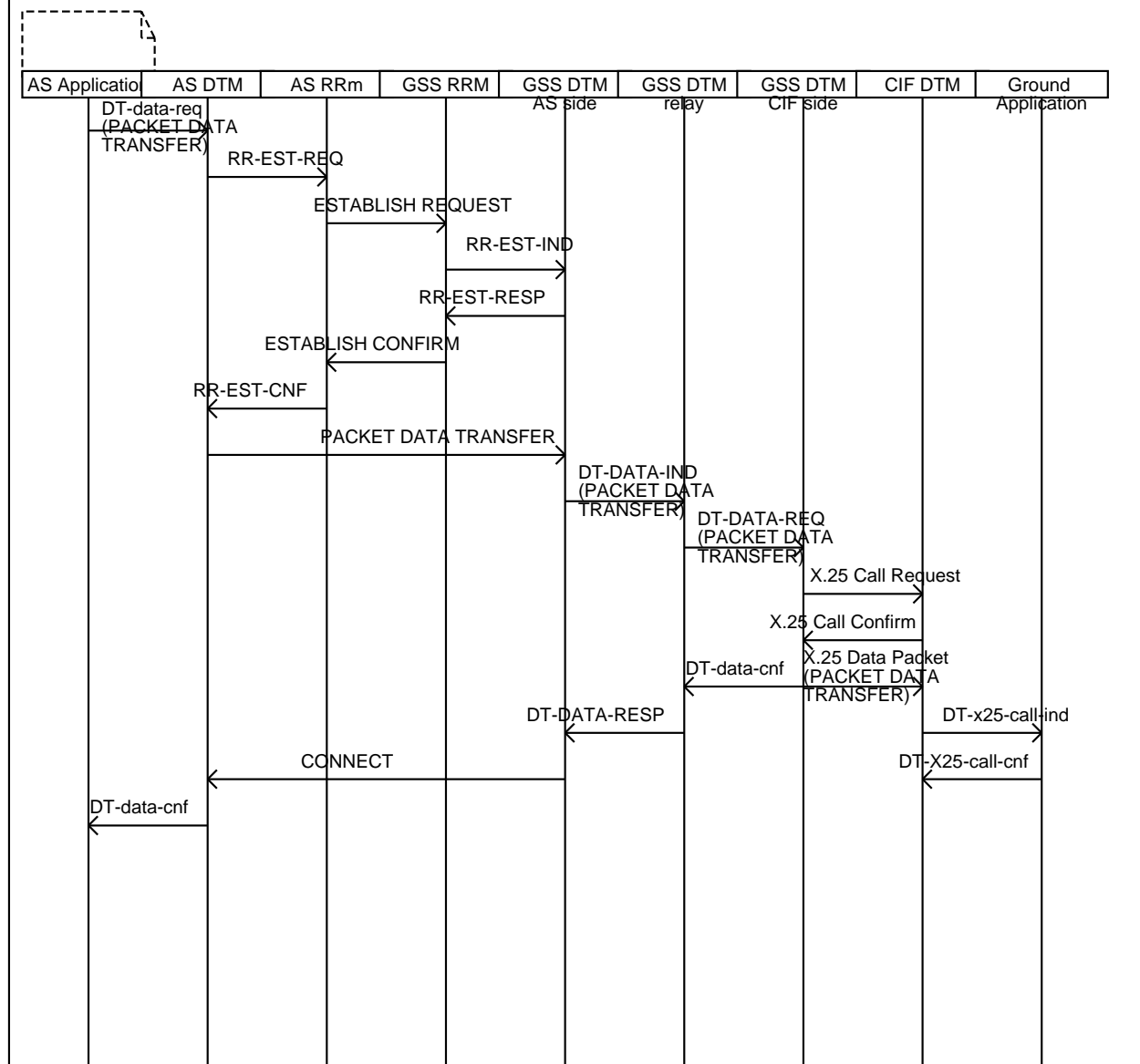


Figure B.1: Transaction establishment, AS originating, GSS-CIF not connected

# MSC TFTS\_DTM\_Scenario\_2

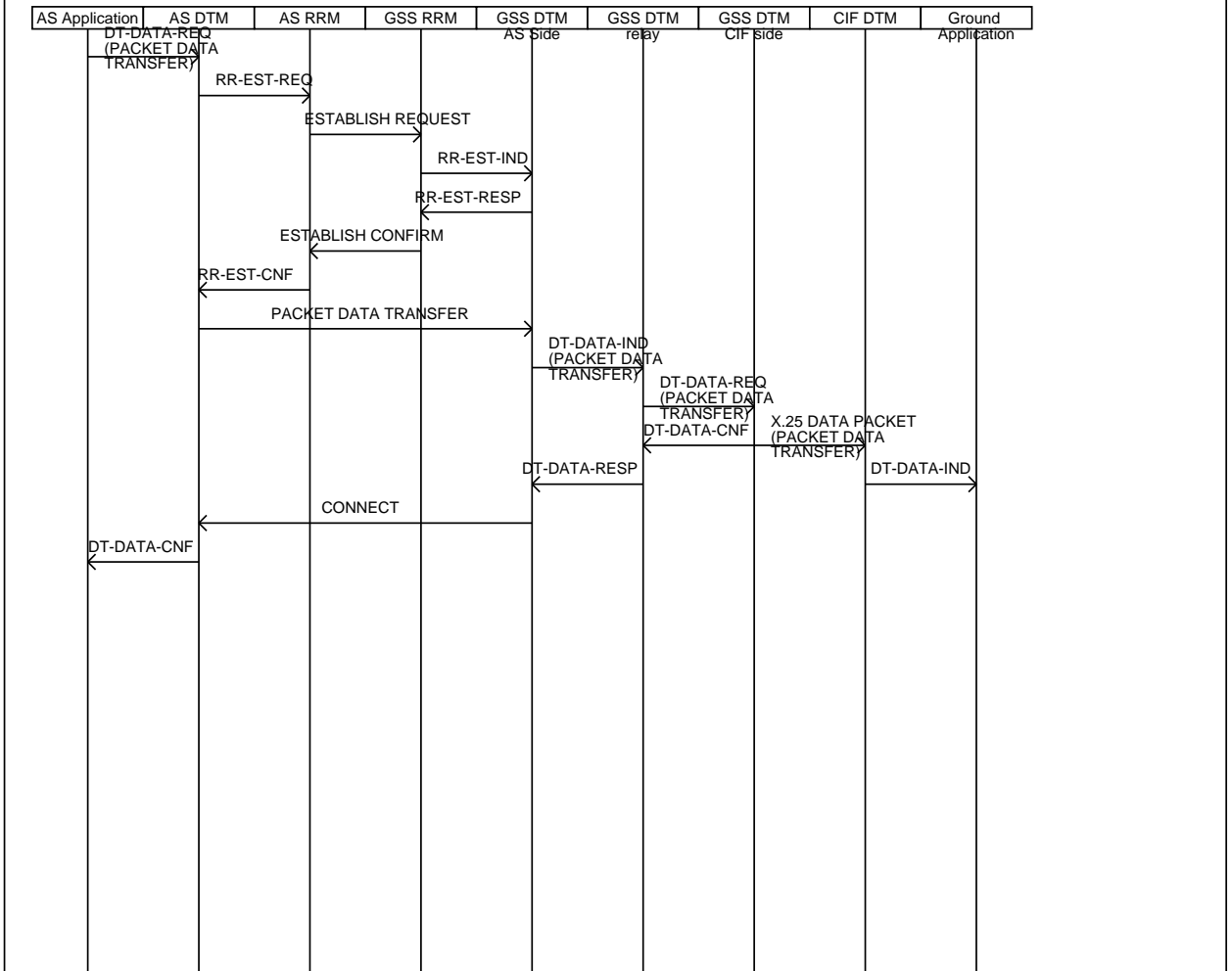


Figure B.2: Transaction establishment. AT originating, GSS-CIF connected

# MSC TFTS\_DTM\_Scenario\_3

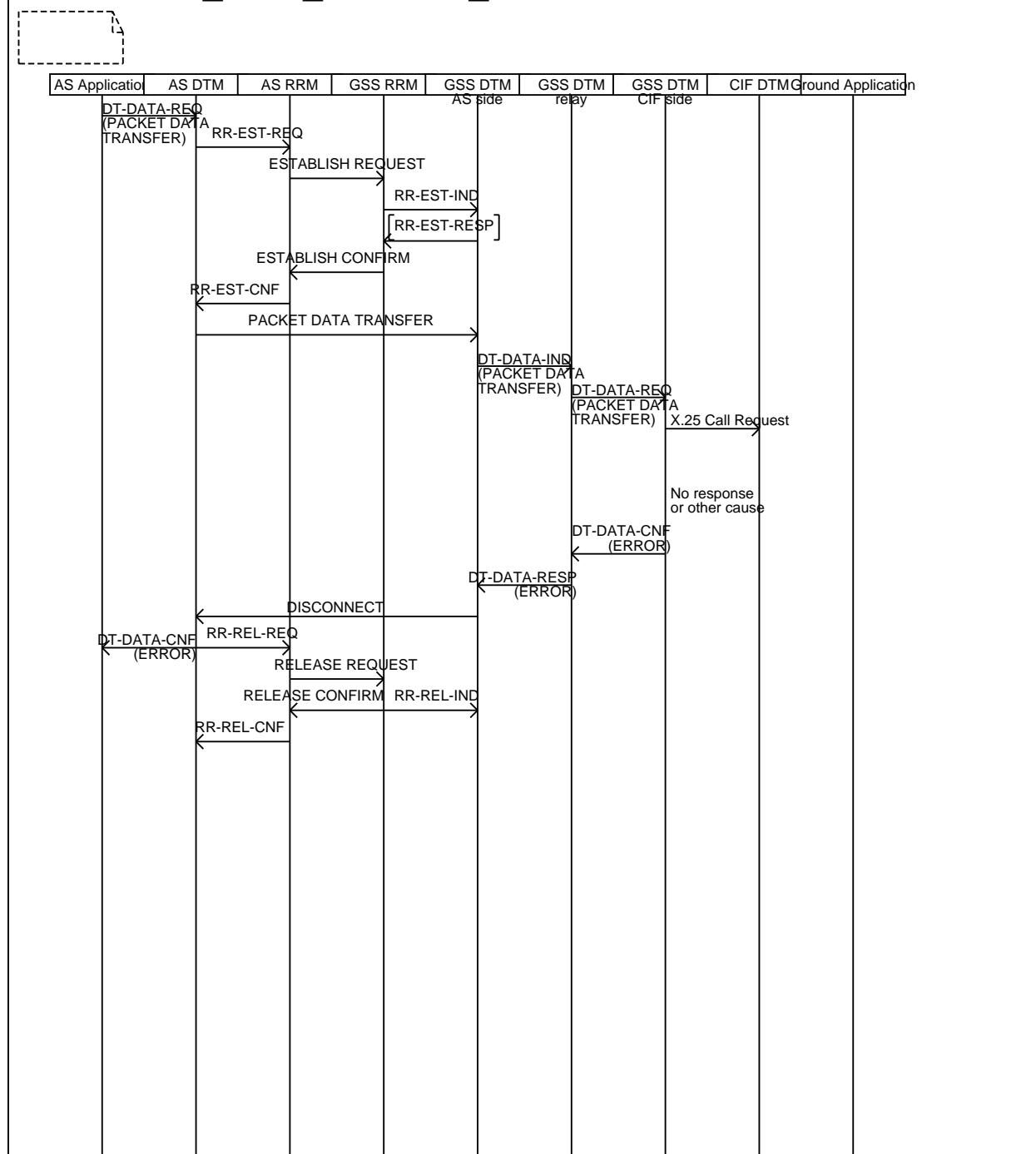


Figure B.3: Transaction establishment. AT originating, GSS-CIF rejected



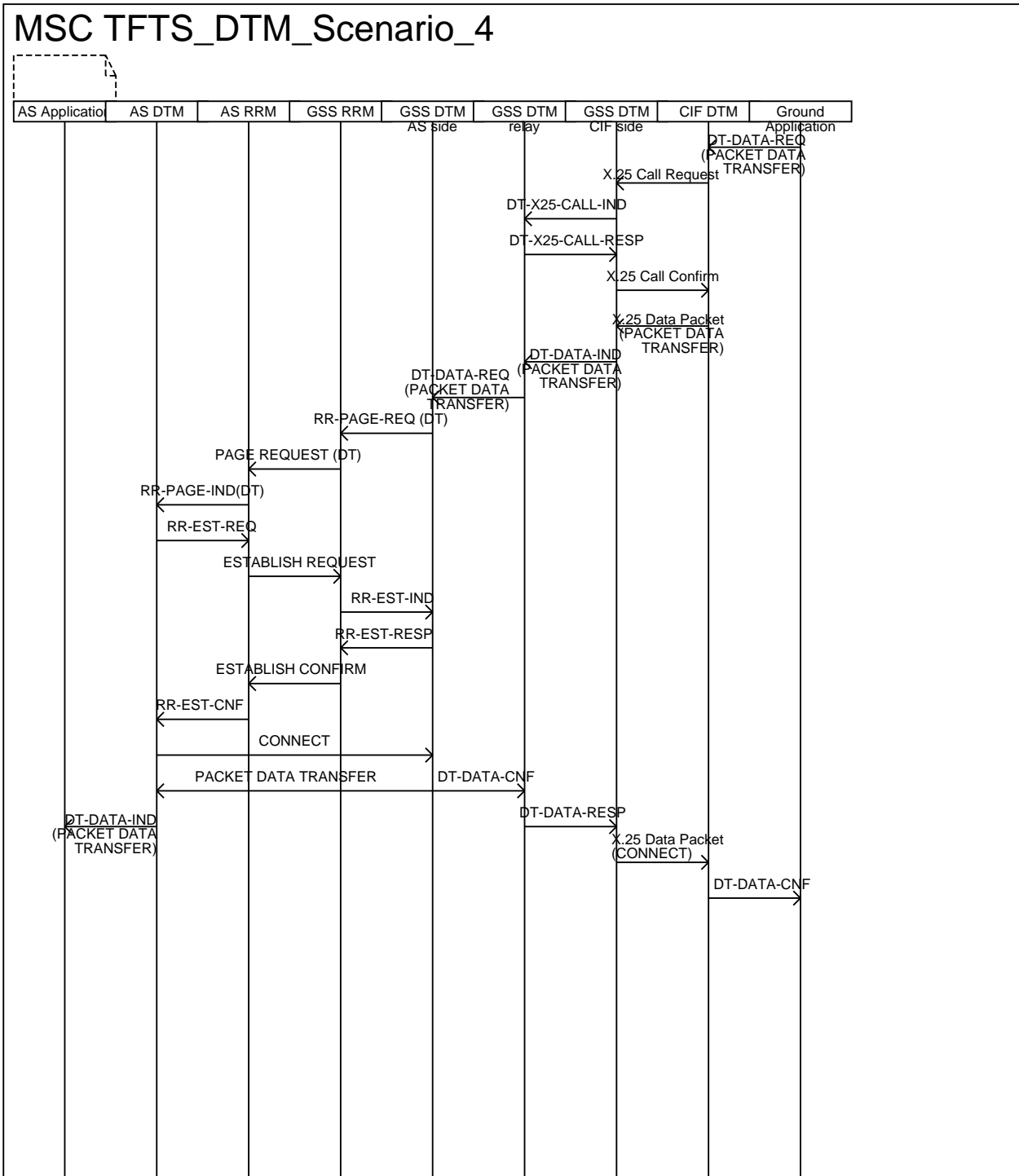


Figure B.4: Transaction establishment. CIF originating, GSS-CIF not connected

# MSC TFTS\_DTM\_Scenario\_5

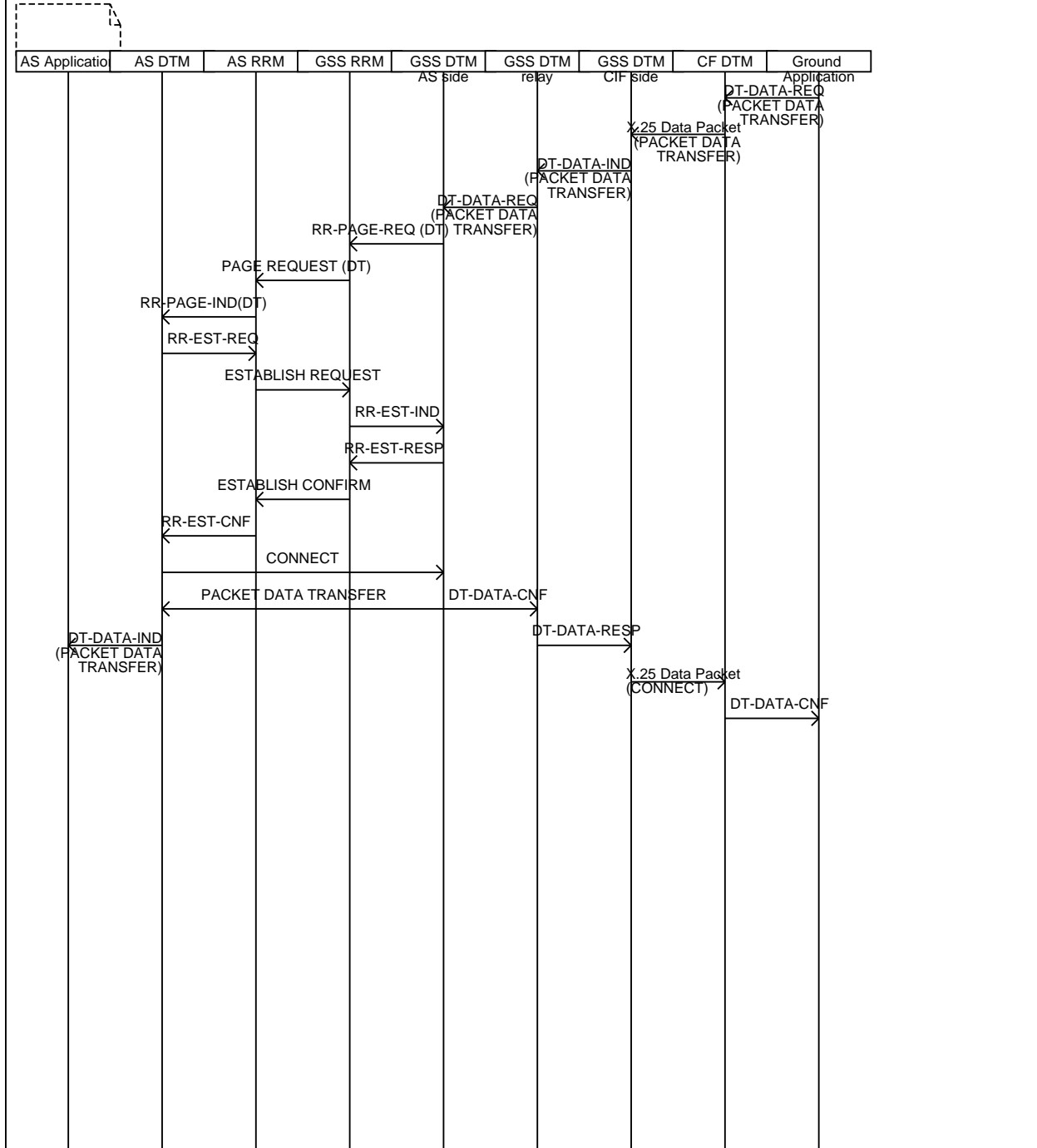


Figure B.5: Transaction establishment. CIF originating, GSS-CIF connected

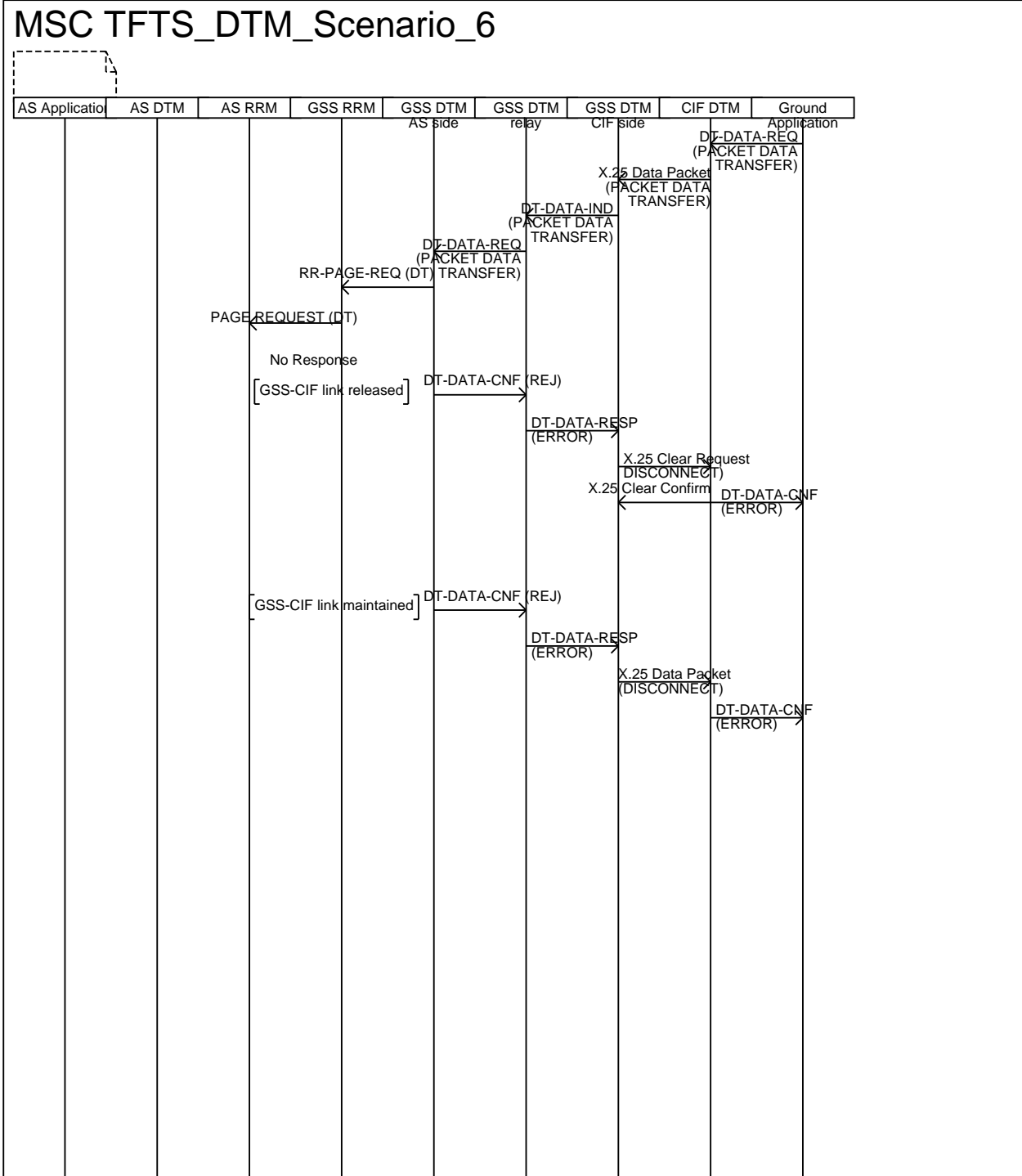


Figure B.6: Transaction establishment. CIF originating, GSS-CIF connection unsuccessful

# MSC TFTS\_DTM\_Scenario\_7

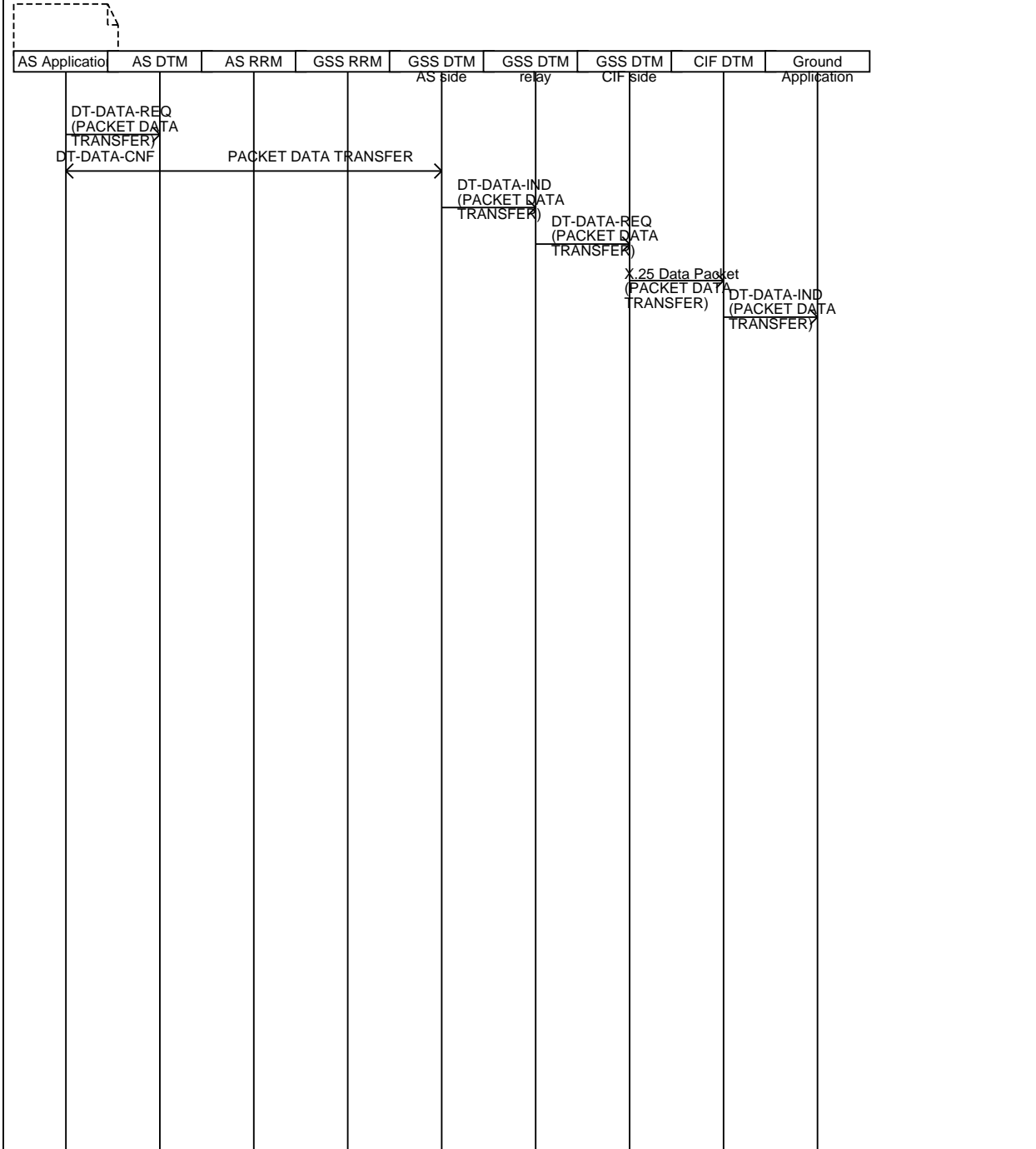


Figure B.7: Transaction established. Transfer AT to CIF

# MSC TFTS\_DTM\_Scenario\_8

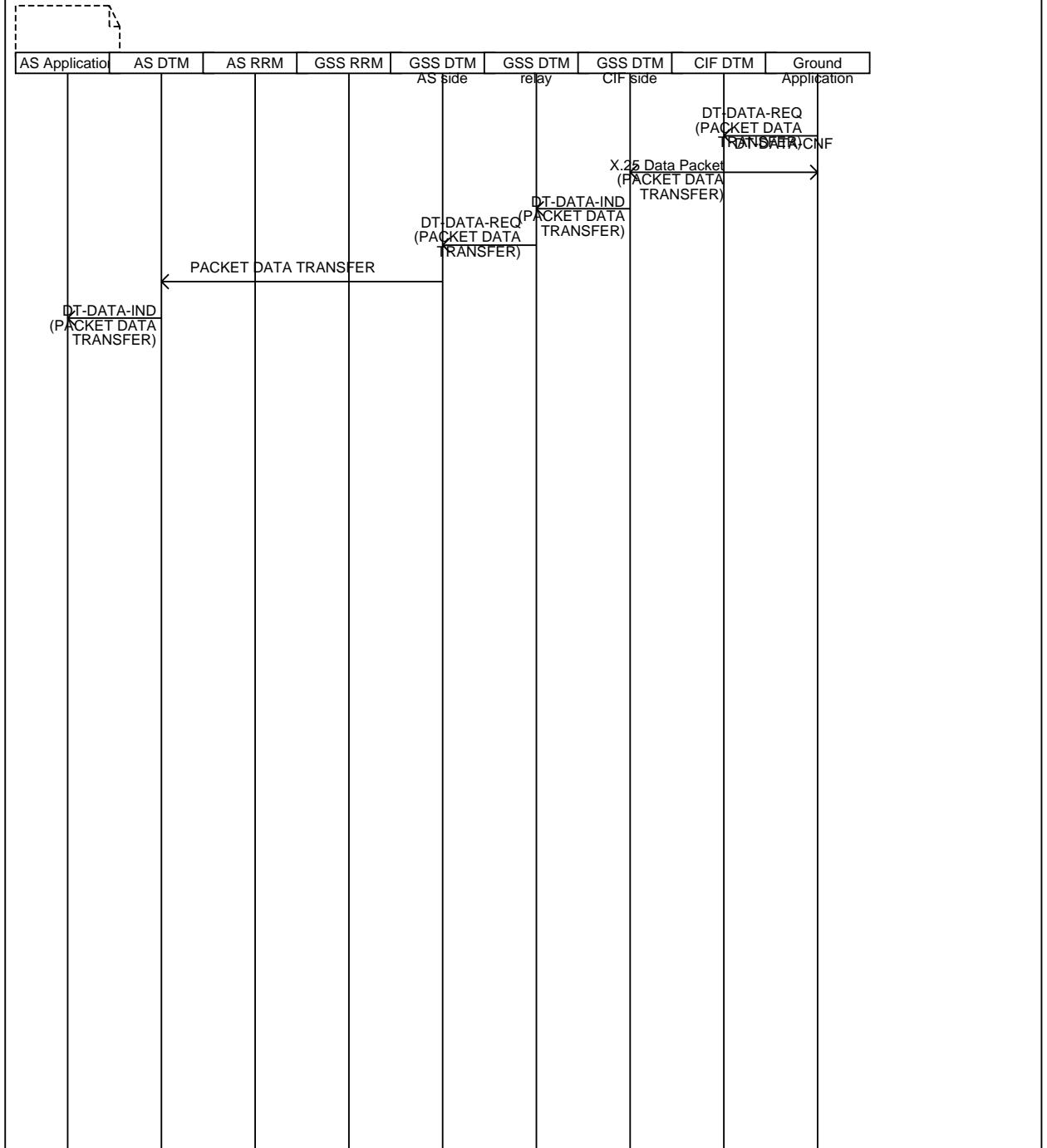


Figure B.8: Transaction established. Transfer CIF to AT

# MSC TFTS\_DTM\_Scenario\_9

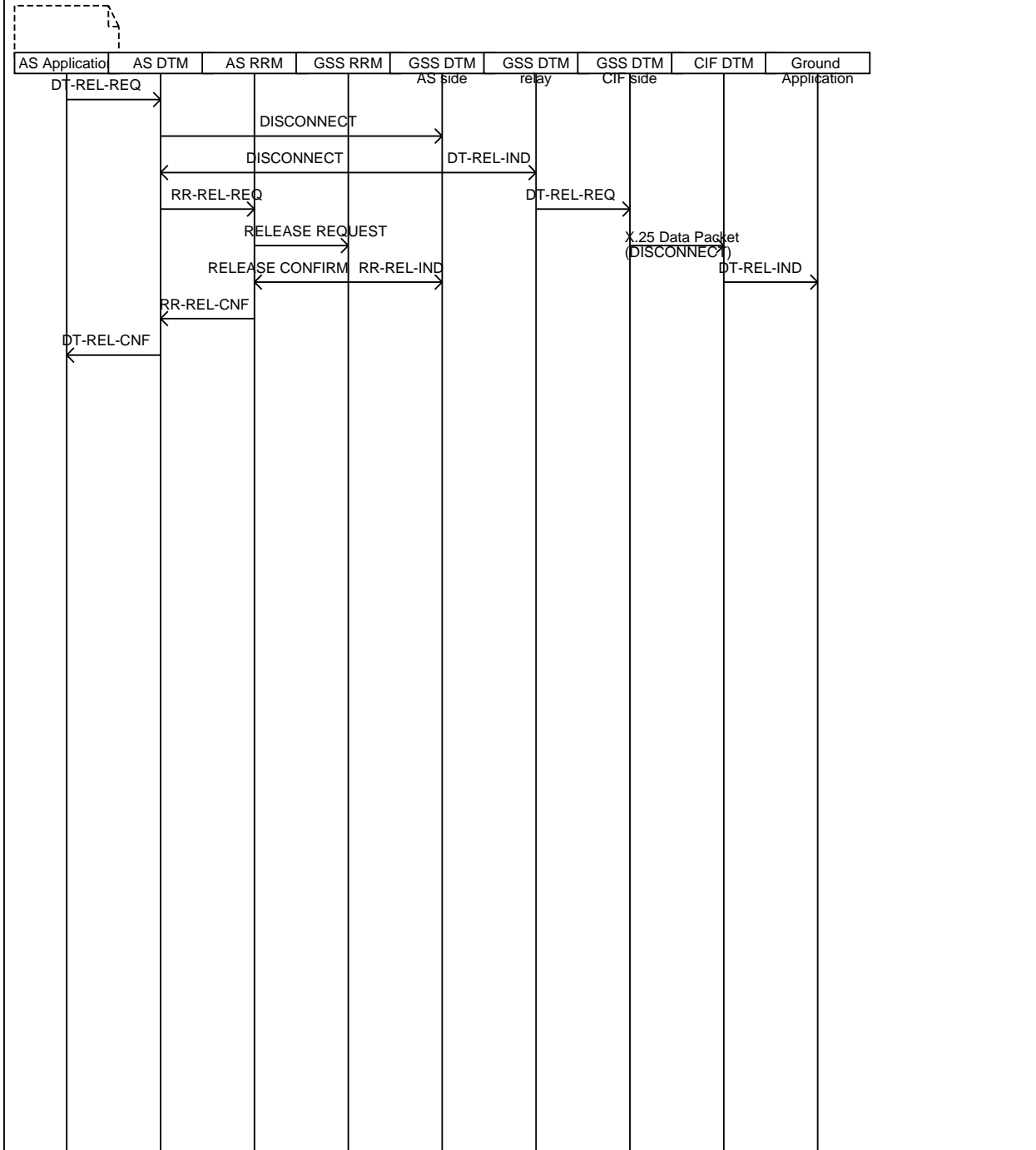


Figure B.9: Transaction release, AT originating. GSS-CIF connection maintained

# MSC TFTS\_DTM\_Scenario\_10

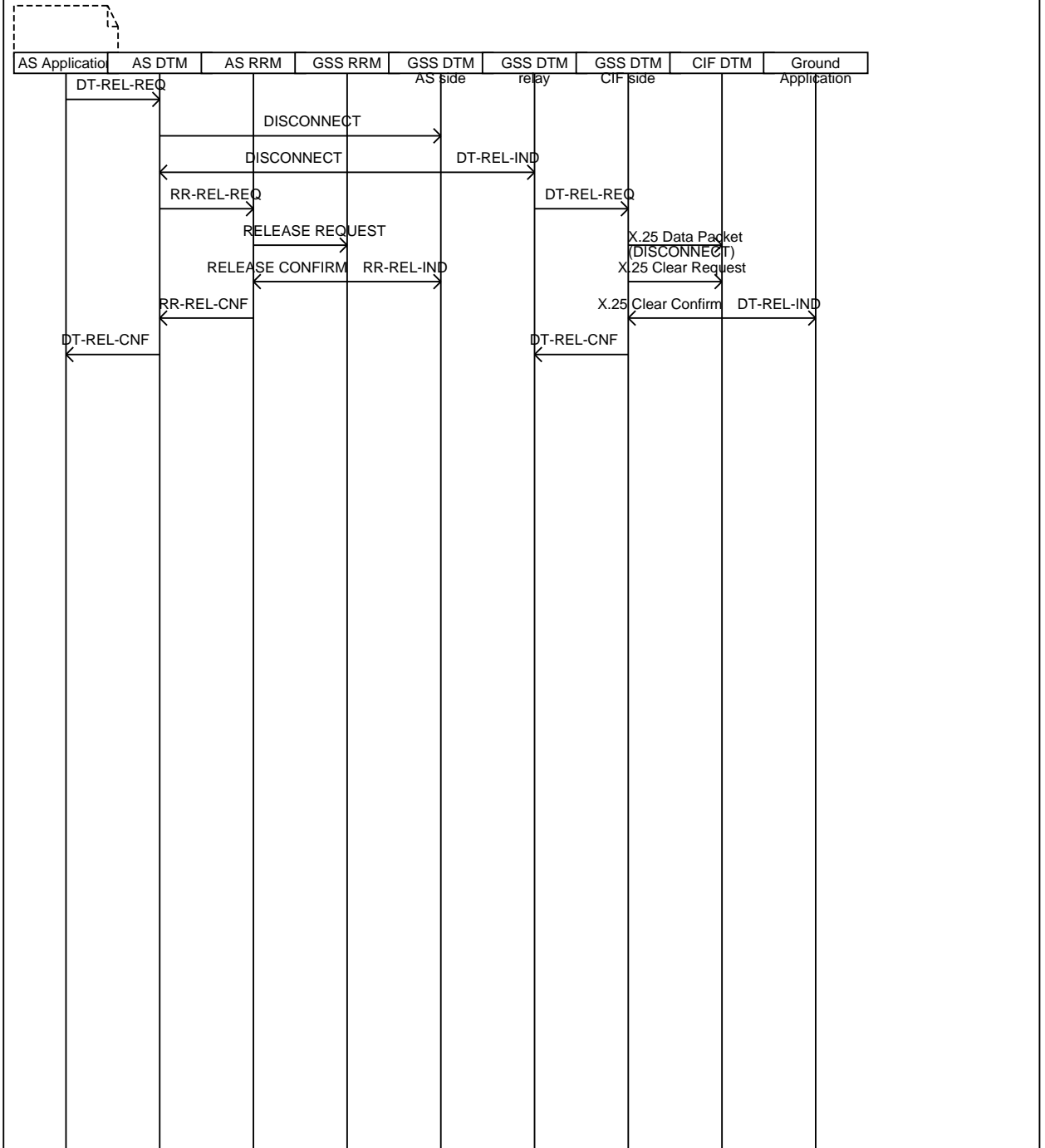


Figure B.10: TRANSFER transaction release. AT originating. GSS-CIF connection released

# MSC TFTS\_DTM\_Scenario\_11

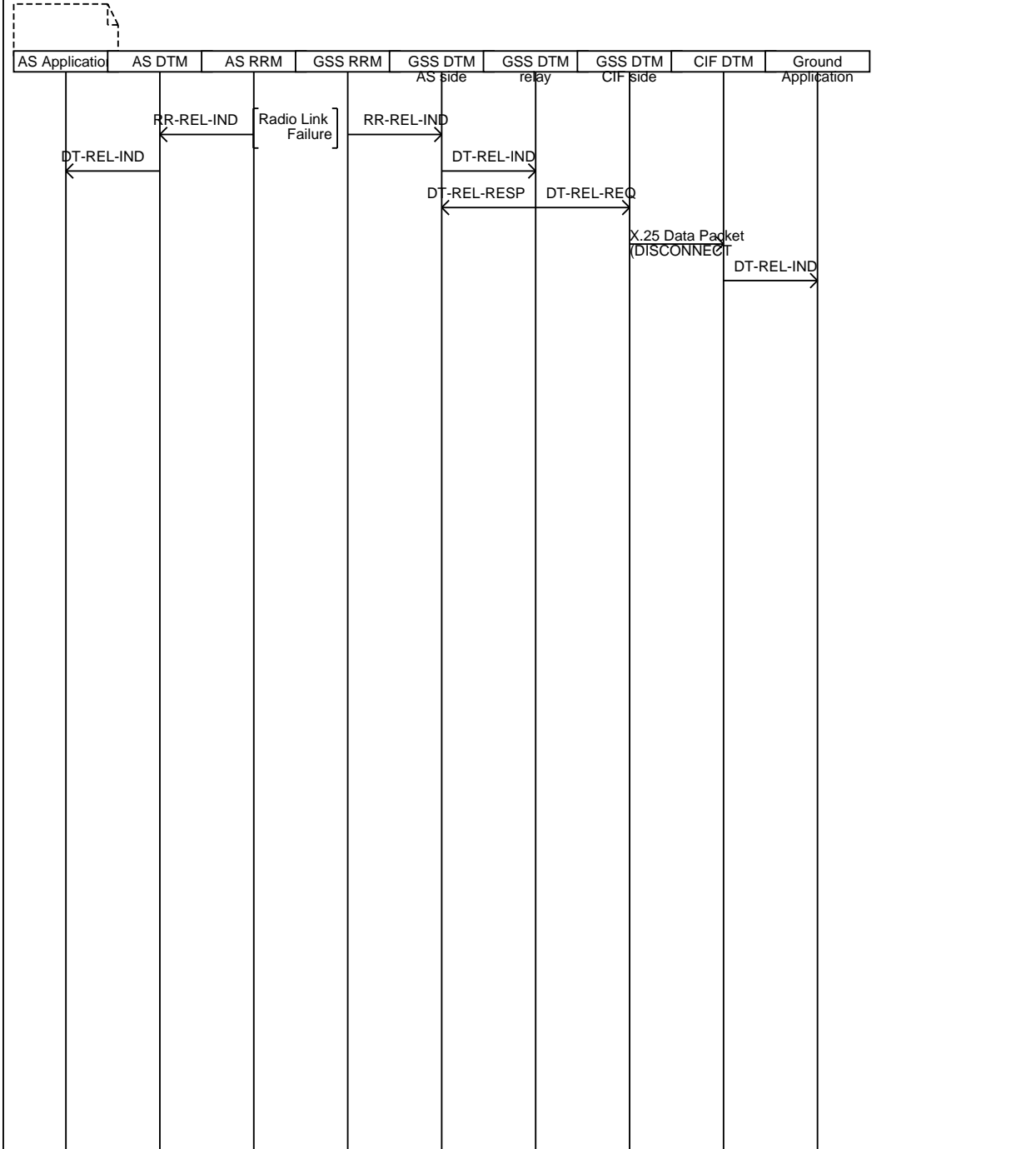


Figure B.11: Transaction release. AT-GSS data link failure. GSS-CIF connection maintained



# MSC TFTS\_DTM\_Scenario\_12

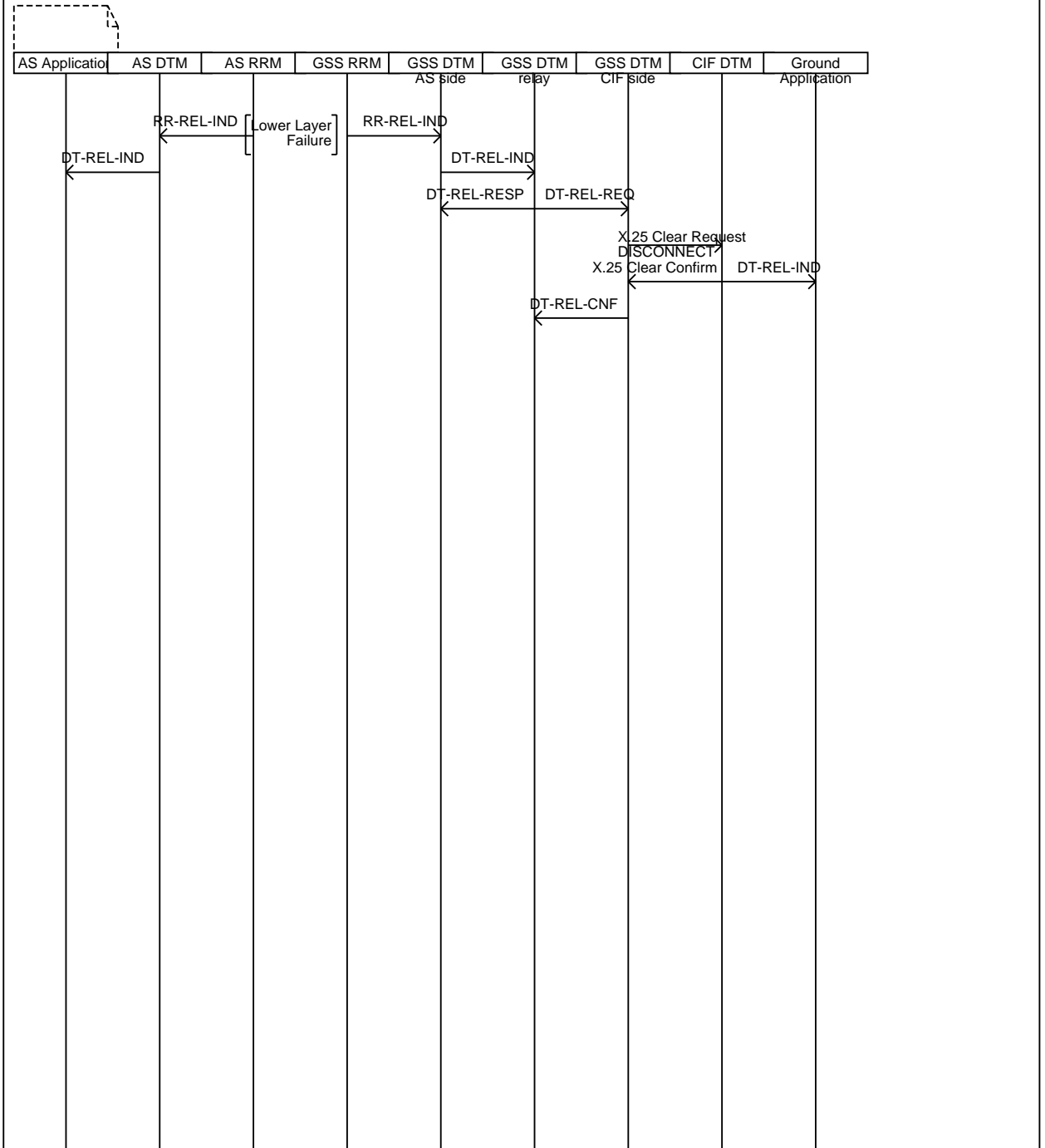


Figure B.12: Transaction release. AT-GSS data link failure. GSS-CIF connection released

# MSC TFTS\_DTM\_Scenario\_13

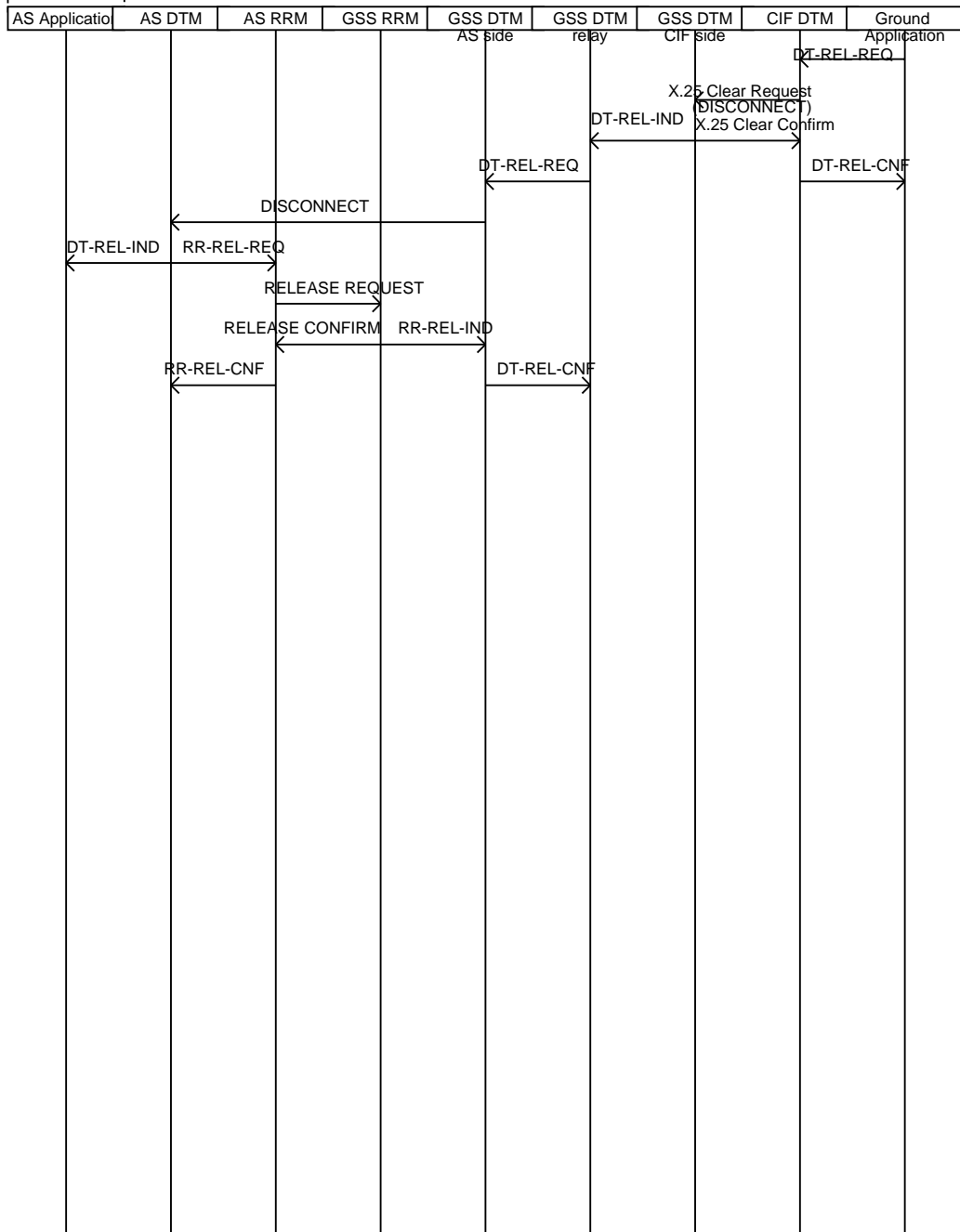


Figure B.13: Transaction release. CIF originating

# MSC TFTS\_DTM\_Scenario\_14

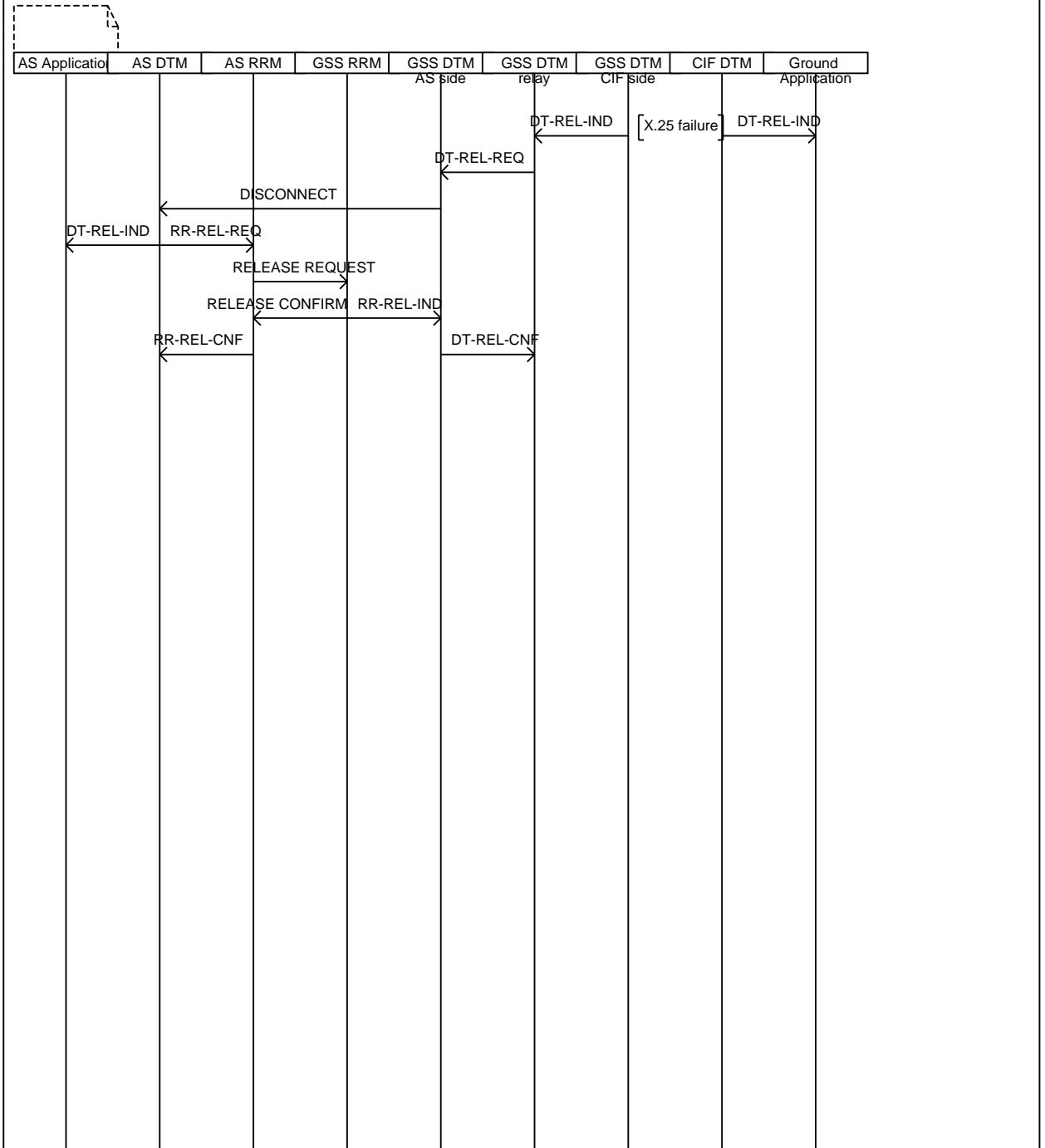


Figure B.14: Transaction release. GSS-CIF data link failure

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

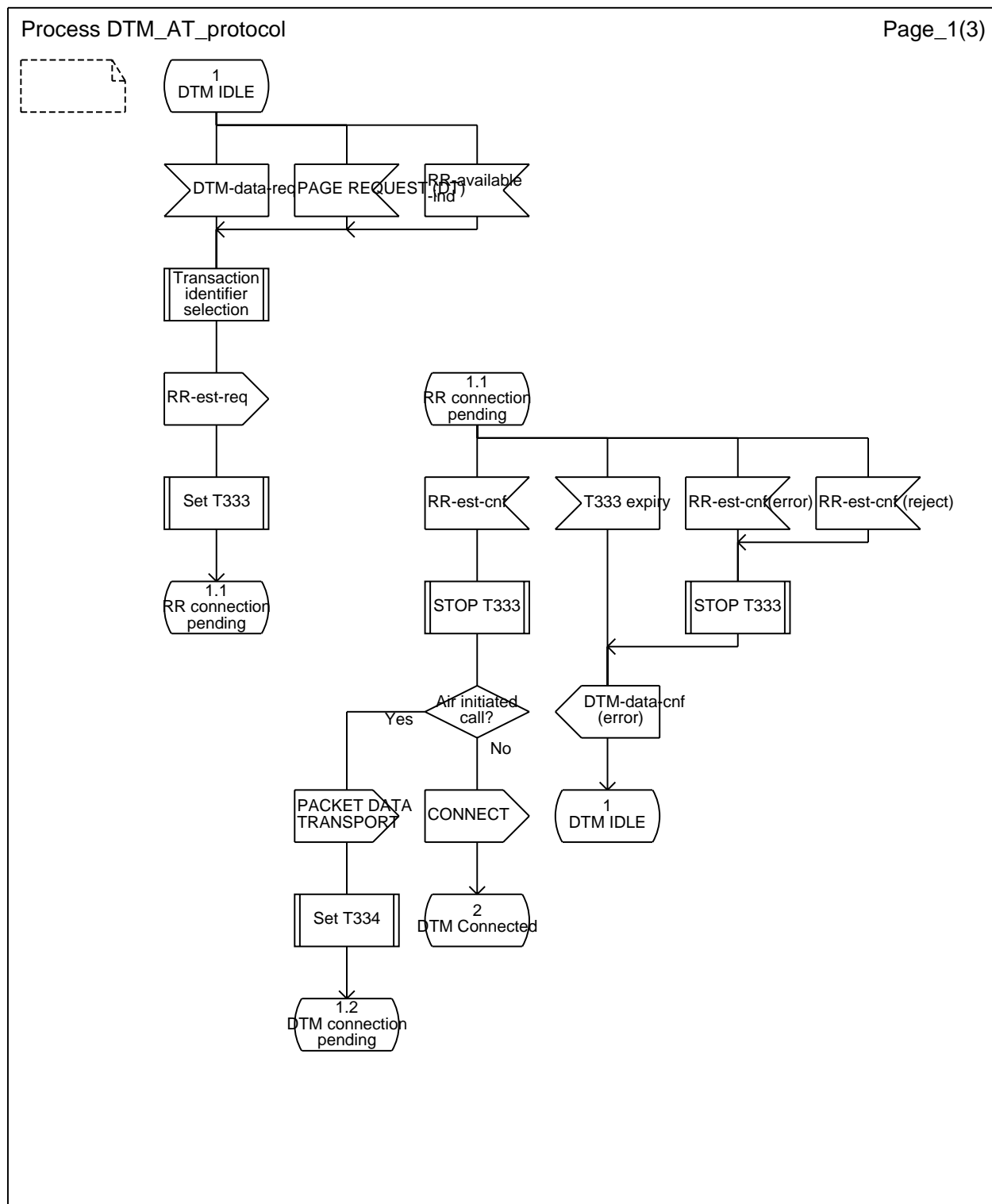


Figure C.1: (sheet 1 of 3) DTM AT protocol

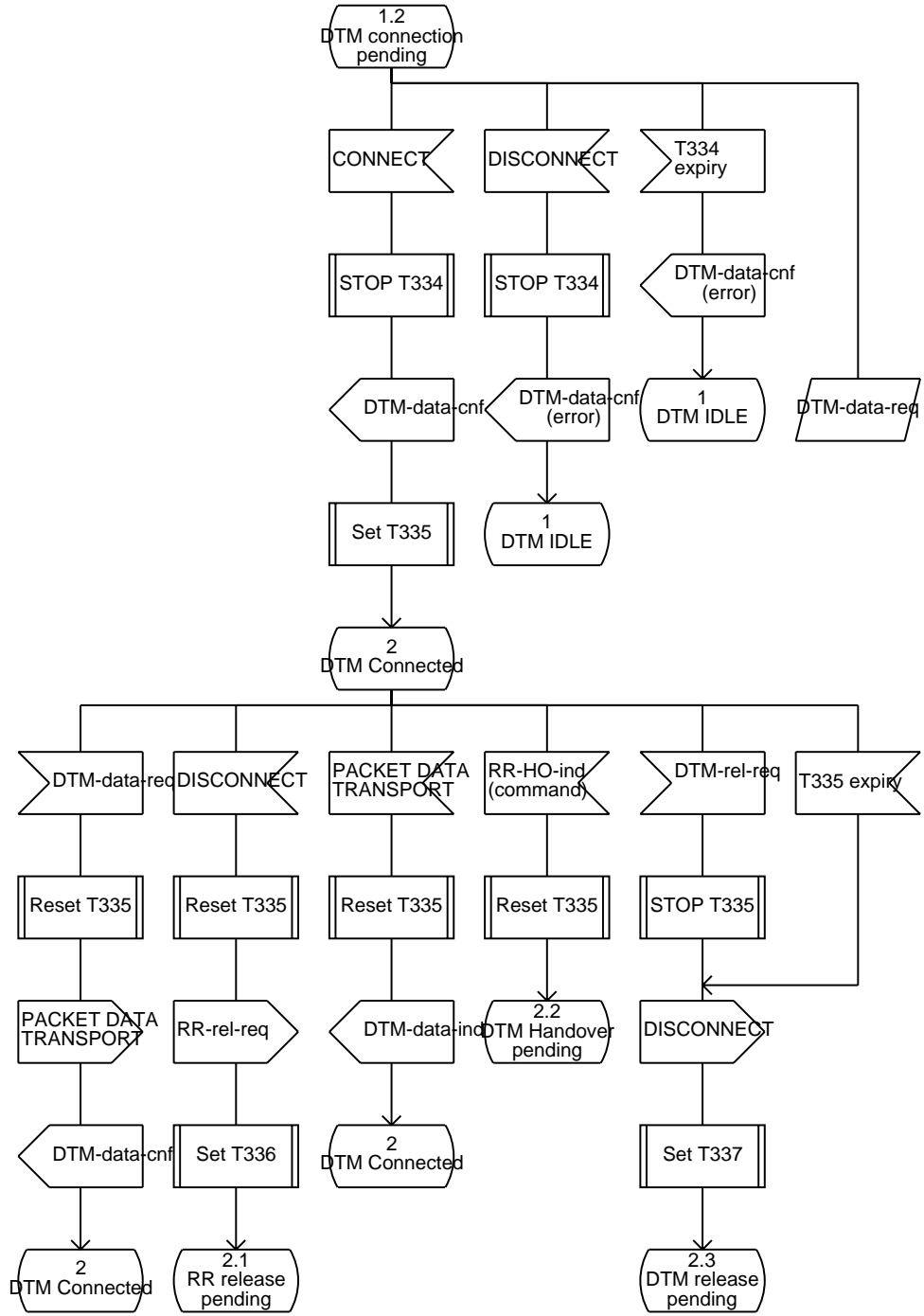


Figure C.1: (sheet 2 of 3) DTM AT protocol

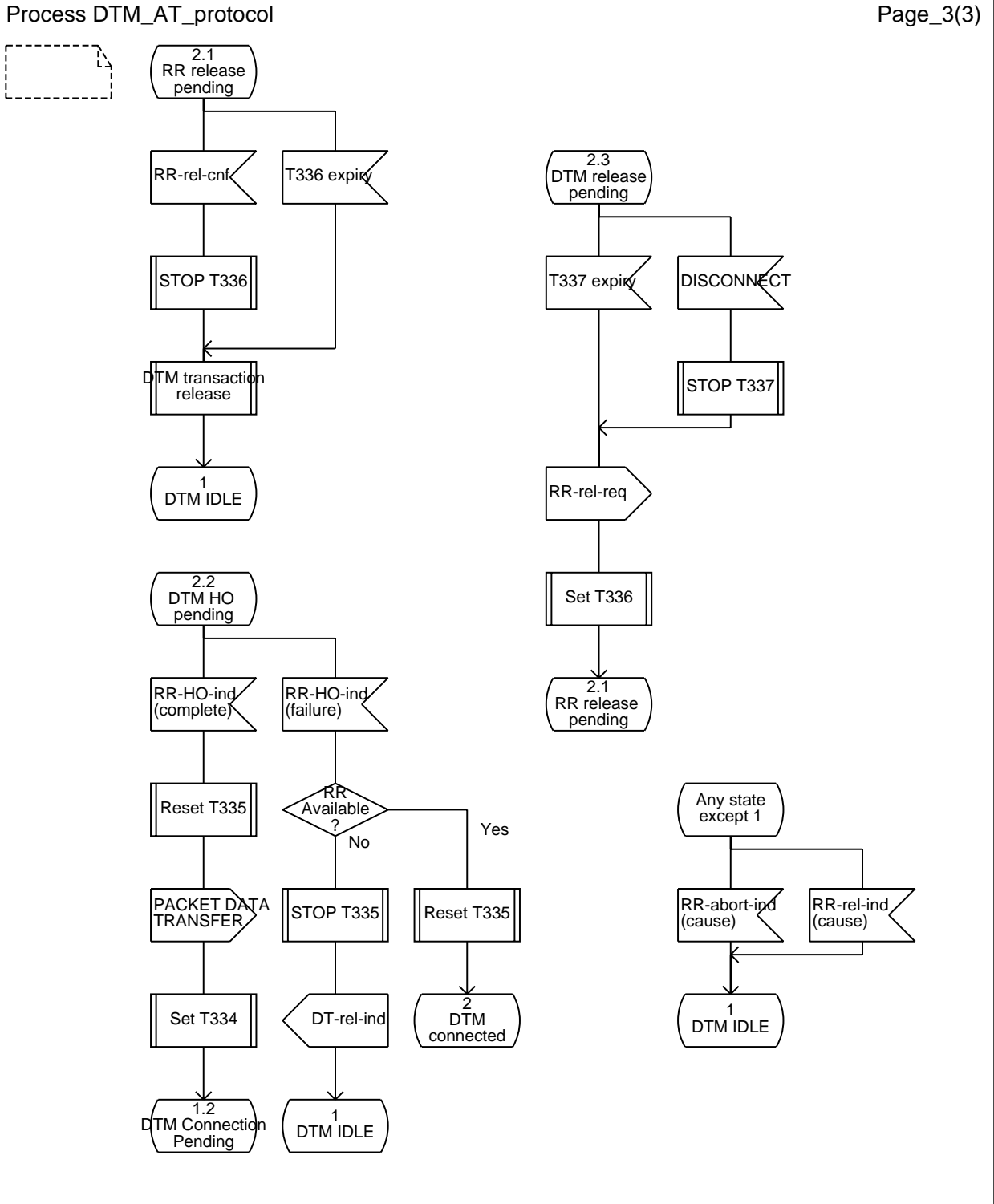


Figure C.1: (sheet 3 of 3) DTM AT protocol

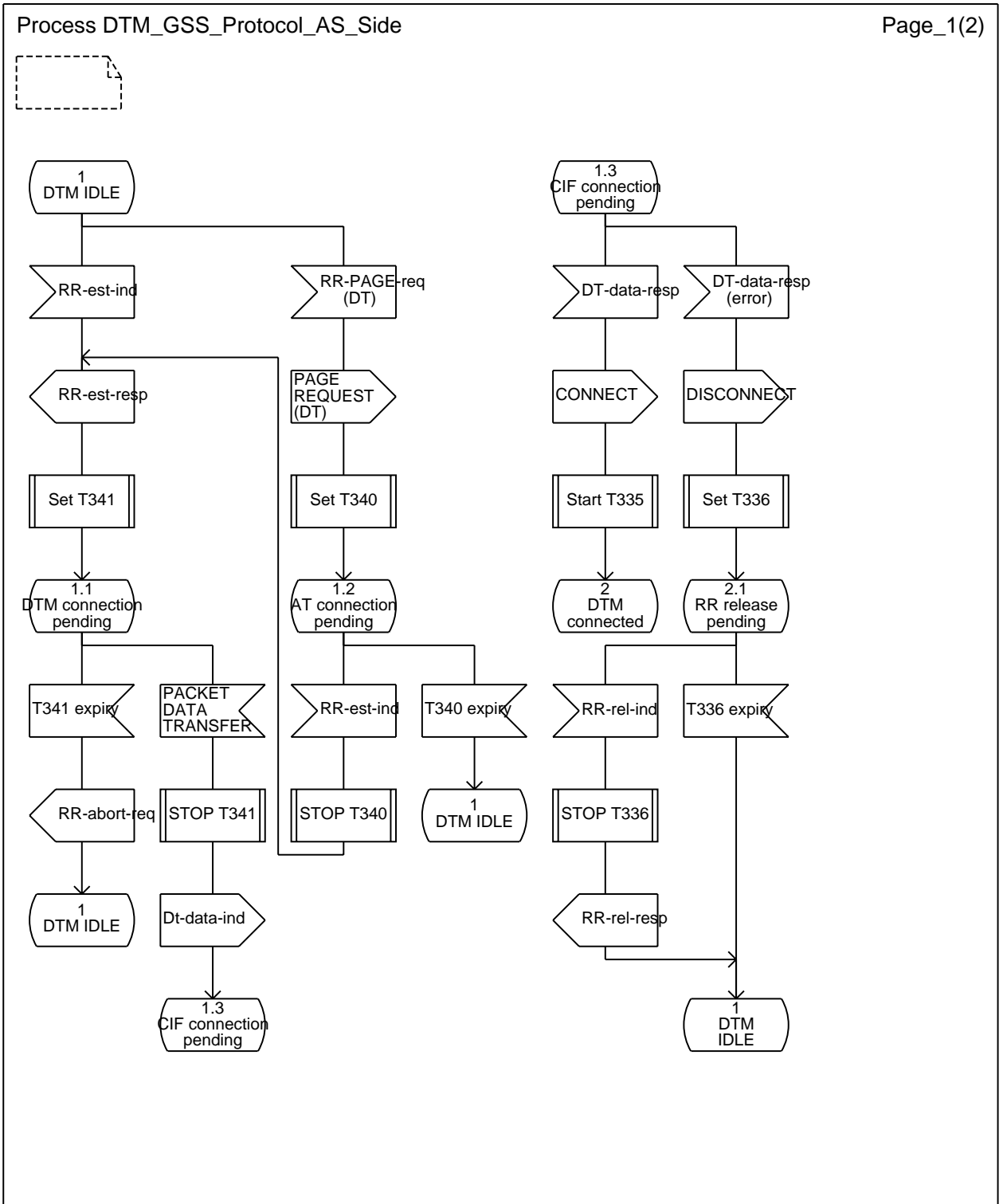


Figure C.2: (sheet 1 of 2) DTM GSS protocol - AS side

Process DTM\_GSS\_Protocol\_AS\_Side

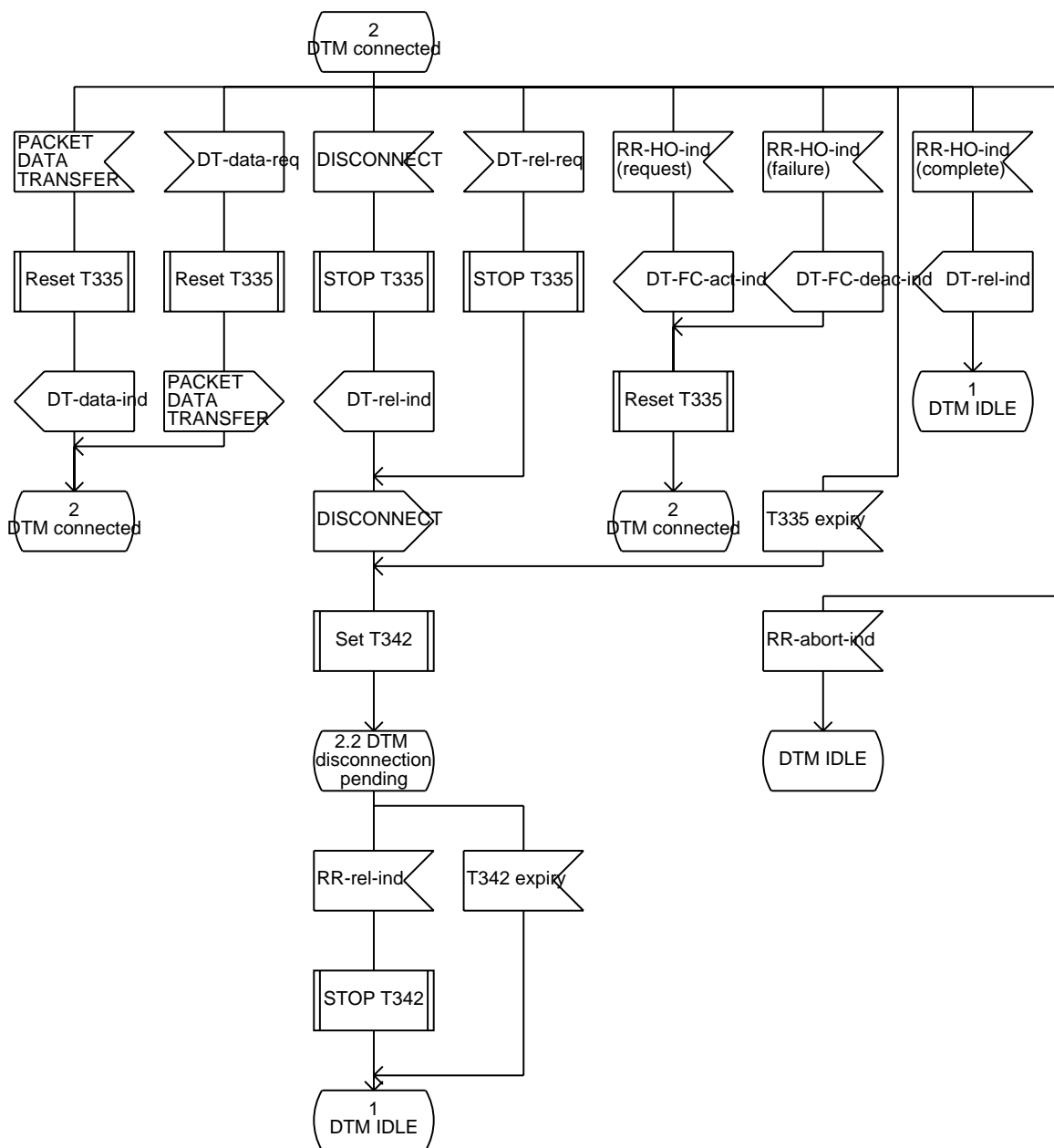


Figure C.2: (sheet 2 of 2) DTM GSS protocol - AS side



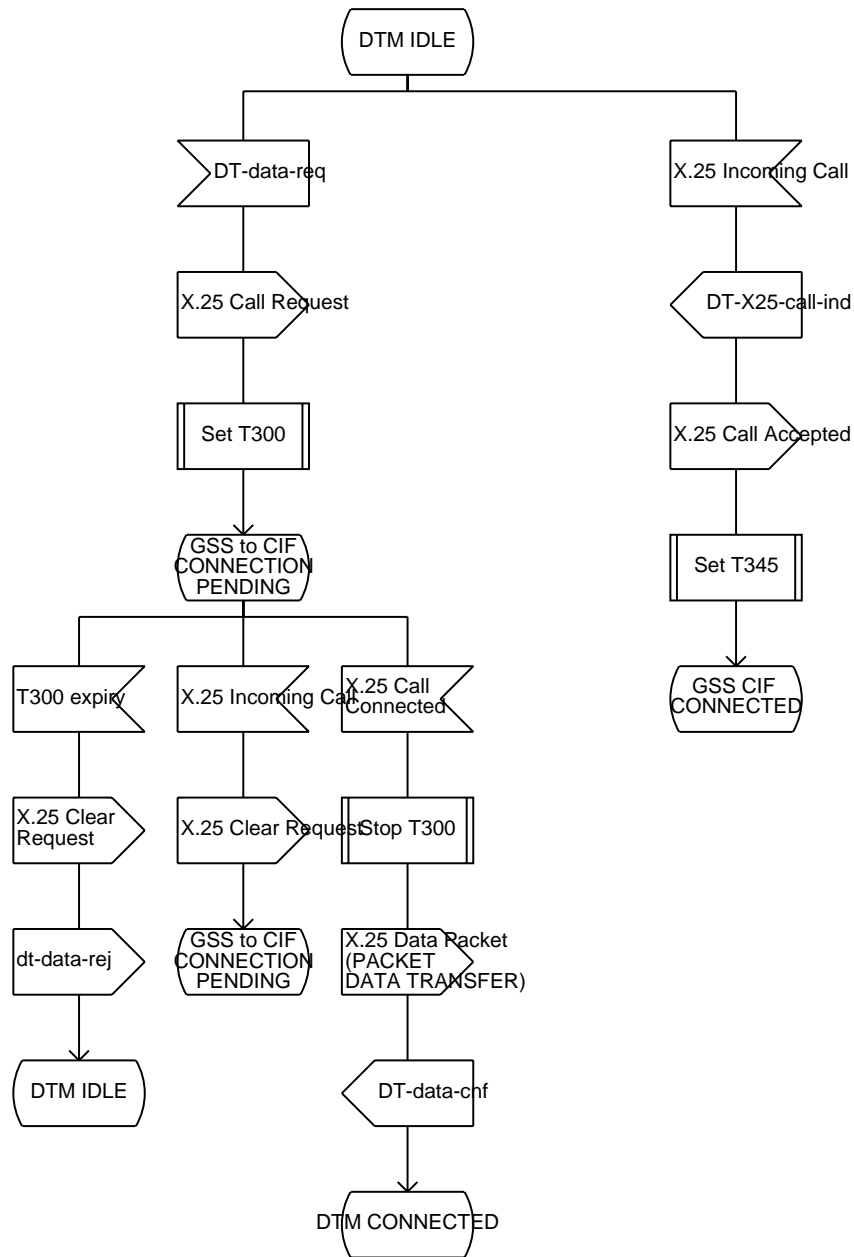


Figure C.3: (sheet 1 of 2) DTM GSS protocol CIF side

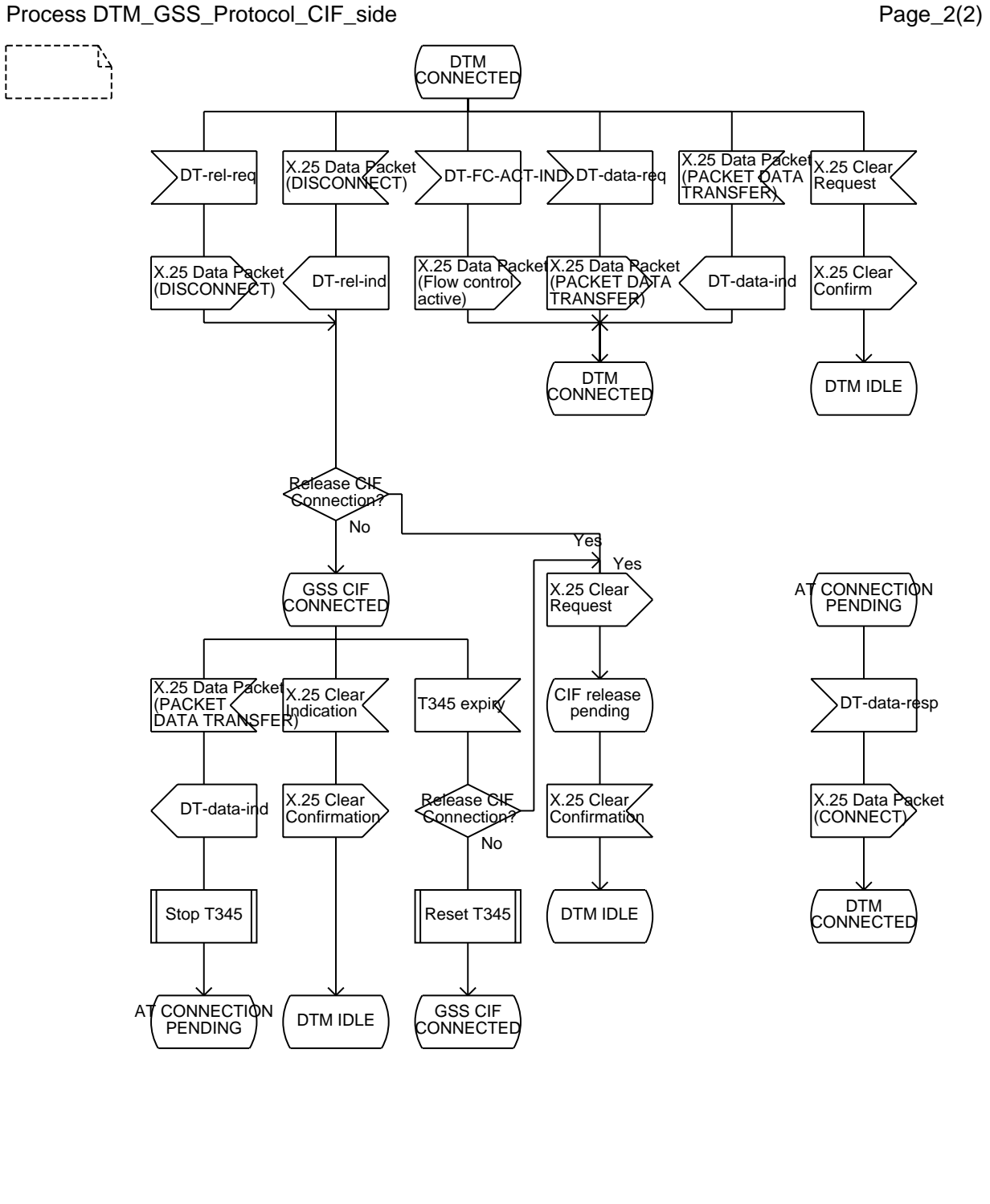


Figure C.3: (sheet 2 of 2) DTM GSS protocol CIF side

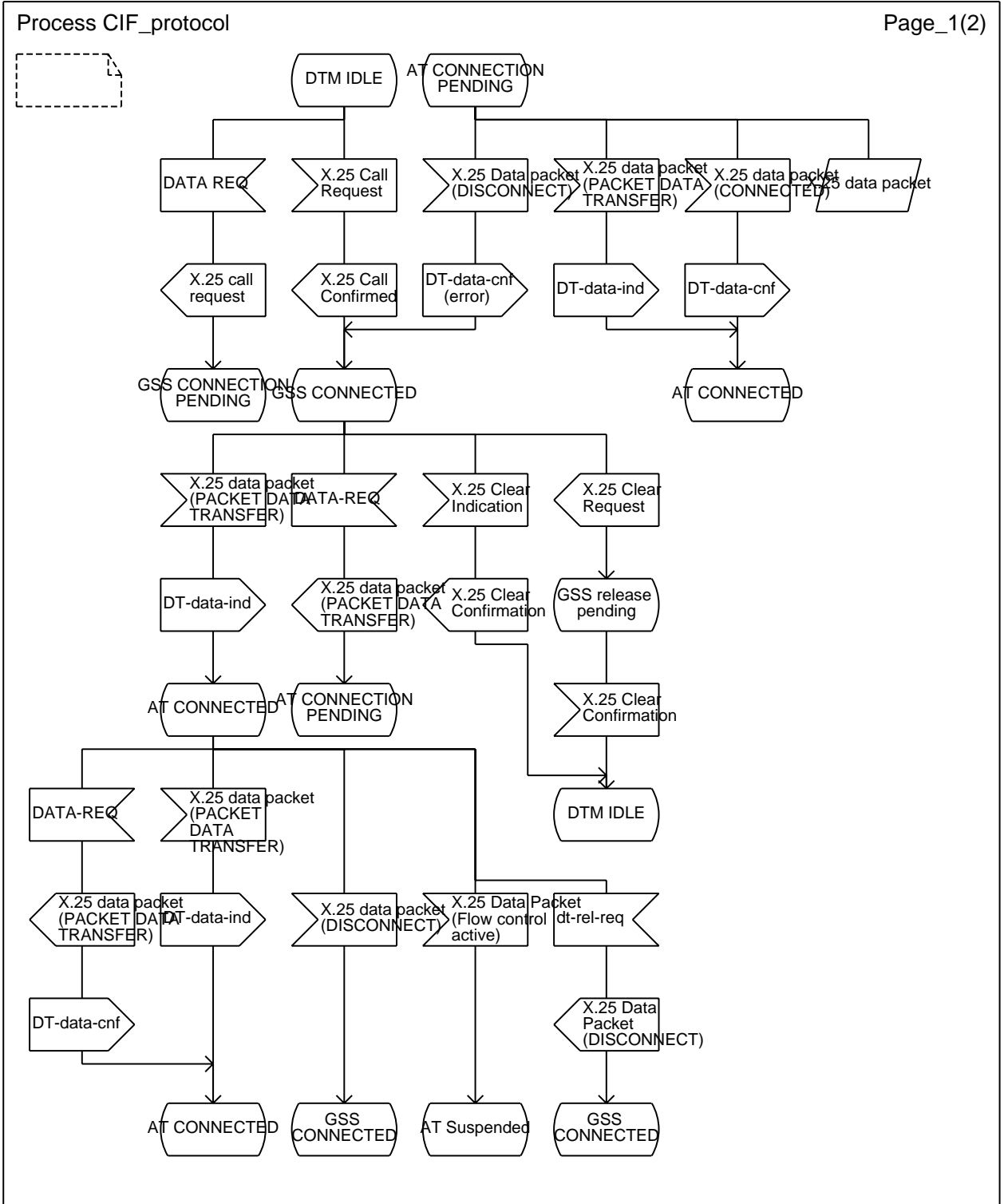


Figure C.4: (sheet 1 of 2) CIF protocol

Process CIF\_protocol

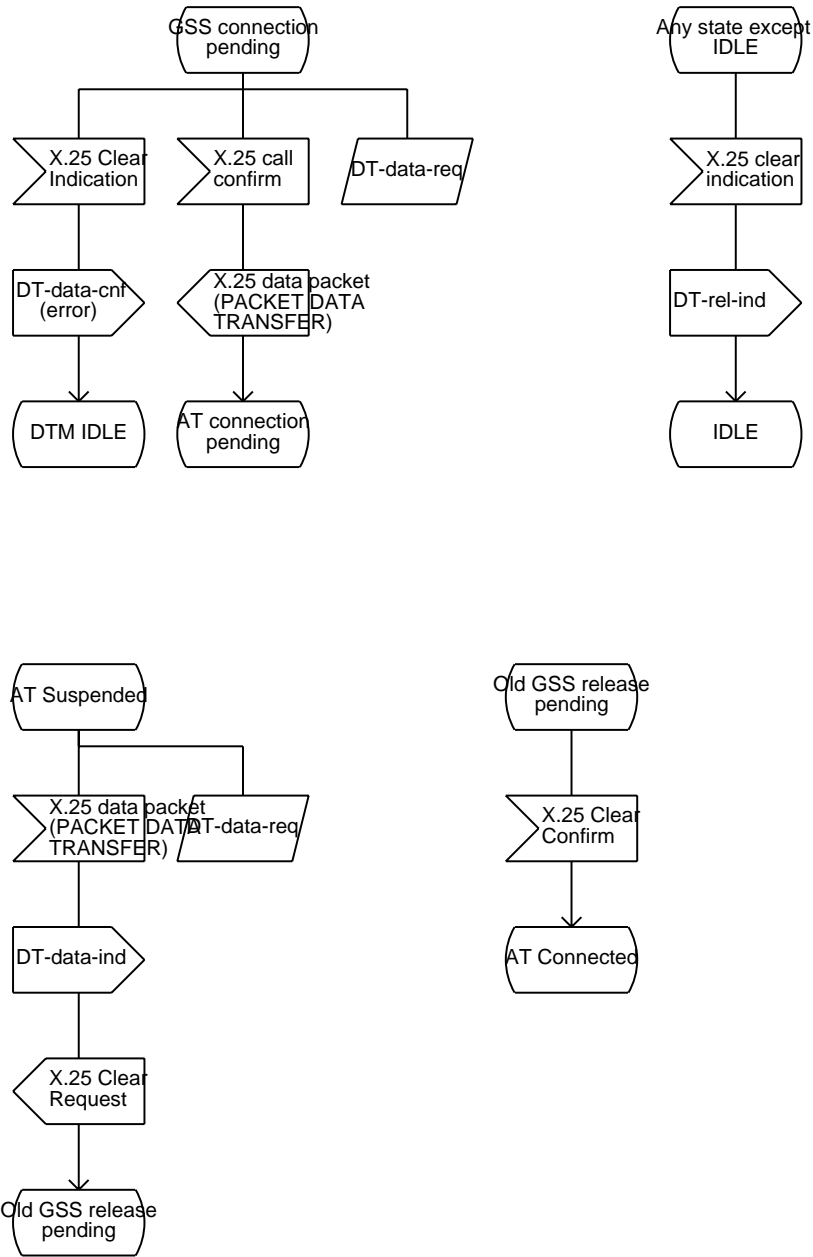


Figure C.4: (sheet 2 of 2) CIF protocol

Process RR\_AT\_Protocol

SE03262\_F142(17)

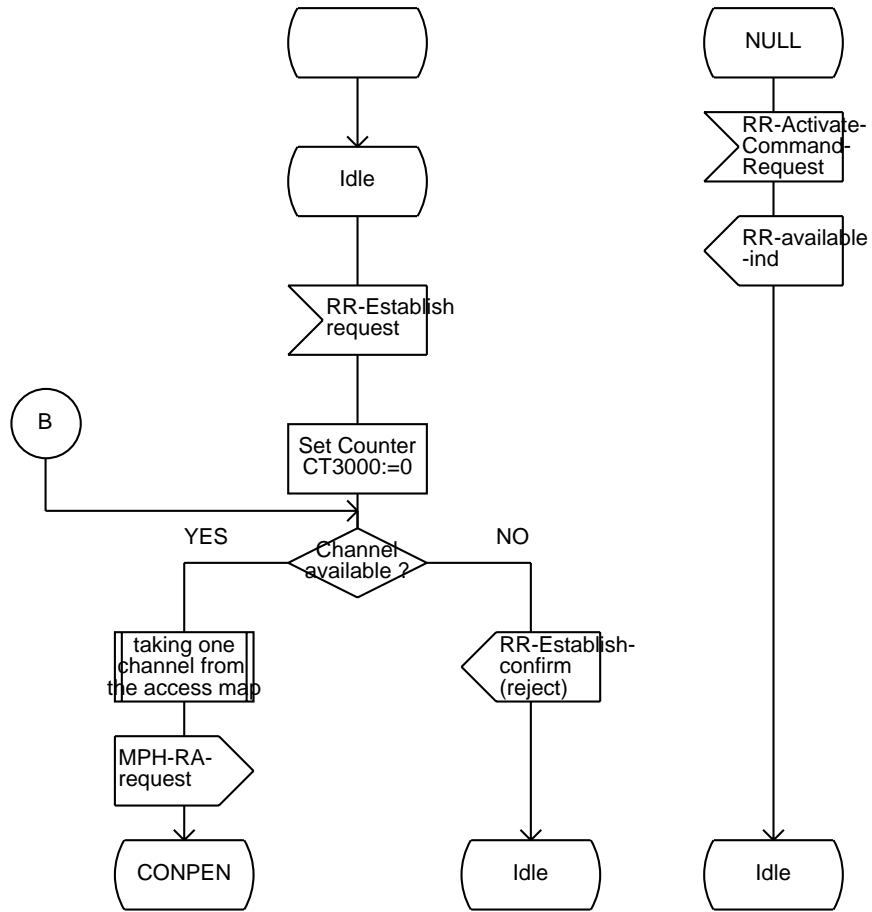


Figure C.5: (sheet 1 of 17) RR AT protocol

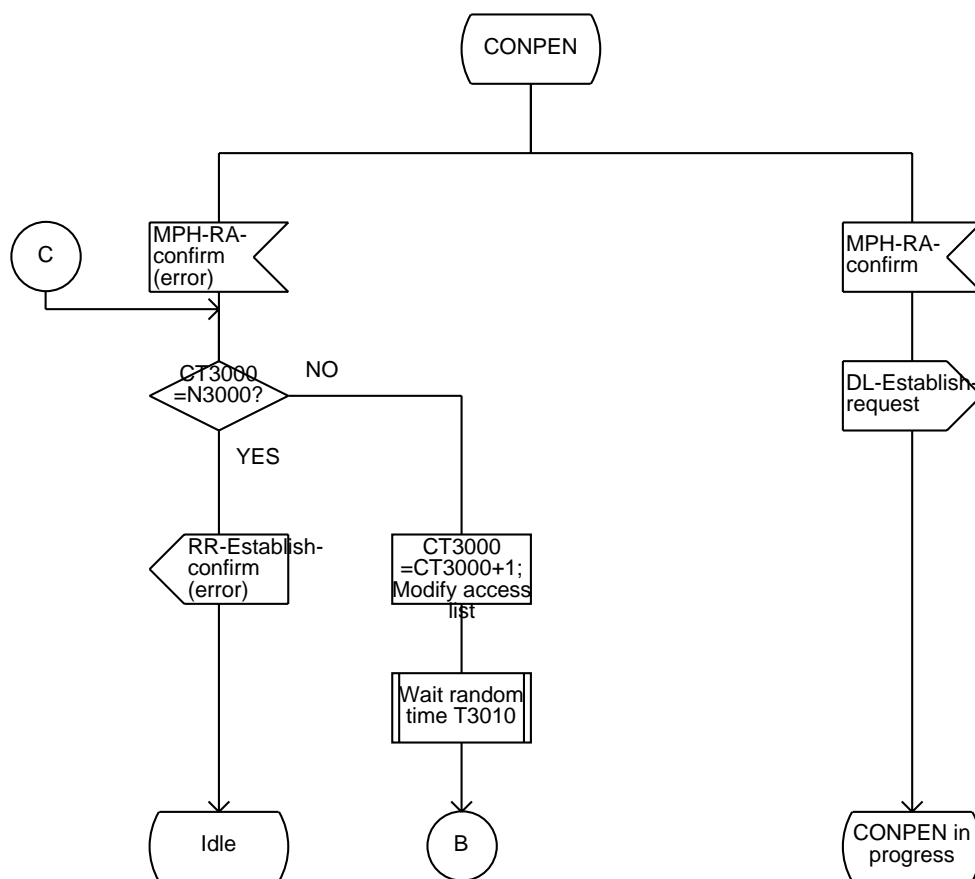


Figure C.5: (sheet 2 of 17) RR AT protocol

Process RR\_AT\_Protocol

SE03262\_F144(17)

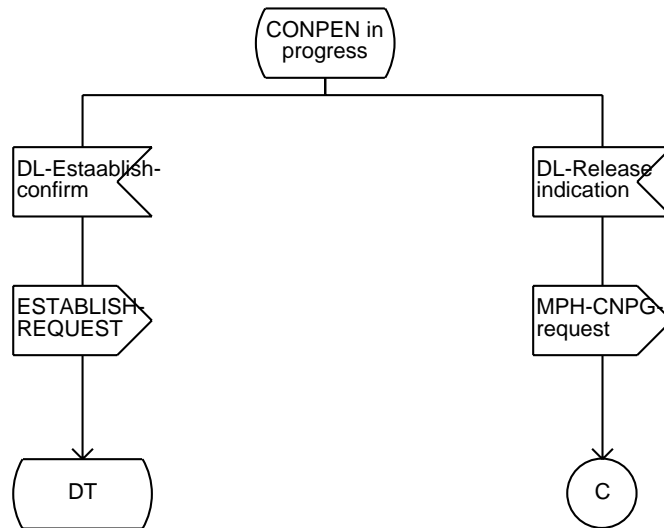


Figure C.5: (sheet 3 of 17) RR AT protocol

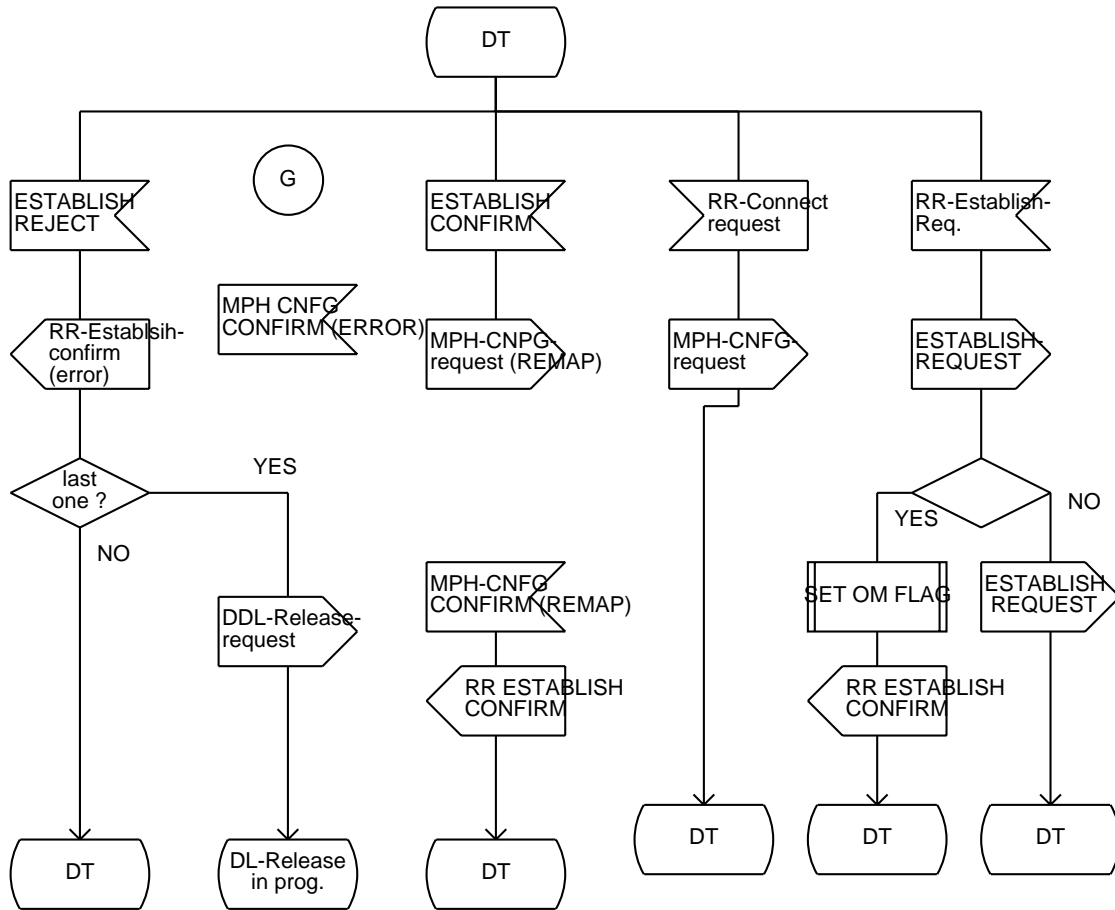


Figure C.5: (sheet 4 of 17) RR AT protocol



Process RR\_AT\_Protocol

SE03262\_F146(17)

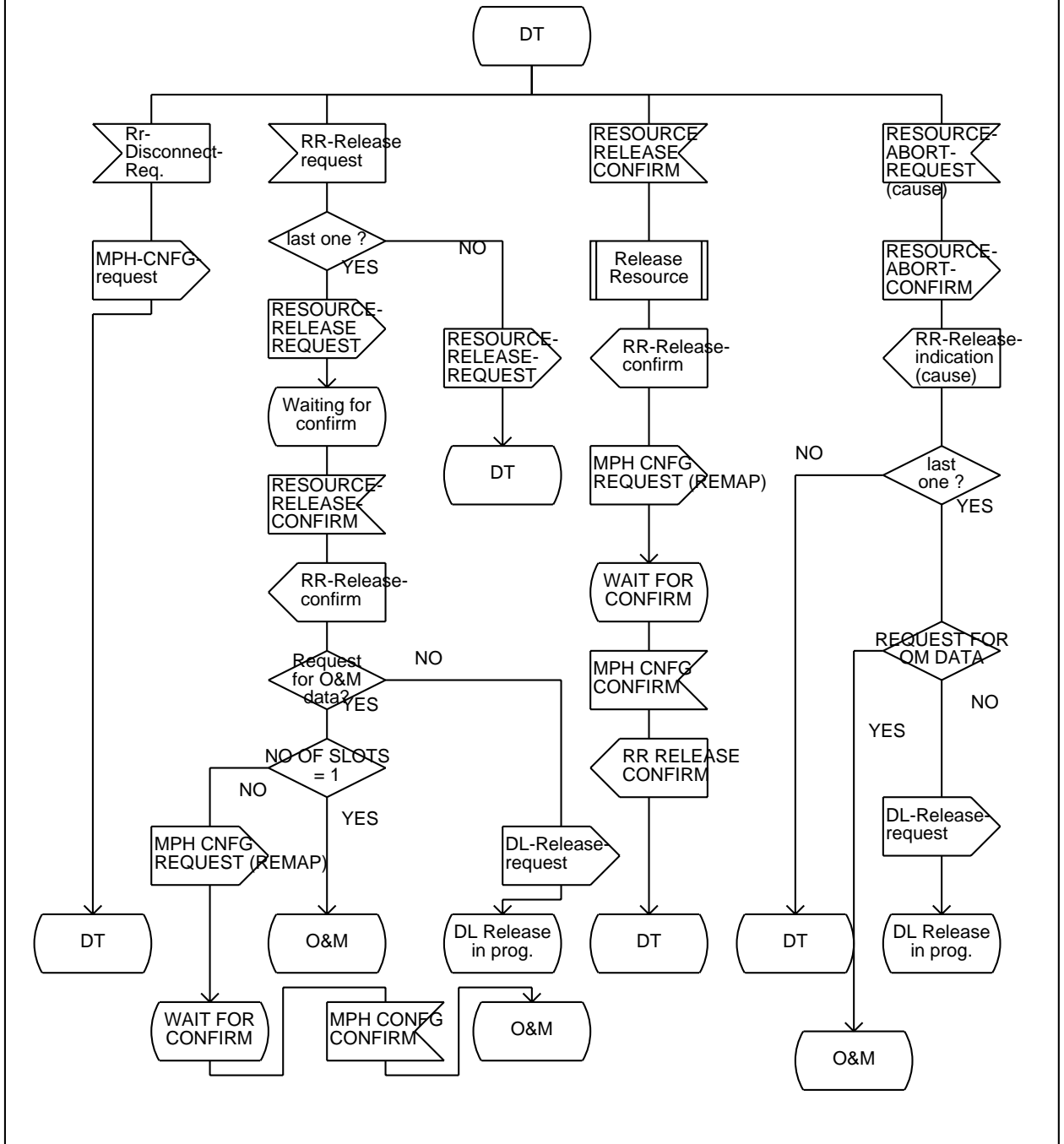
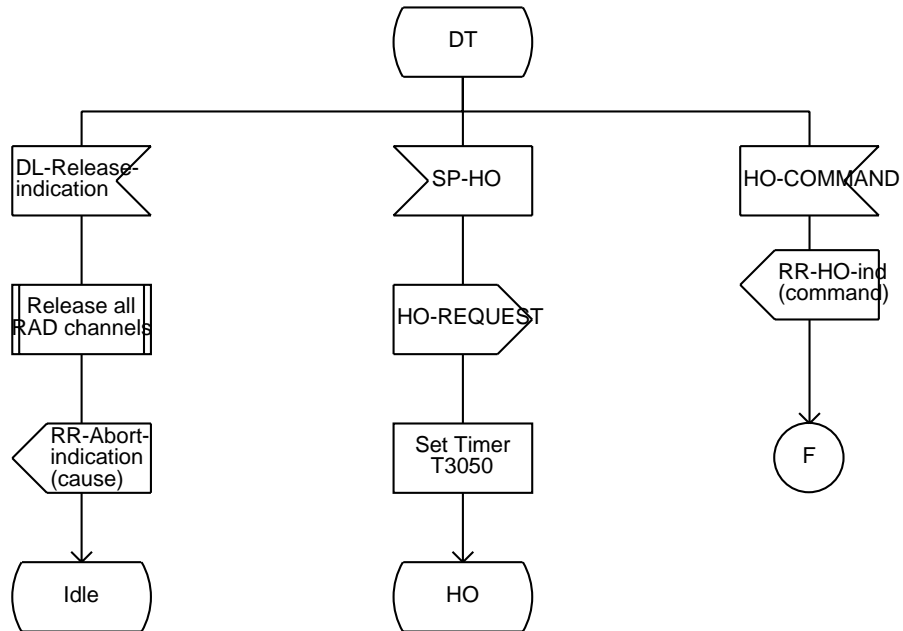


Figure C.5: (sheet 5 of 17) RR AT protocol

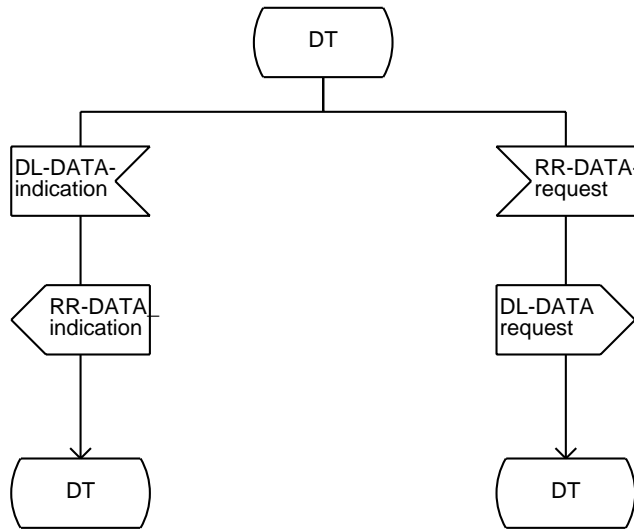


NOTE: SP means scanning process.

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

Process RR\_AT\_Protocol

SE03262\_F148(17)



NOTE: DATA messages with different PD than RRM.

Figure C.5: (sheet 7 of 17) RR AT protocol

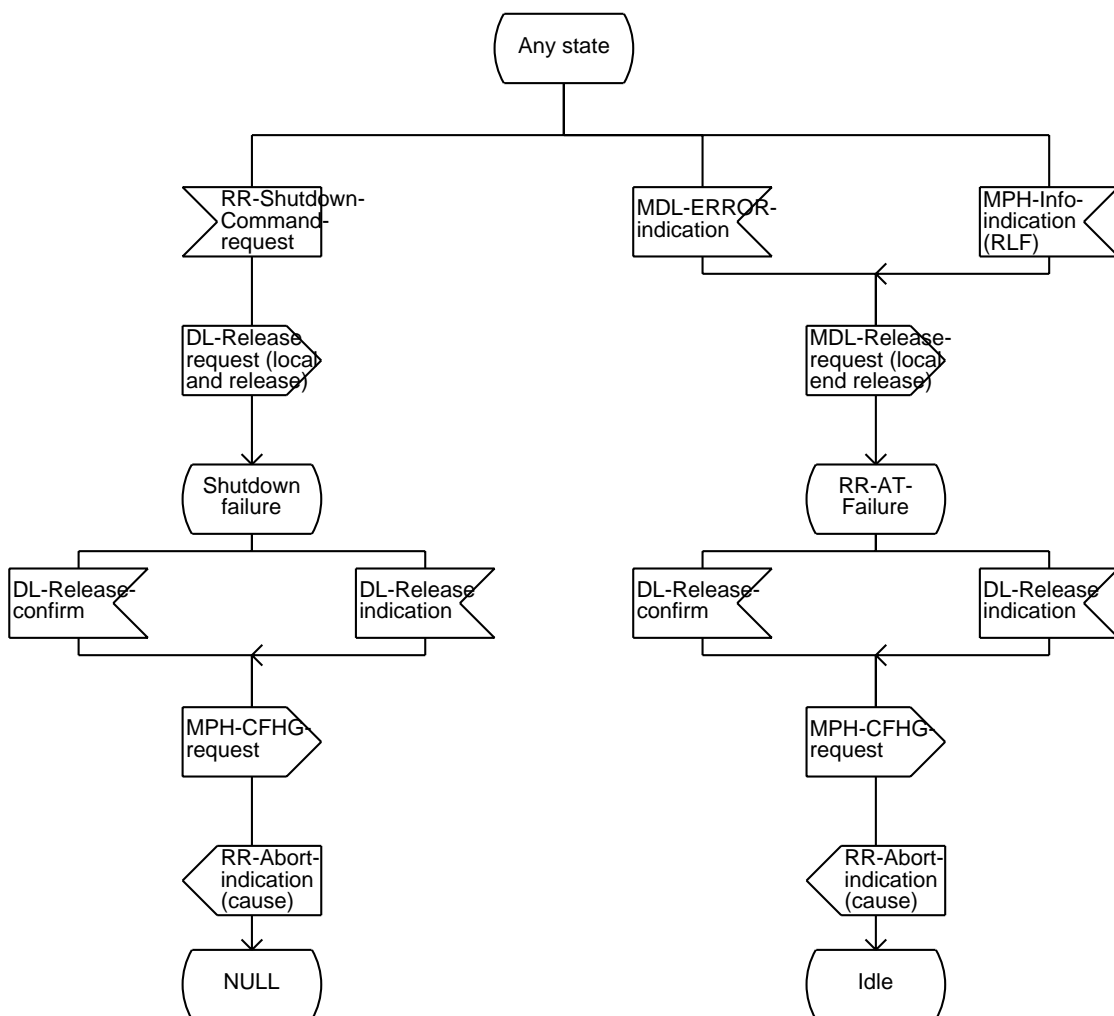


Figure C.5: (sheet 8 of 17) RR AT protocol

Process RR\_AT\_Protocol

SE03262\_F150(17)

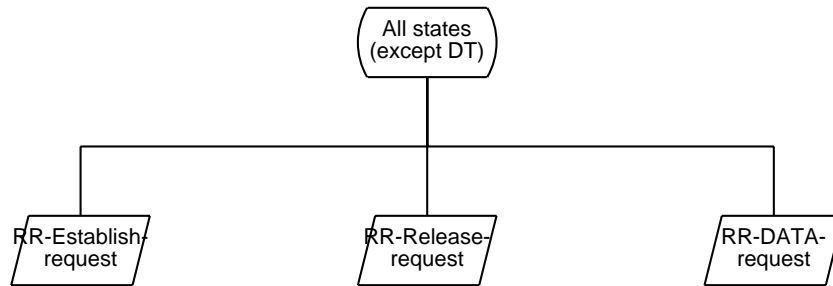


Figure C.5: (sheet 9 of 17) RR AT protocol

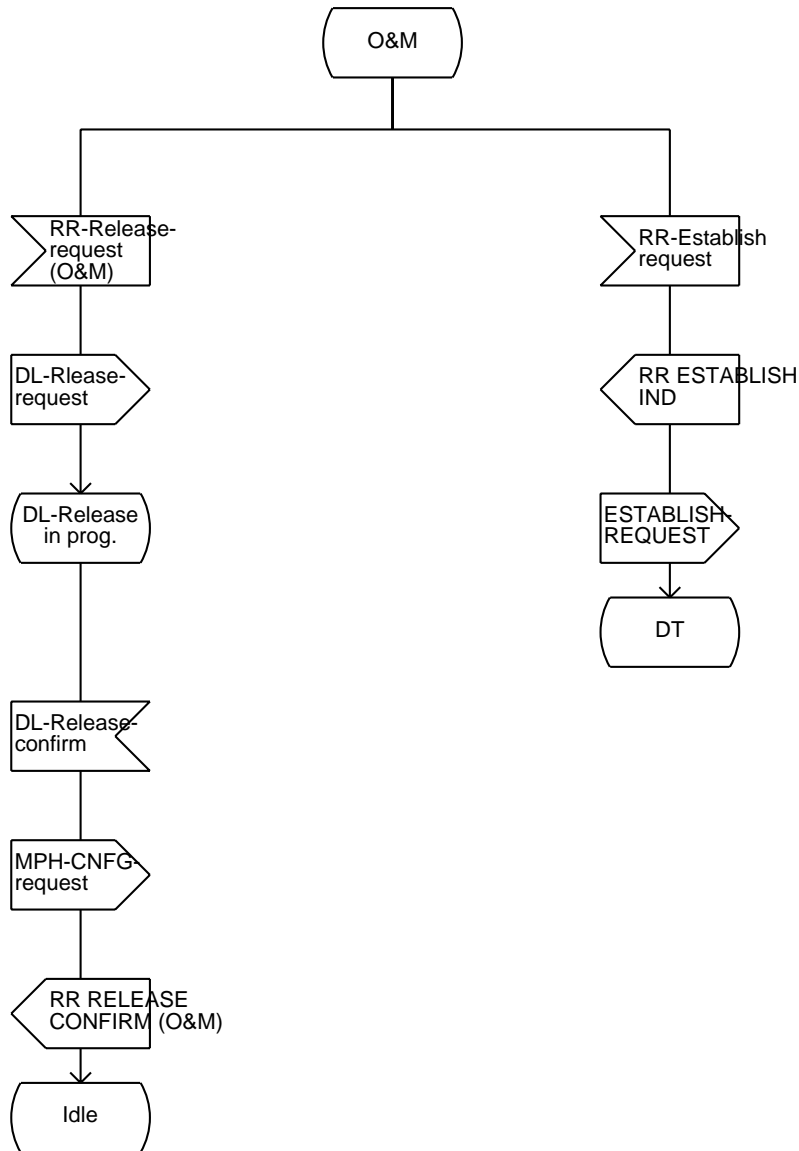
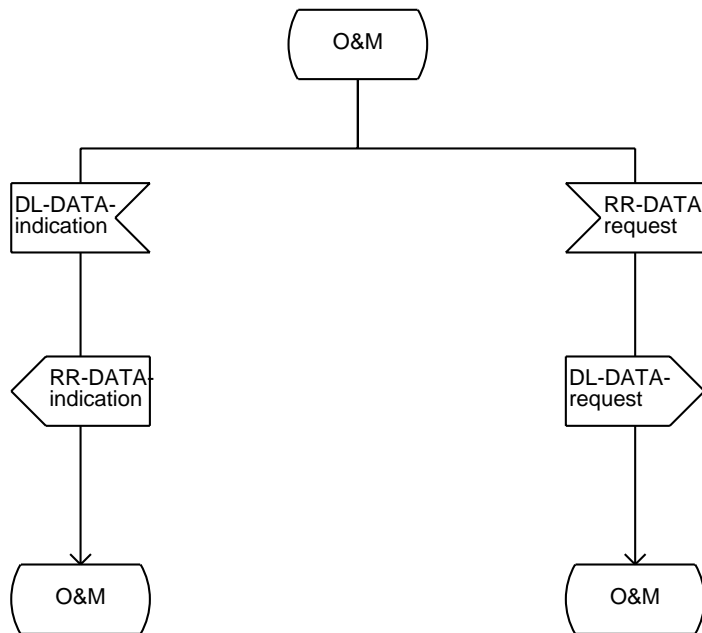


Figure C.5: (sheet 10 of 17) RR AT protocol

Process RR\_AT\_Protocol

SE03262\_F152(17)



NOTE: Data messages with different PD than RRM.

Figure C.5: (sheet 11 of 17) RR AT protocol

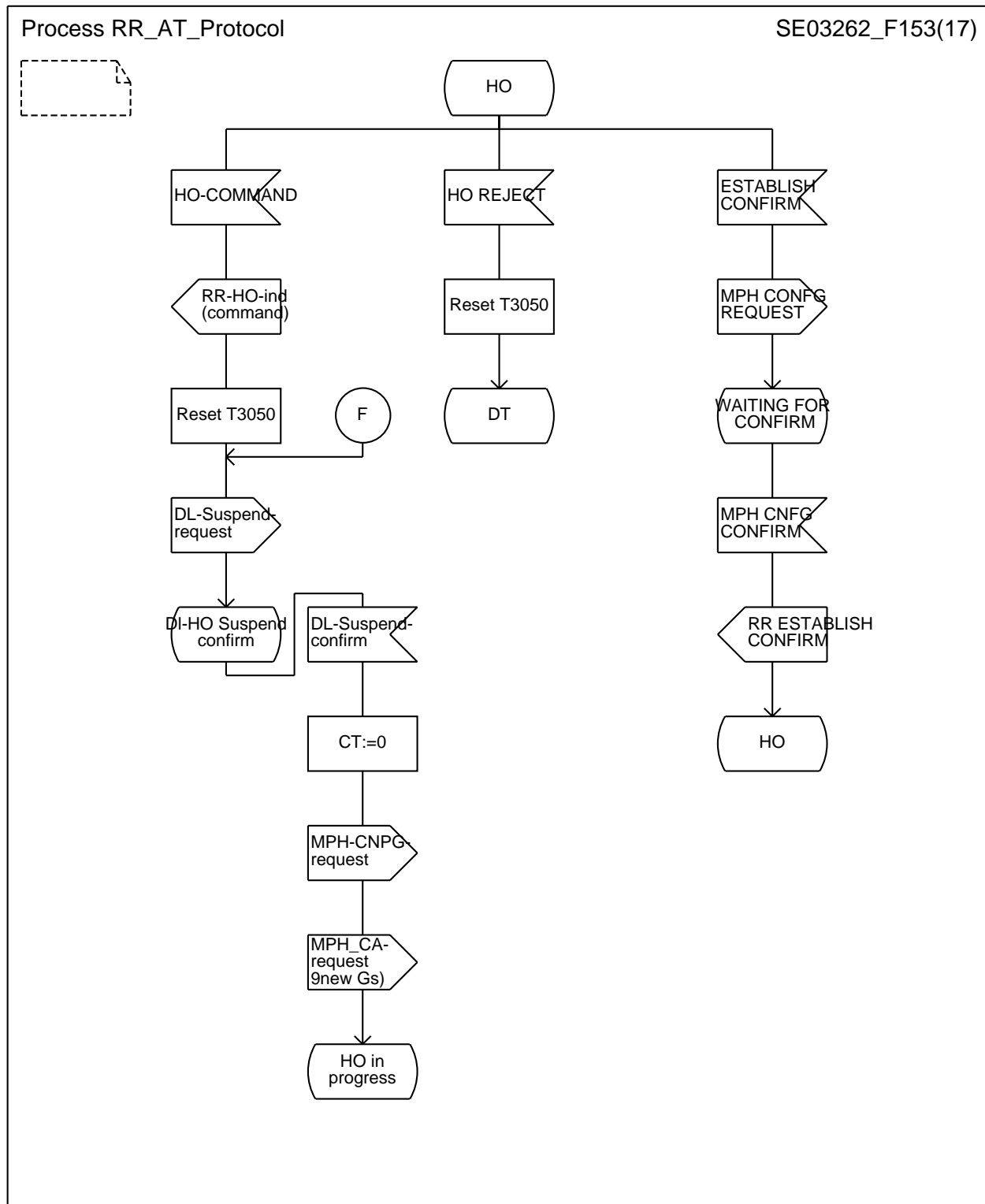


Figure C.5: (sheet 12 of 17) RR AT protocol



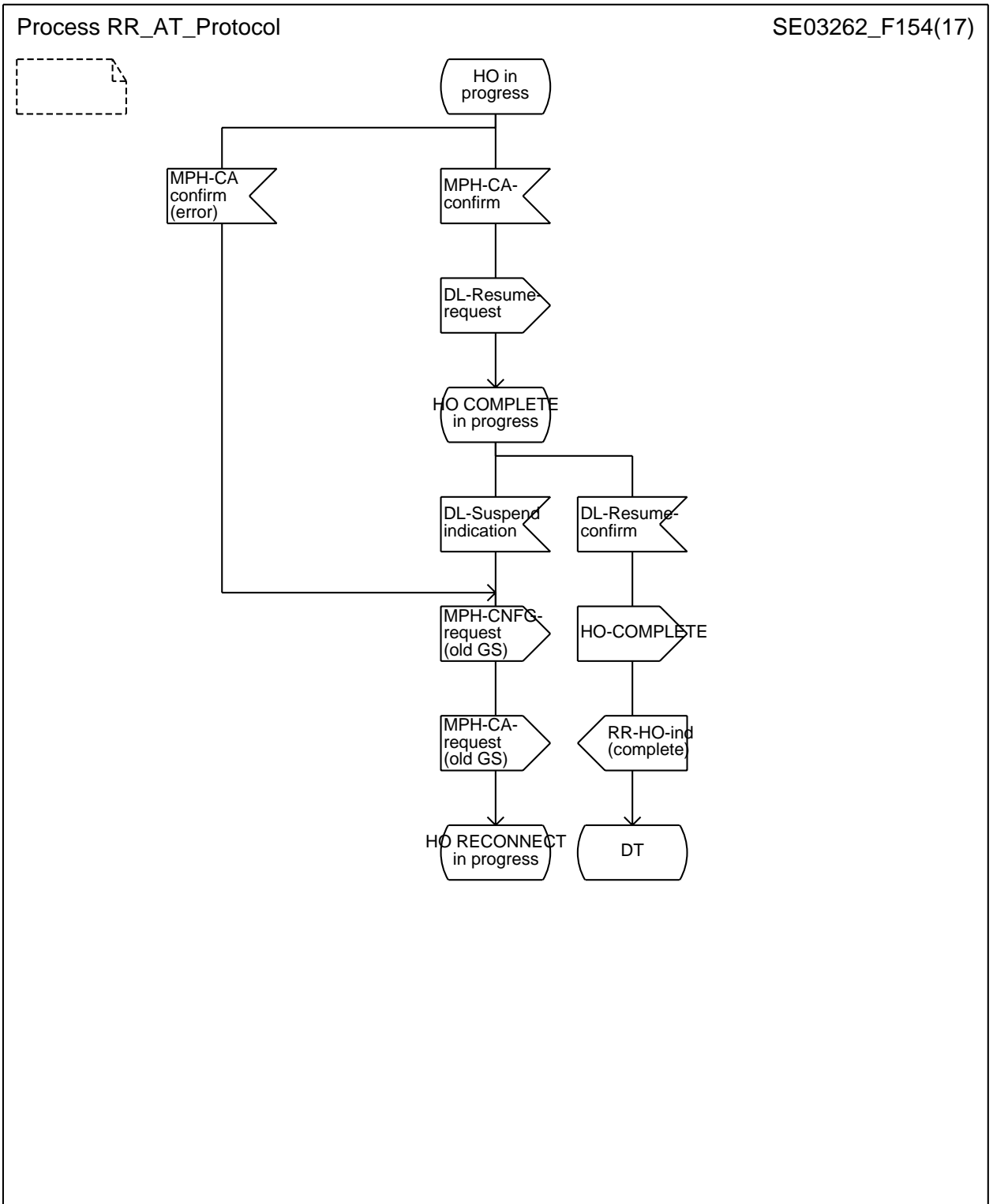


Figure C.5: (sheet 13 of 17) RR AT protocol

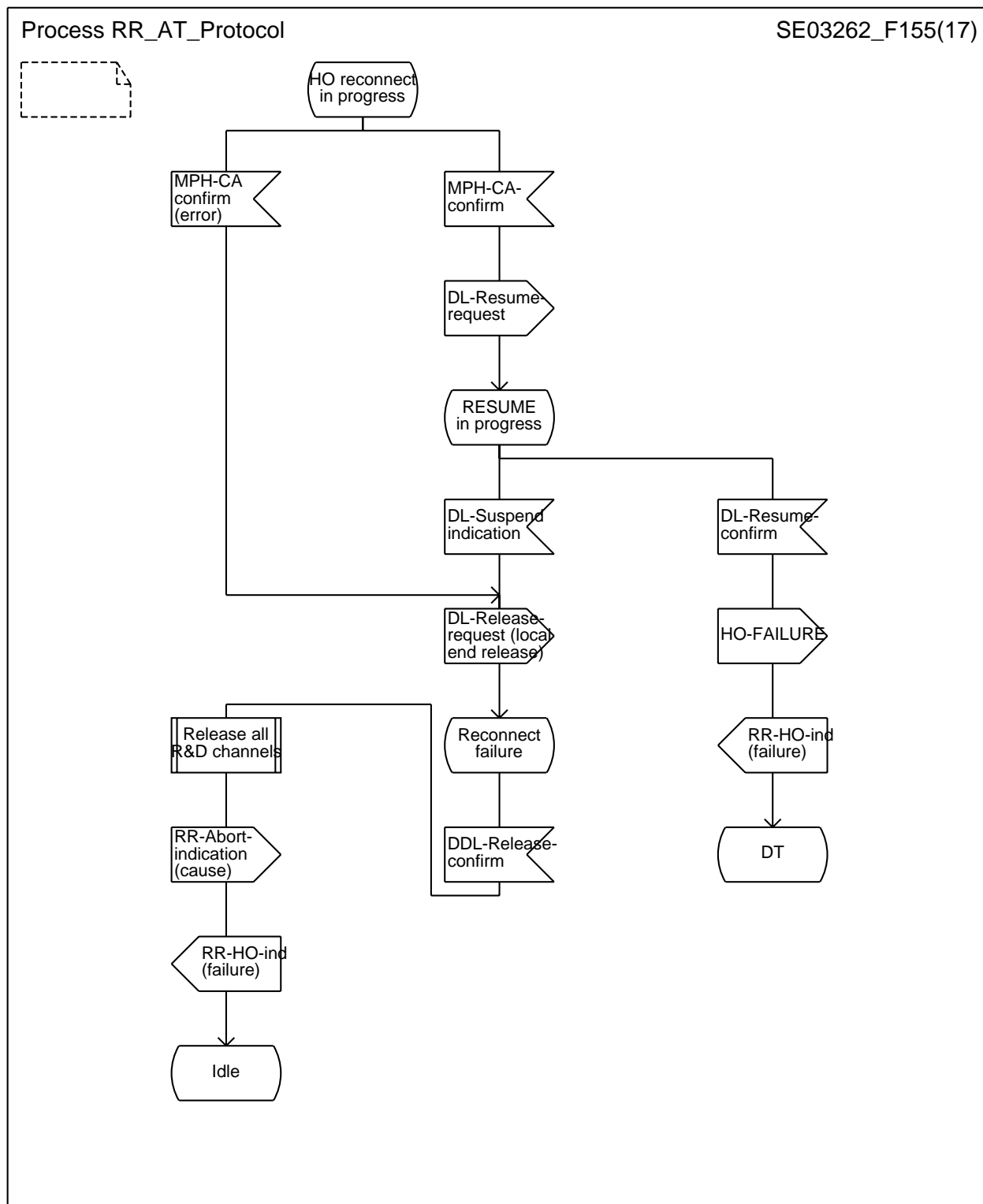


Figure C.5: (sheet 14 of 17) RR AT protocol

Process RR\_AT\_Protocol

SE03262\_F156(17)



Figure C.5: (sheet 15 of 17) RR AT protocol

Process RR\_AT\_Protocol

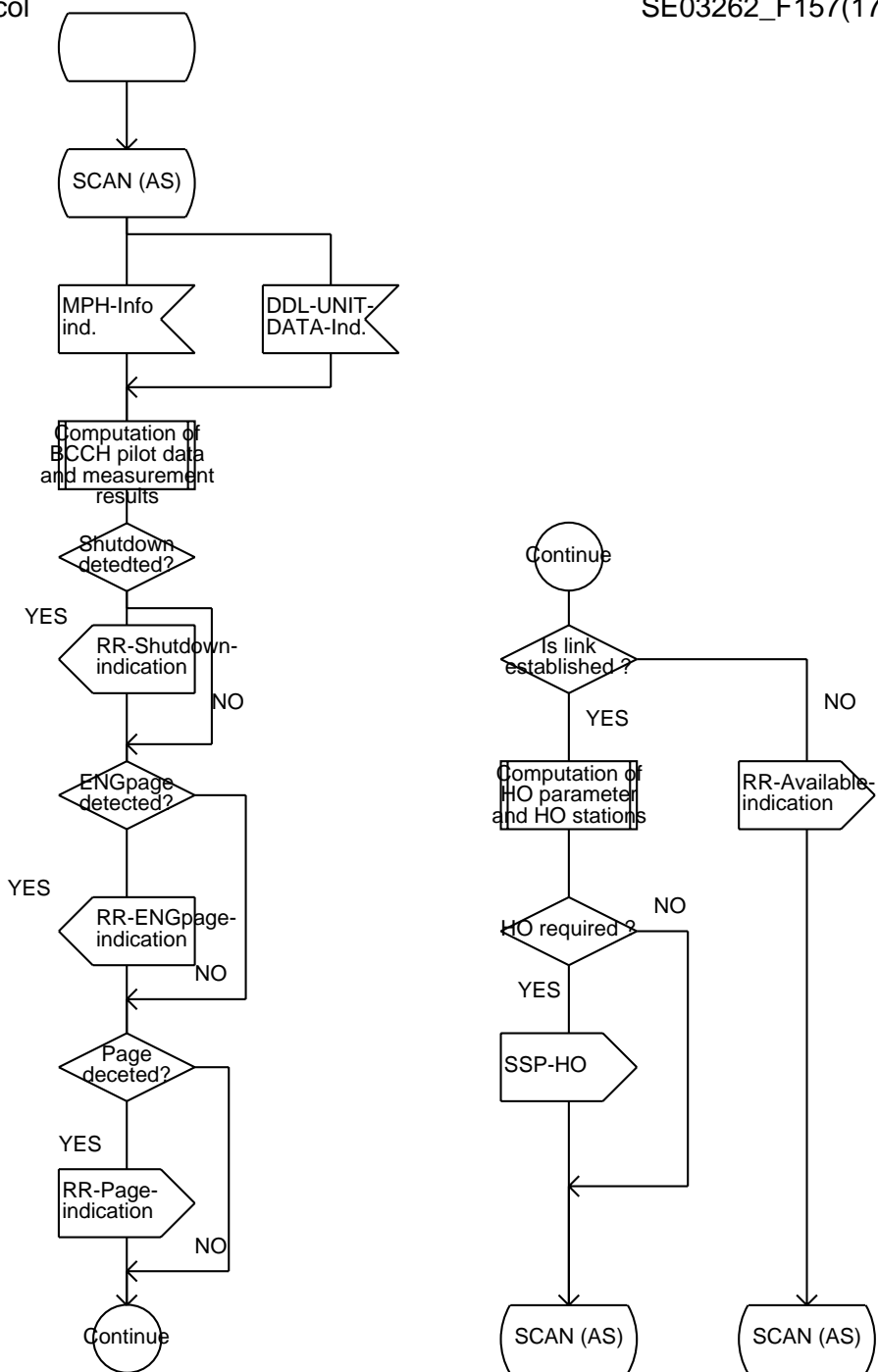


Figure C.5: (sheet 16 of 17) RR AT protocol

Process RR\_AT\_Protocol

SE03262\_F158(17)

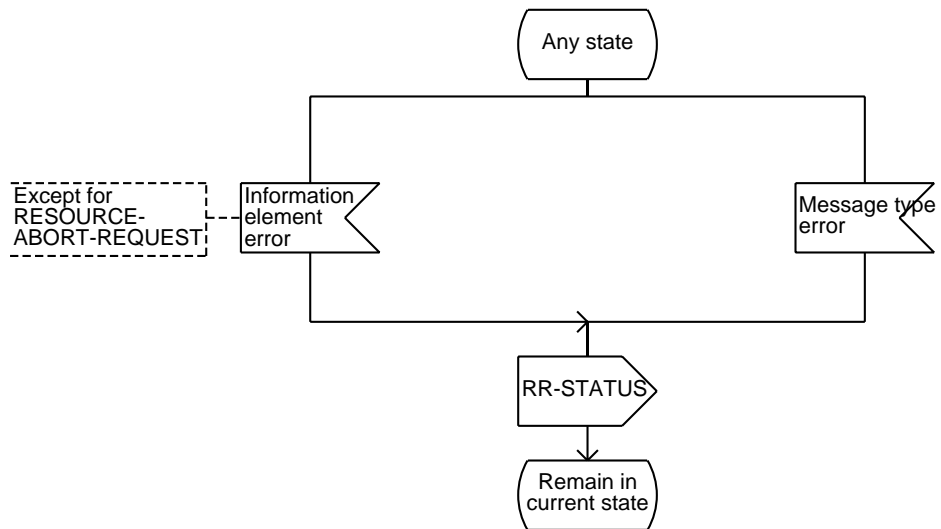


Figure C.5: (sheet 17 of 17) RR AT protocol

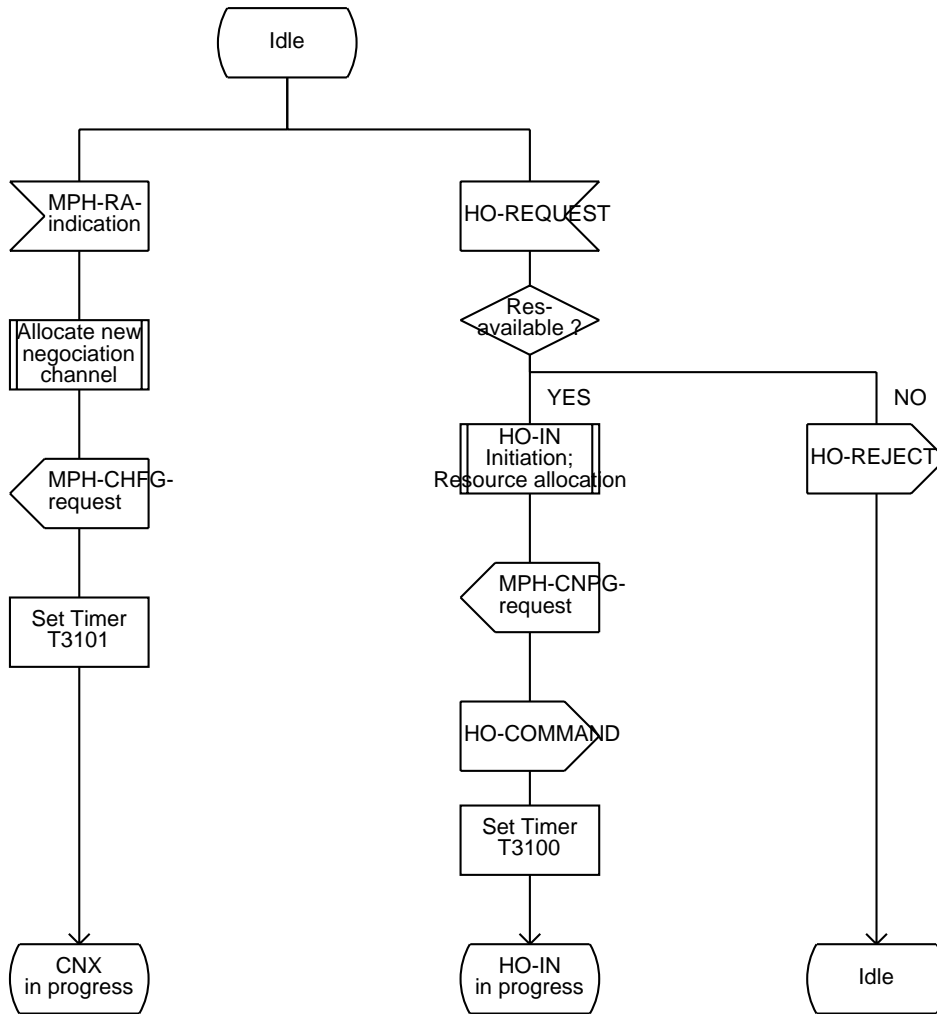


Figure C.6: (sheet 1 of 14) RR GS protocol

Process RR\_GS\_Protocol

SE03262\_F160(14)

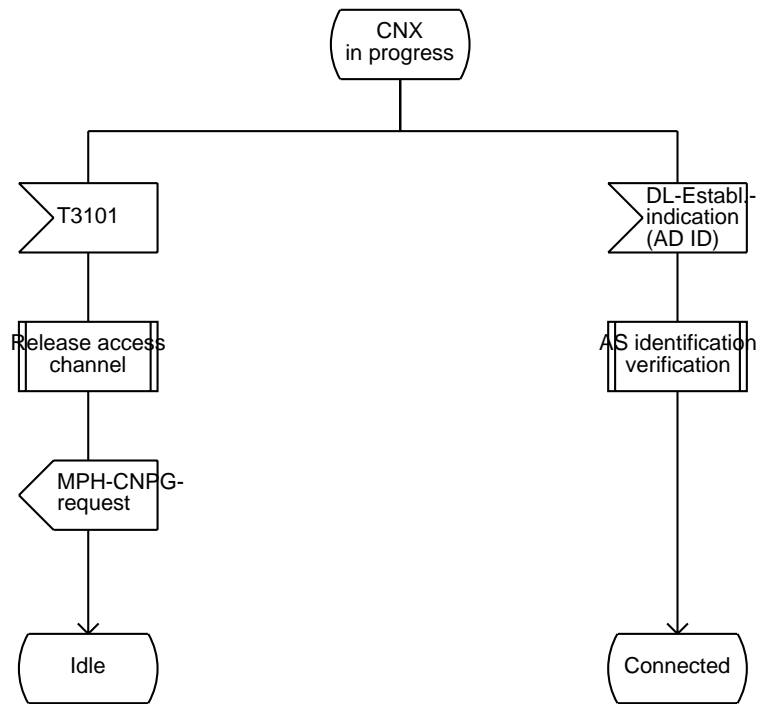


Figure C.6: (sheet 2 of 14) RR GS protocol

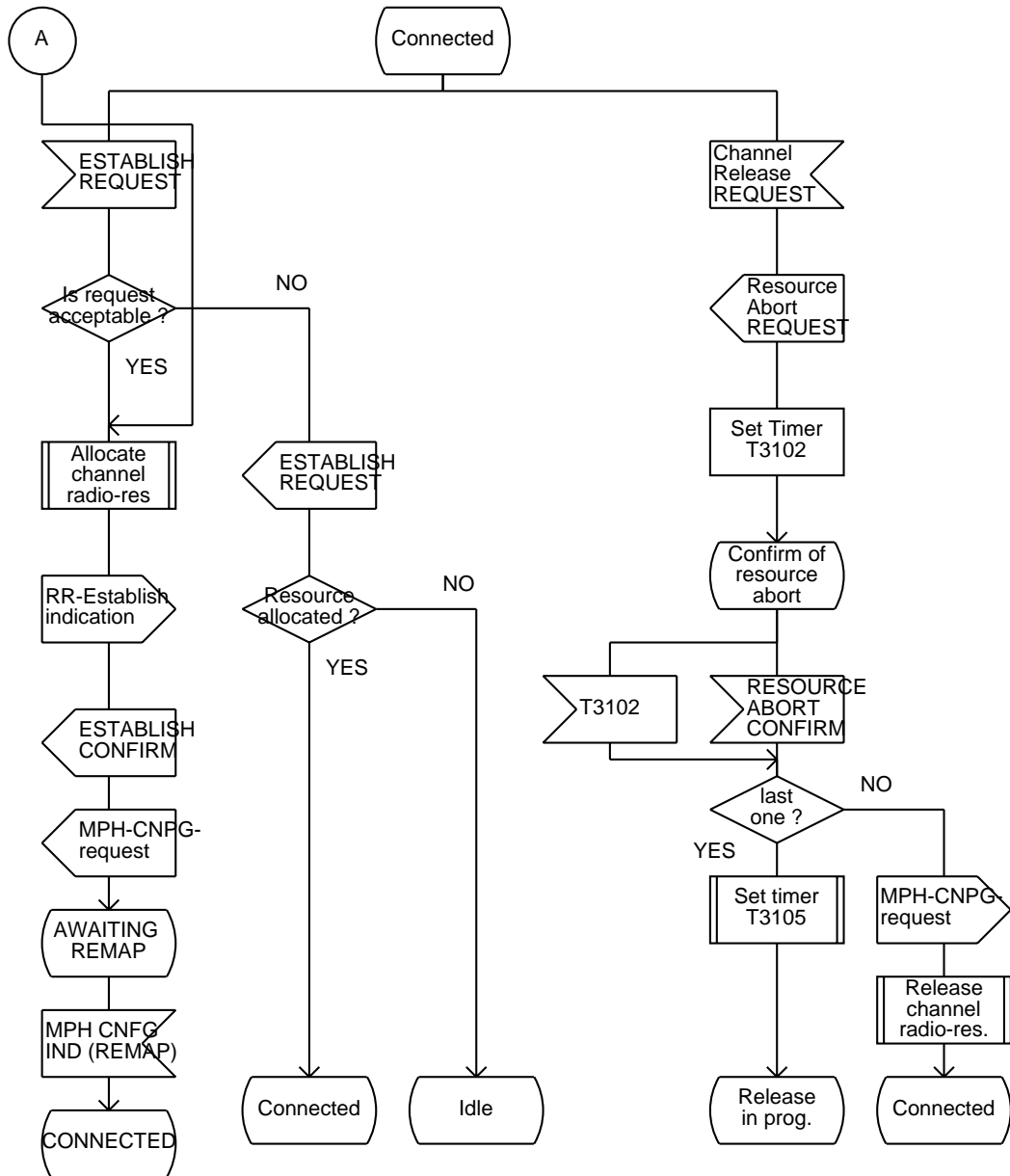


Figure C.6: (sheet 3 of 14) RR GS protocol



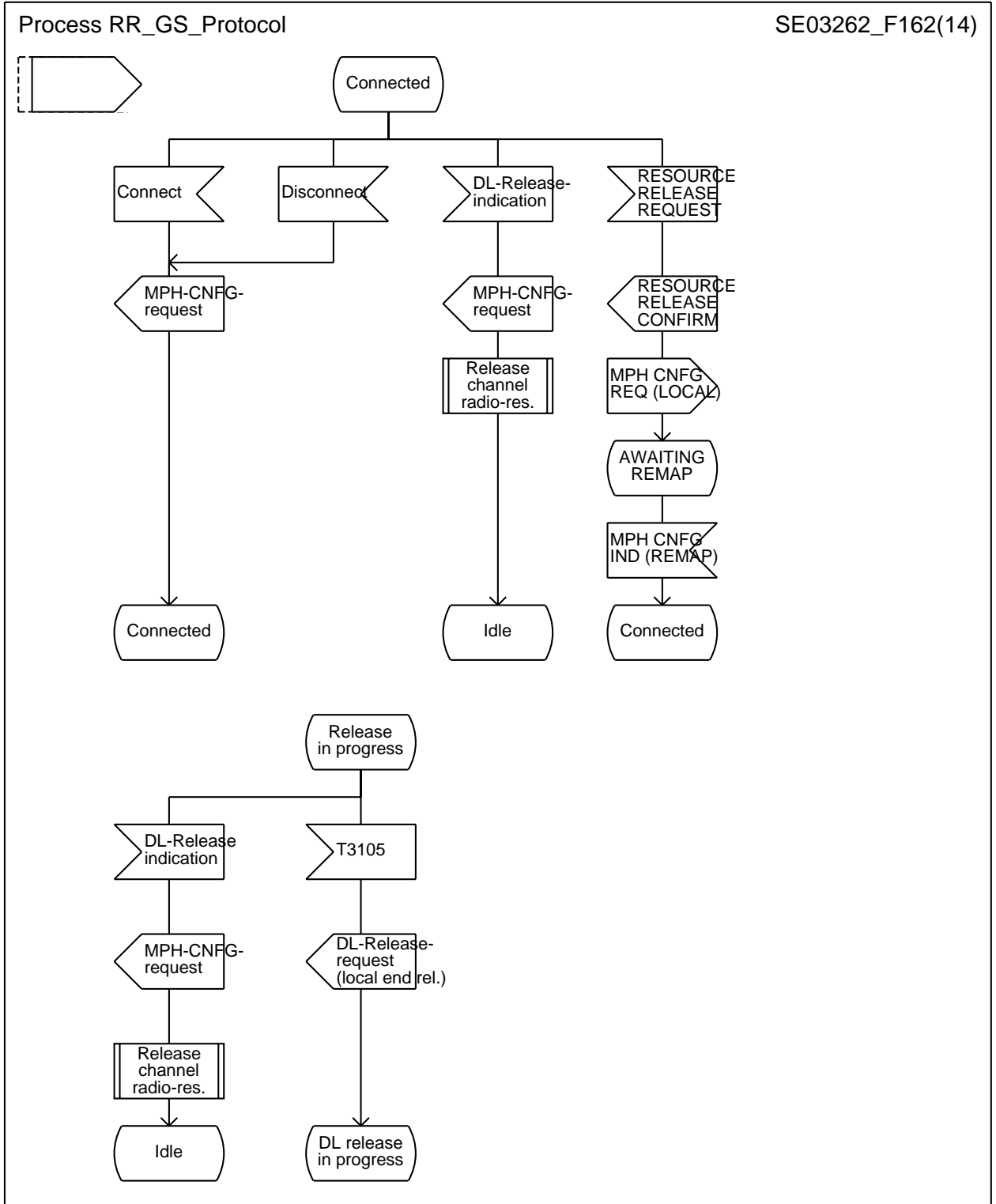


Figure C.6: (sheet 4 of 14) RR GS protocol

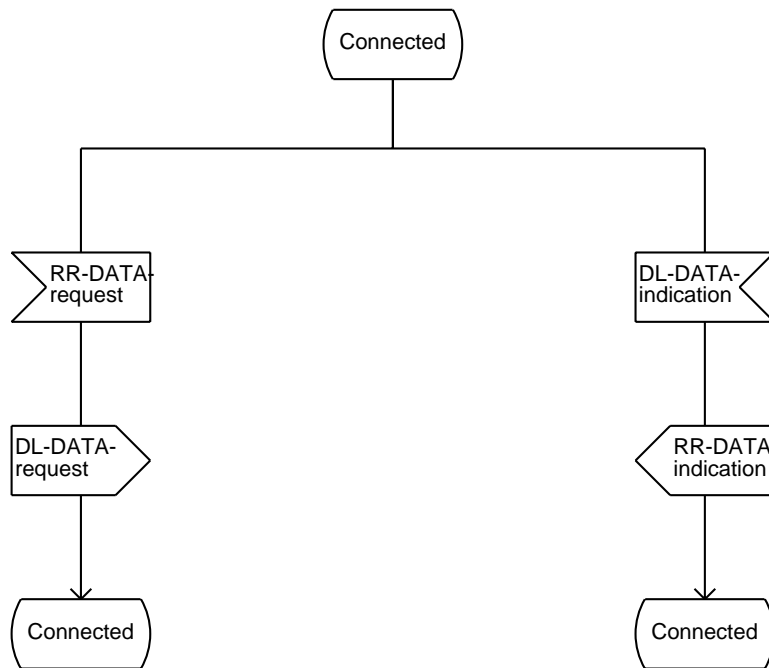


Figure C.6: (sheet 5 of 14) RR GS protocol

Process RR\_GS\_Protocol

SE03262\_F164(14)

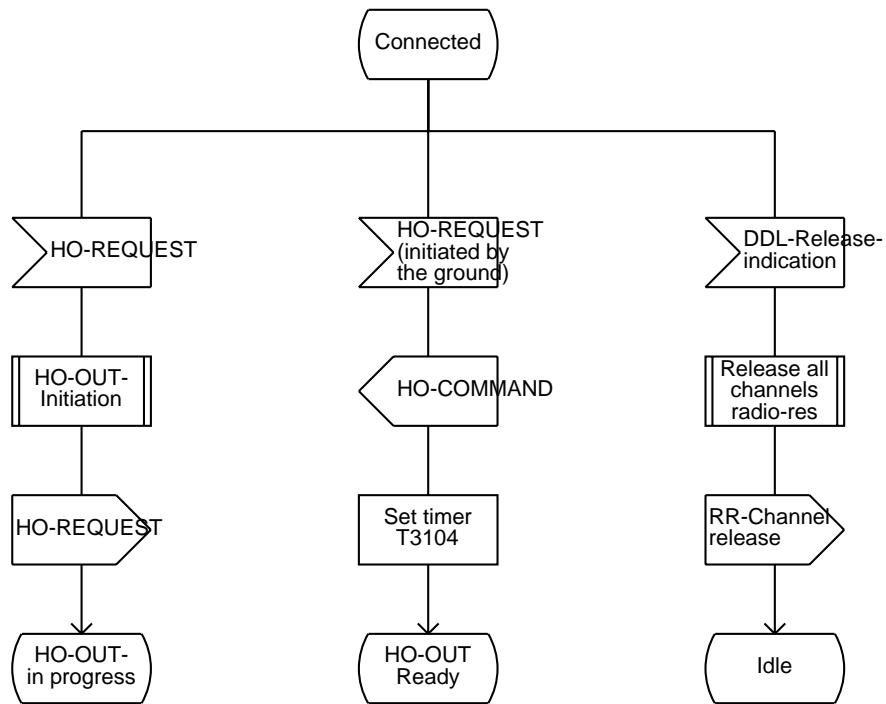


Figure C.6: (sheet 6 of 14) RR GS protocol

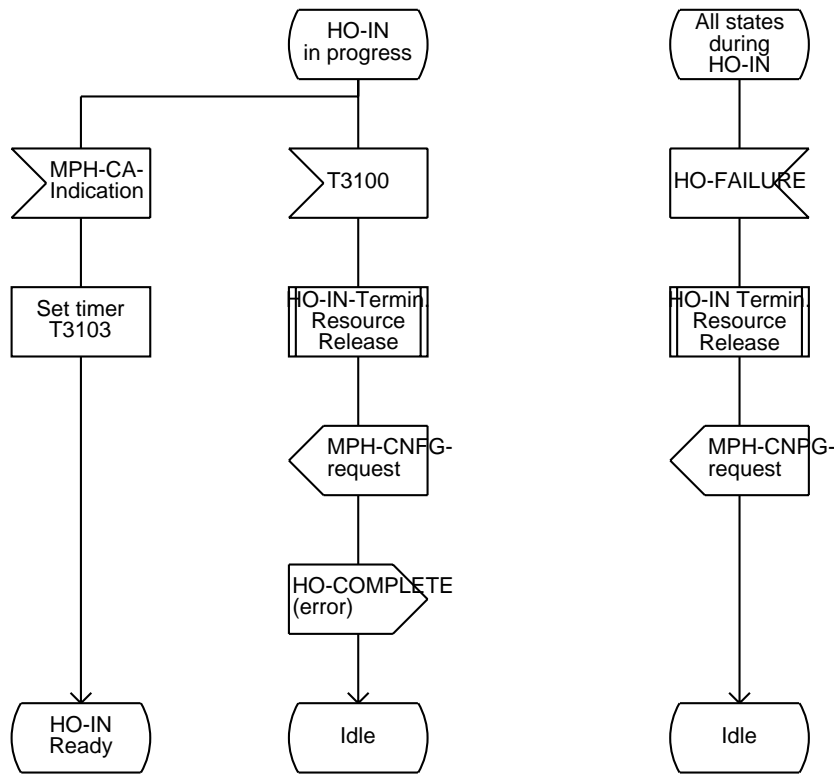


Figure C.6: (sheet 7 of 14) RR GS protocol

Process RR\_GS\_Protocol

SE03262\_F166(14)

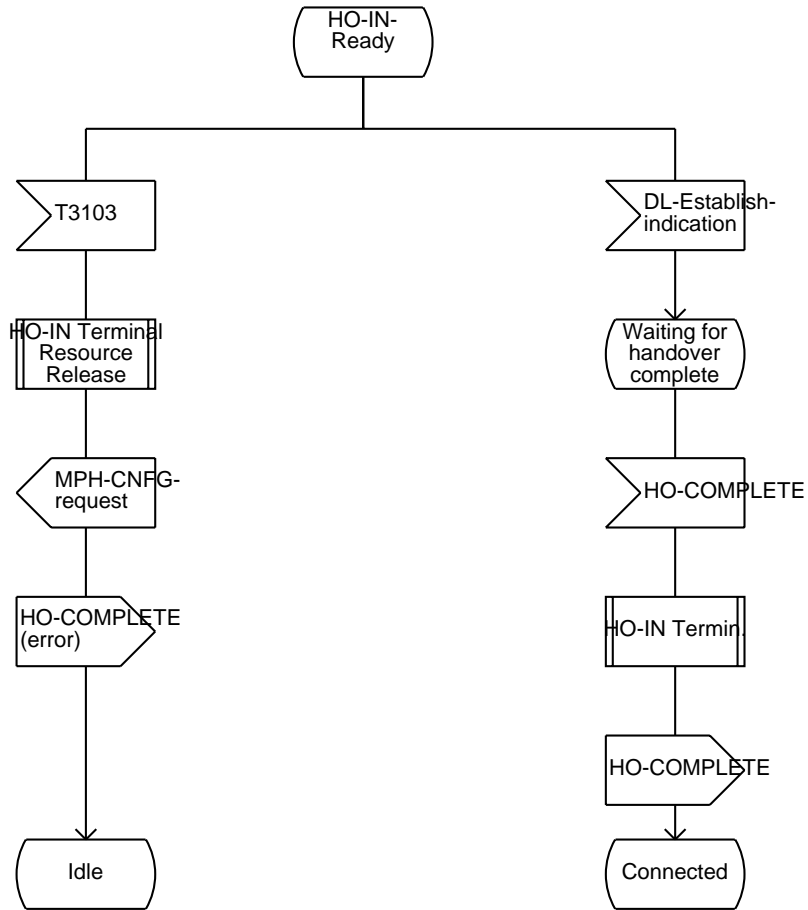


Figure C.6: (sheet 8 of 14) RR GS protocol

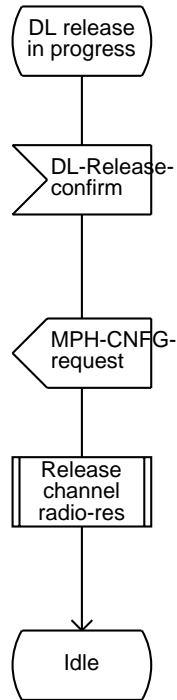


Figure C.6: (sheet 9 of 14) RR GS protocol

Process RR\_GS\_Protocol

SE03262\_F168(14)

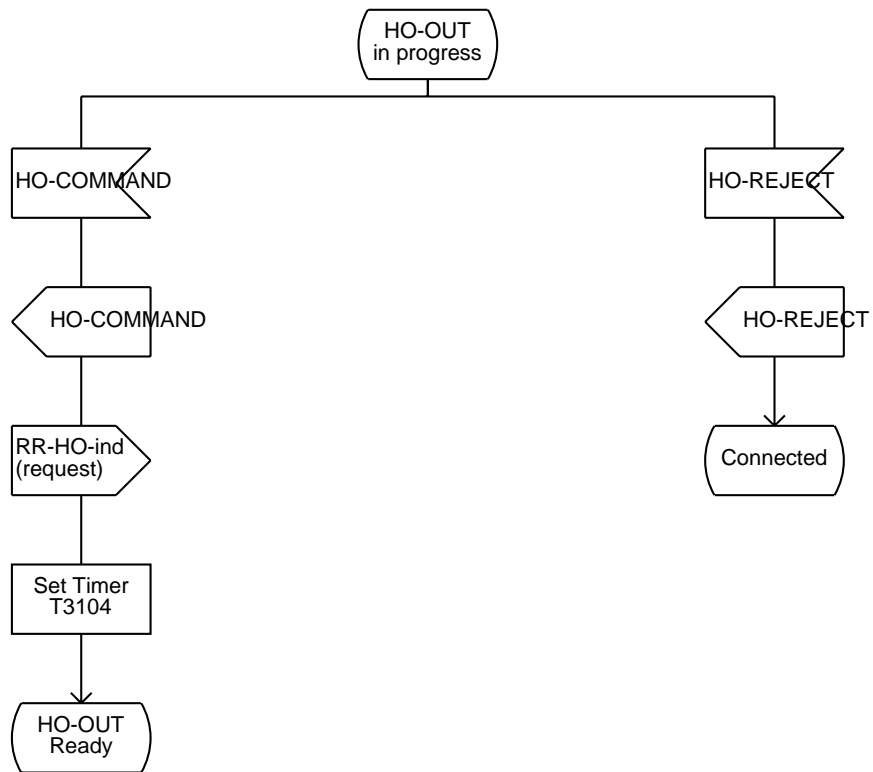


Figure C.6: (sheet 10 of 14) RR GS protocol

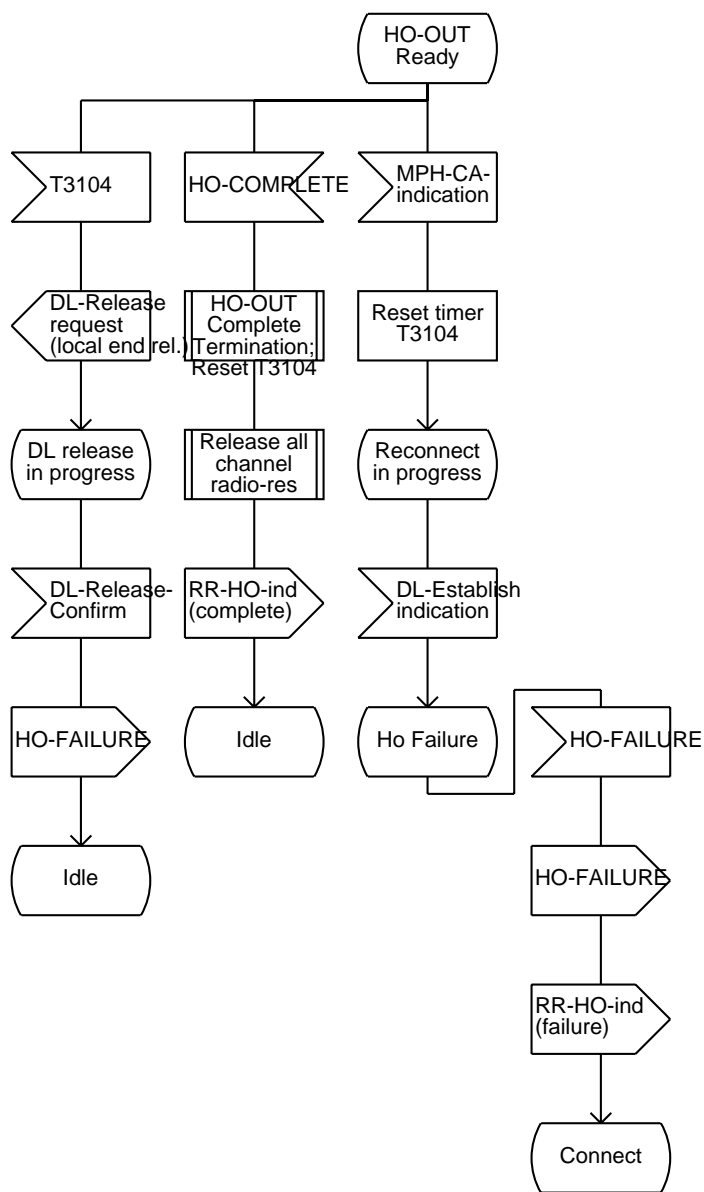


Figure C.6: (sheet 11 of 14) RR GS protocol



Process RR\_GS\_Protocol

SE03262\_F170(14)

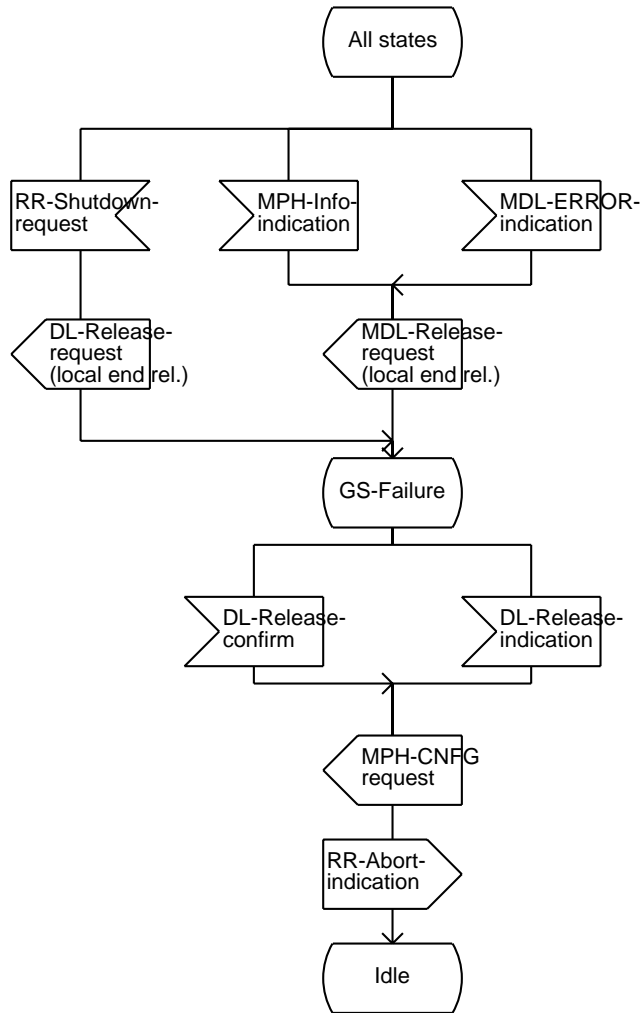


Figure C.6: (sheet 12 of 14) RR GS protocol

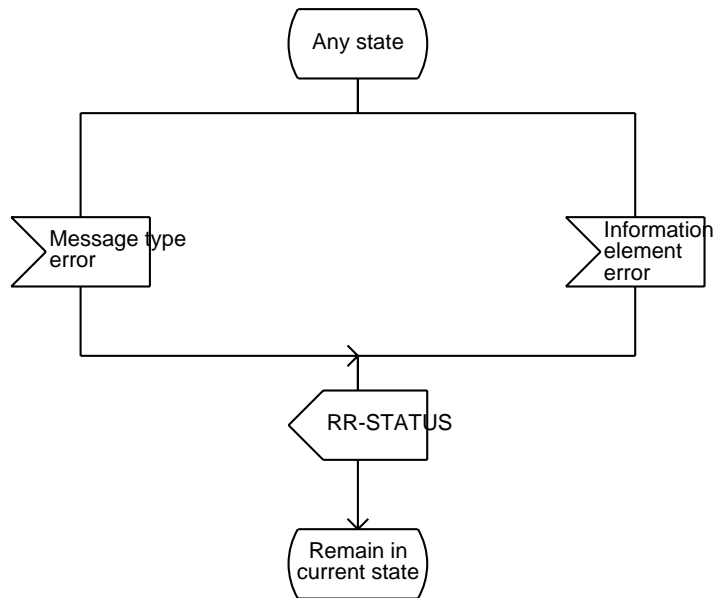


Figure C.6: (sheet 13 of 14) RR GS protocol

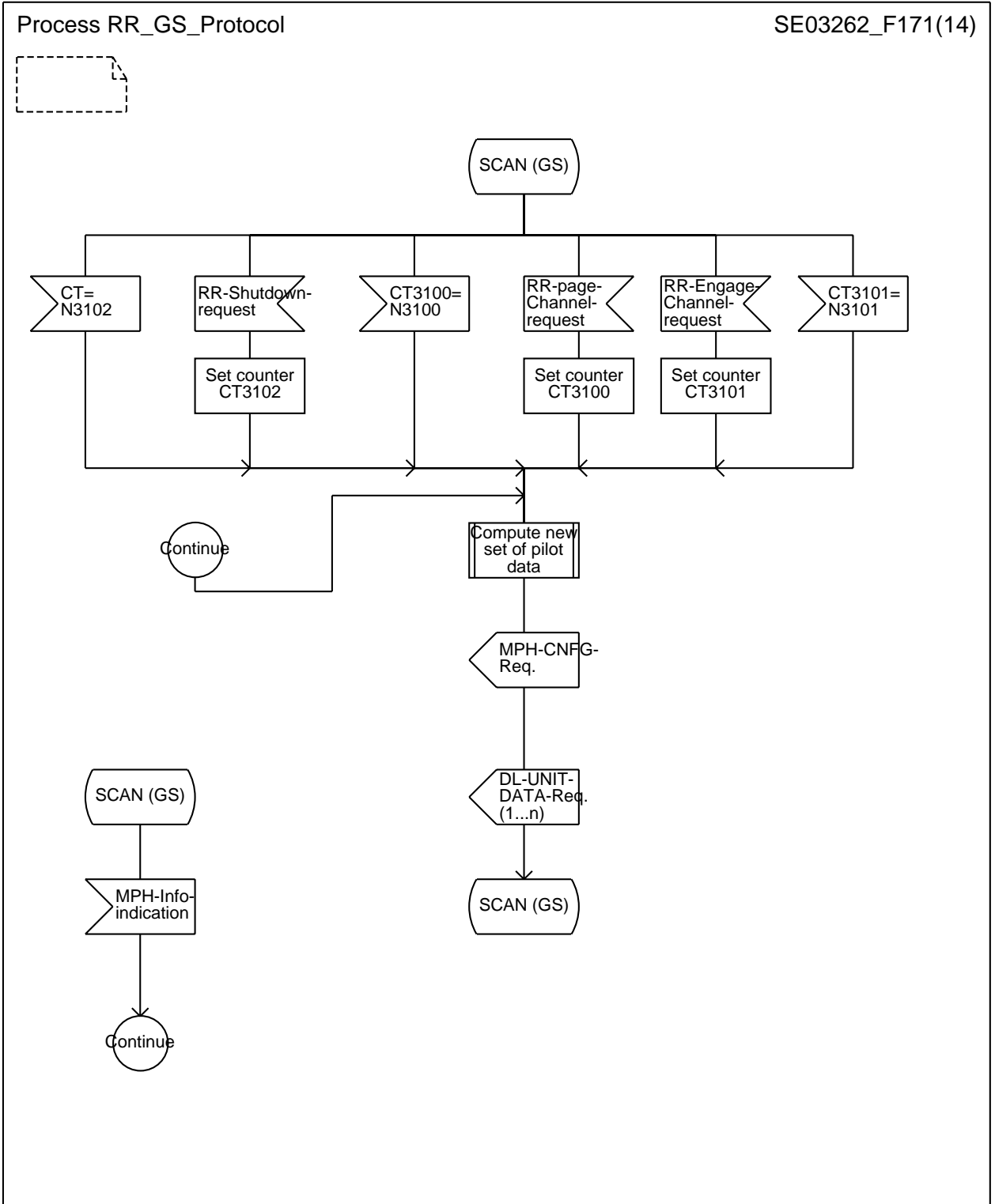


Figure C.6: (sheet 14 of 14) RR GS protocol

## History

Document history	
June 1996	Public Enquiry PE 108: 1996-06-24 to 1996-10-18