RCR STD-27

ENGLISH TRANSLATION

PERSONAL DIGITAL CELLULAR TELECOMMUNICATION SYSTEM ARIB STANDARD

RCR STD-27 L

Fascicle 3

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Association of Radio Industries and Businesses

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   http://www.arib.or.jp/english/index.html

5. The original "Personal Digital Cellular Telecommunication System (RCR STD-27L)" is written in Japanese and has been approved by the 60th Standard Assembly Meeting (November 30, 2005).

6. The note about IPR (Industrial Property Rights) in the INTRODUCTION of Fascicle 1 of the Standard applies to the use of Essential IPR for the ARIB Standard in Japan. If the ARIB Standard is adopted outside Japan, Essential IPR will be treated in accordance with policies stated by each IPR owner. The IPR owners are, however, expected to apply the rules of the preface of the "Guidelines for Treatment of Industrial Property Rights in connection with the ARIB Standard" (September 5, 1995, approved by the 1st Standard Assembly Meeting). In the preface of the Guidelines, it is stated that it is "desirable that the Essential IPR which relates to any or all parts of the contents of the ARIB Standard should be used free of charge by anyone and that it would not block the use of such Essential IPR in any other country where such an ARIB Standard is adopted".

CONTENTS

Annex 1 Authentication, Ciphering and Subscriber Data Registration Standard for the Personal Digital Cellular Telecommunication System

Note: Disclosure of this standard is specified in accordance with the "Disclosure Regulation on the Standard for Authentication, Ciphering and Subscriber Data Registration of the Personal Digital Cellular Telecommunication System" and the "Exceptional Disclosure Regulation on the Standard for Authentication, Ciphering and Subscriber Data Registration of the Personal Digital Cellular Telecommunication System" approved in the Standard Assembly.

Annex 2 Data Transmission Standard for the PersonalDigital Cellular Telecommunication System (G3 facsimile and modem (V.42 ANNEX))

CONTENTS

1. General

1.1 Overview

This standard specifies G3 facsimile and modem (V.42 Annex) communications in the Digital Cellular Telecommunication System.

1.2 System configuration

Data communication services to be offered in the Digital Cellular Telecommunication System, which include G3 facsimile communications and modem communications, are provided by connecting data communication units to mobile stations and switches respectively. The basic system configuration for these data communication services is shown in Fig. 1.2.

Since ARQ is performed for facsimile communications, controls are needed to prevent the switch-side data communication units from getting switched during channel handover.

2. Activation and deactivation procedures

2.1 Activation procedures

2.1.1 Activation types

The activation types for a data communication unit are listed in Table 2.1.1. When activation type 1 is used, the data communication mode can be triggered either by setting the terminal (G3 facsimile terminal or modem-equipped data terminal) "OFF-HOOK" or by operating the mobile station (handset etc.)

2.1.2 Activation procedures on the mobile station side

The activation sequence for each activation type is shown in Figs. 2.1.2.1 (1) to (5).
The initial operation flow of a G3 fax in each activation sequence is shown in Fig. 2.1.2.2. In contrast, no specific initial operation flow is set for a modem.

INFO (CR,FI (terminal, active)) can be monitored by starting a timer after transmission of INFO (CR, FA (terminal)), where the terminal is either G3FAX or MODEM. However, INFO(CR, FA (terminal)) is not retransmitted on timer expiry.

The communication path is not switched on reception of INFO (CR, FI (terminal, non-active)).

2.1.3 Activation procedures on the network side

The network always switches to facsimile communications (1) after the originating or terminating sequence has been completed and (2) after the TCH has been established and (3) INFO(CR, FA (terminal)) is received from the MS. This procedure applies to all of the activation types.

The activation sequence used for data communications on the network side is shown in Fig. 2.1.3.

The initial operation flow of a facsimile unit is the same as that used on the mobile station side. (See Fig. 2.1.2.2.)

2.2 Deactivation procedures

2.2.1 Deactivation types

The types of deactivation for a data communication unit are listed in Table 2.2.1.

2.2.2 Deactivation procedures on the mobile station side

The deactivation sequence used for each deactivation type is shown in Figs. 2.2.2 (1) to (4).

2.2.3 Deactivation procedures on the network side

The deactivation sequence used for each deactivation type is shown in Figs. 2.2.3 (1) and (2).

3. G3 facsimile communication procedures

3.1 Communication procedures

G3 facsimile communications procedures are shown in Fig. 3.1.1.

G3 facsimile communication procedures consist of the activation procedure (Phase A), the pre-message procedure (Phase B), the image signal transmission procedure (Phase C), the post-message procedure (Phase D) and the deactivation procedure (Phase E). Phases B, C and D are based on the ITU-T T.30 recommendation.

The activation and deactivation procedures are the same as for modem communications and are shown in Chapter 2.

Details of each procedure are shown in the following sections.

3.2 Pre-message procedure (Phase B)

3.2.1 Transmission on the activating side

The pre-message procedure for transmission from the activating side is shown in Fig. 3.2.1.1.

Details of this procedure are as follows.

- Fig. 3.2.1.2 shows the output conditions for "TCF Error Detection", while Fig. 3.2.1.3 shows the selection algorithm for CFR//CRP/FTT.
- Fig. 3.2.1.4 shows the output conditions for FTT and the specified rate decision algorithm for DCS.
- Fig. 3.2.1.5 shows the interval length decision algorithm for the TCF pre-message response signal.
- Fig. 3.2.1.6 shows the preamble length decision algorithm for the pre-message response signal.
- Fig. 3.2.1.7 shows the air interface quality estimation method.

3.2.2 Reception on the activating side

The pre-message procedure for reception on the activating side is shown in Fig. 3.2.2.

3.2.3 Semi-normal processing

Semi-normal processing procedures are shown in Figs. 3.2.3.1 to 3.2.3.12. The stand-by method for both V.21 and V.27ter modems is shown in Fig. 3.2.3.13.

3.3 Image signal transmission (Phase C)

The image signal transmission procedure is shown in Fig. 3.3.1.

The fill insertion control algorithm used for the image signal memory in the reception unit and the control algorithm when no image signal exists for transmission are shown in Figs. 3.3.2 and 3.3.3, respectively. Details of the ARQ control for the image signal are given in section 3.6.

3.4 Post-message procedure (Phase D)

3.4.1 End-of-procedure control (EOP)

The basic sequence for the end-of-procedure is shown in Fig. 3.4.1.1.

Fig. 3.4.1.2 shows the sequence when the response to EOP is RTP or RTN.
Fig. 3.4.1.3 shows the sequence for PRI-EOP.
Fig. 3.4.1.4 shows the sequence when the response to EOP is PIP or PIN.

3.4.2 Multi-page signal (MPS)

The basic sequence used for the multi-page signal (MPS) is shown in Fig. 3.4.2.1.

Fig. 3.4.2.2 shows the sequence used when the response to MPS is RTP or RTN.
Fig. 3.4.2.3 shows the sequence for PRI-MPS.
Fig. 3.4.2.4 shows the sequence used when the response to MPS is PIP or PIN.

3.4.3 End-of-message control (EOM)

The basic sequence for the end-of-message control (EOM) is shown in Fig. 3.4.3.1.
The algorithm for EOM response selection is shown in Fig. 3.4.3.2.
The sequence for reception on the activating side after EOM is shown in Fig. 3.4.3.3.

Fig. 3.4.3.4 shows the sequence when the response to EOM is RTP or RTN.
Fig. 3.4.3.5 shows the sequence for PRI-EOM.
Fig. 3.4.3.6 shows the sequence when the response to EOM is PIP or PIN.

3.4.4 Semi-normal processing

Semi-normal processing procedures are shown in Figs. 3.4.4.1 to 3.4.4.9.

3.5 List of threshold values

Various threshold values used in the sequences are listed in Table 3.5.

3.6 Error control

3.6.1 Frame structure

3.6.1.1 Frame structure

One frame consists of one TCH burst (224 bits). The frame structure is shown in Fig. 3.6.1.1. Signals used for the air interface are listed in Table 3.6.1.1.

3.6.1.2 Bit transmission order

3.6.1.2.1 Backward channel control information and forward channel control information transmission order

Control information from the backward and forward channels is transmitted from the MSB of the control information with b7 at the top to the frame and the CRC encoder. (See Fig. 3.6.1.2.1.)

3.6.1.2.2 Forward channel information transmission order

3.6.1.2.2.1 Image signals

The input bits from the line side are divided into bytes sequentially from the first input bit through successive bits and they are written in the Pix accumulation memory beginning with the LSB. Following this, with the progress of ARQ, the written data is transmitted in bytes from the MSB of the Pix accumulation memory to the frames or CRC encoder with b191 at the top. (See Fig. 3.6.1.2.2.1.)

3.6.1.2.2.2 Procedure signals

(i) Procedure signals received from FAX:

The HDLC signals received from the line side are transmitted to the frame and the CRC encoder in the order LI, A, C, FCF, (FIF) for each parameter from the MSB with b191 at the top. (See Fig. 3.6.1.2.2.2.)

(ii) Procedure signals defined in the air interface:

In the same manner as above, signals are transmitted to the frame and the CRC encoder in the order LI, A, C, FCF (definition signal) for each parameter from the MSB with b191 at the top. (See Fig. 3.6.1.2.2.2.)

3.6.1.2.3 Transmission order of CRC bits to frames

Output (i.e., the results of the operation for all the 208 bits of the above information) from the CRC encoder is sent to the frames sequentially from the first output bit through successive bits with b15 at the top. (See Fig. 3.6.1.2.3.)

3.6.2 ARQ protocol

3.6.2.1 Synchronization establishment control

The flow diagram for establishing synchronization on the transmission side is shown in Fig. 3.6.2.1.1.

The flow diagram for establishing synchronization on the reception side is shown in Fig. 3.6.2.1.2.

3.6.2.2 Data transmission control

The control parameter on the transmission side is shown in Fig. 3.6.2.2.1.
The data transmission control sequence is shown in Figs. 3.6.2.2.2 (1) to (4).

3.6.2.3 Data reception control

The control parameters on the reception side are shown in Fig. 3.6.2.3.1.
The data reception control sequence is shown in Figs. 3.6.2.3.2 (1) to (3).

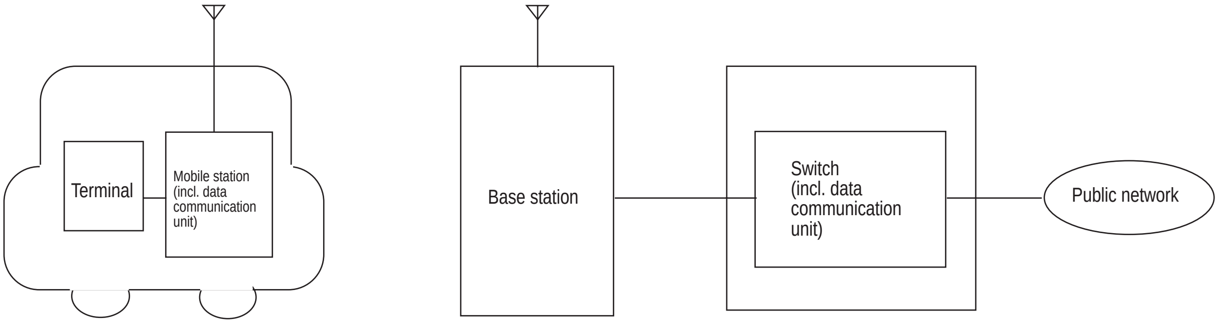
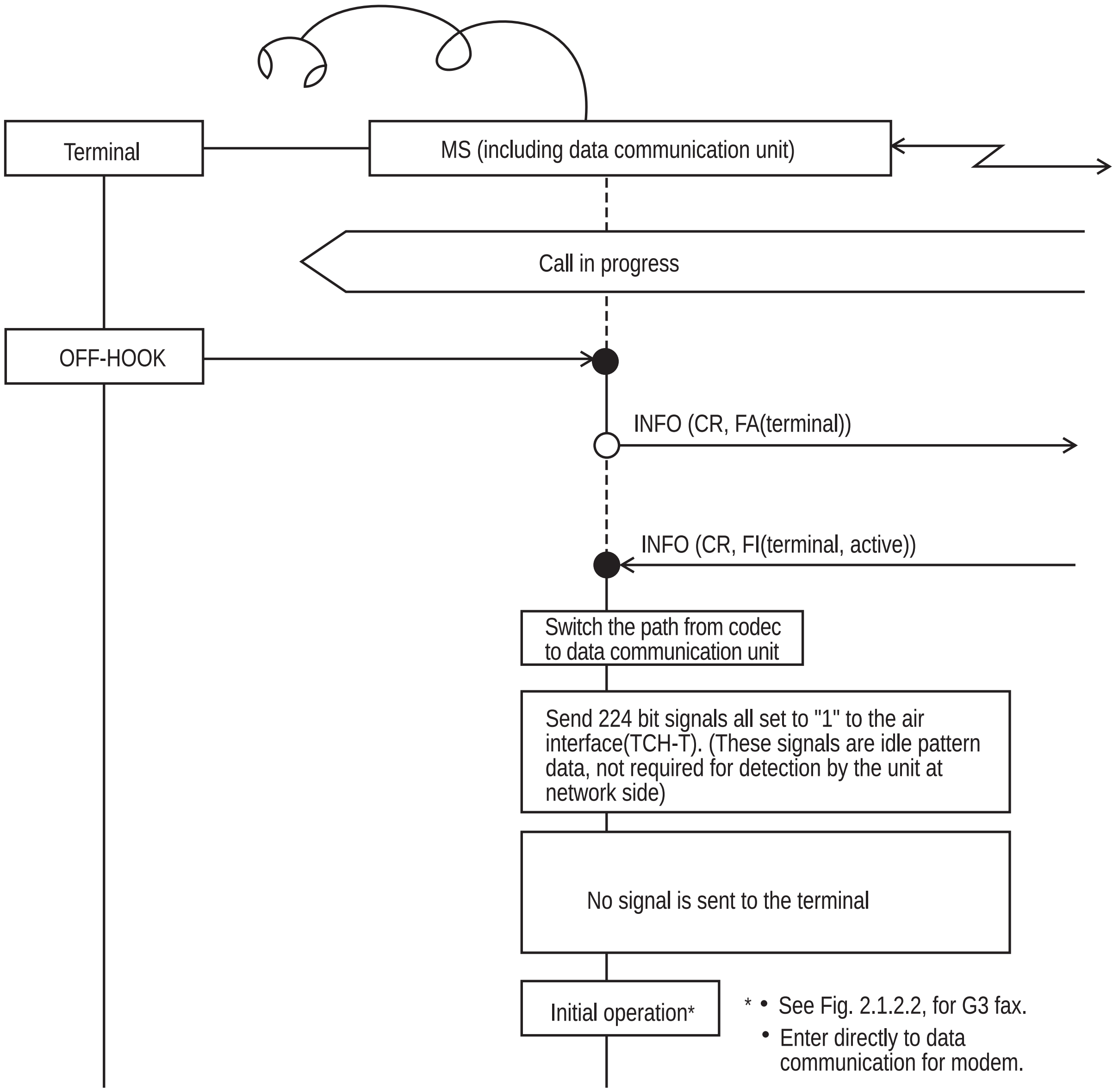


Fig. 1.2: System configuration

Table 2.1.1 : Activation types for data communication units

	1	2	3
Activation type	Switches to data communication during call in progress by MS TEL.	Origination from data terminal (automatic origination)	Termination on data terminal (automatic termination)
Condition of MS handset	OFF-HOOK	ON-HOOK	



* • See Fig. 2.1.2.2, for G3 fax.
  • Enter directly to data communication for modem.

Note • Terminal is G3 fax or modem.
• Initial operation should be done quickly after switching the communication path

Fig. 2.1.2.1 (1) : Activation sequence for the data communication unit on the MS side (when switching to data communication by setting the terminal to OFF-HOOK - activation type 1)

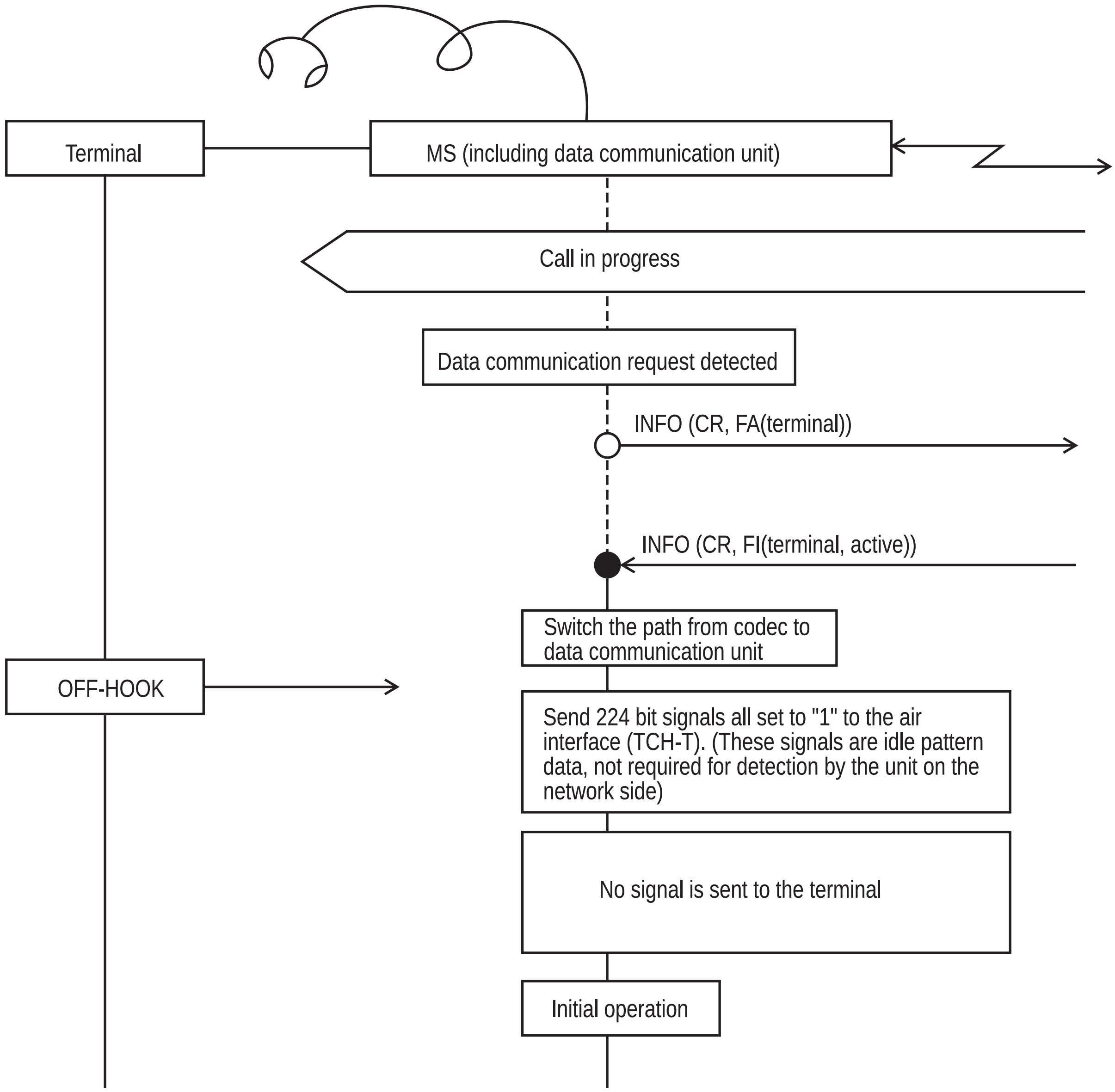


Fig. 2.1.2.1 (2) Activation sequence for the data unit on the MS side (when switching to data communication by operating the handset, etc. - activation type 1)

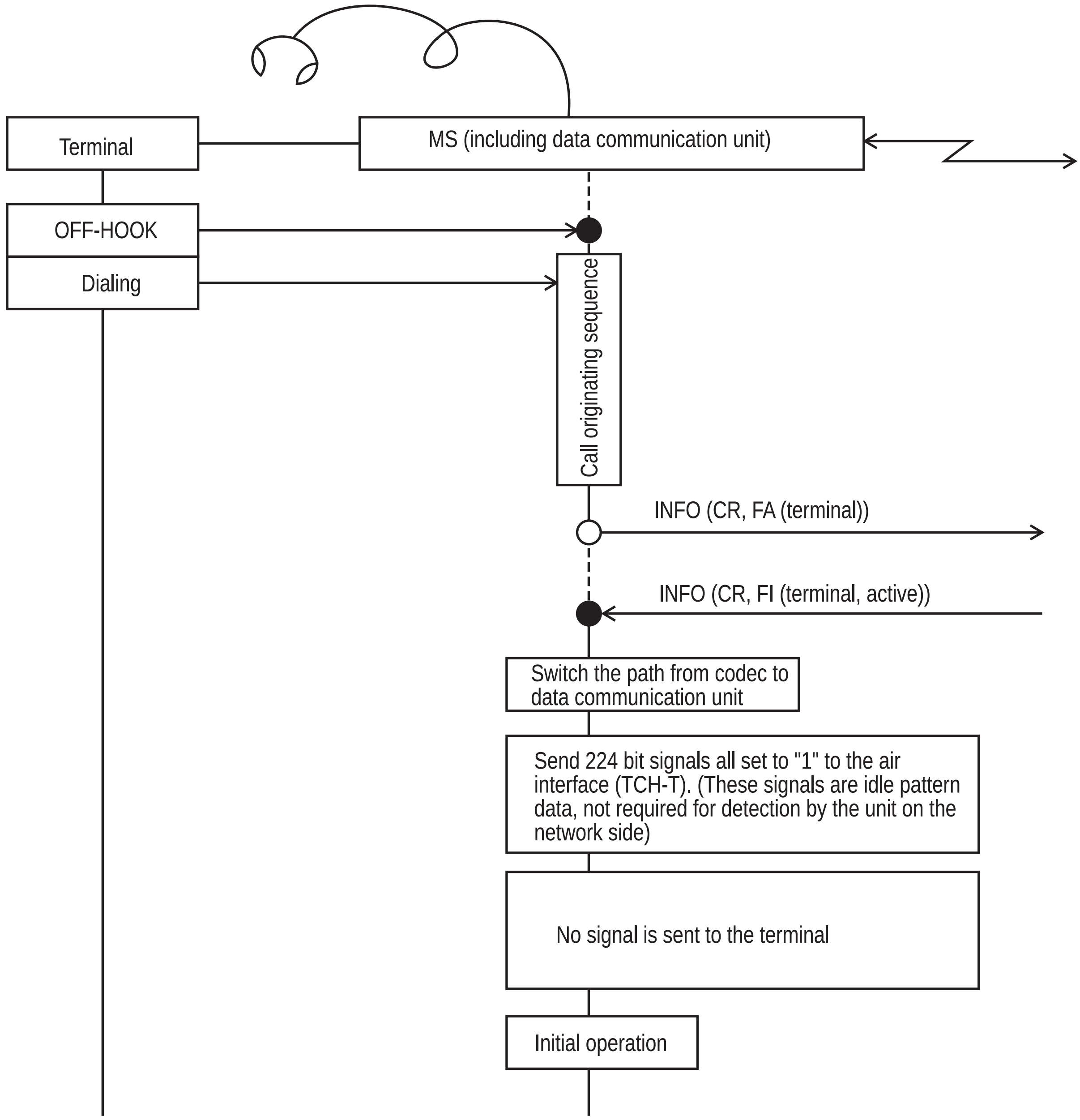


Fig. 2.1.2.1 (3) : Activation sequence for the data communication unit on the MS side (activation type 2)

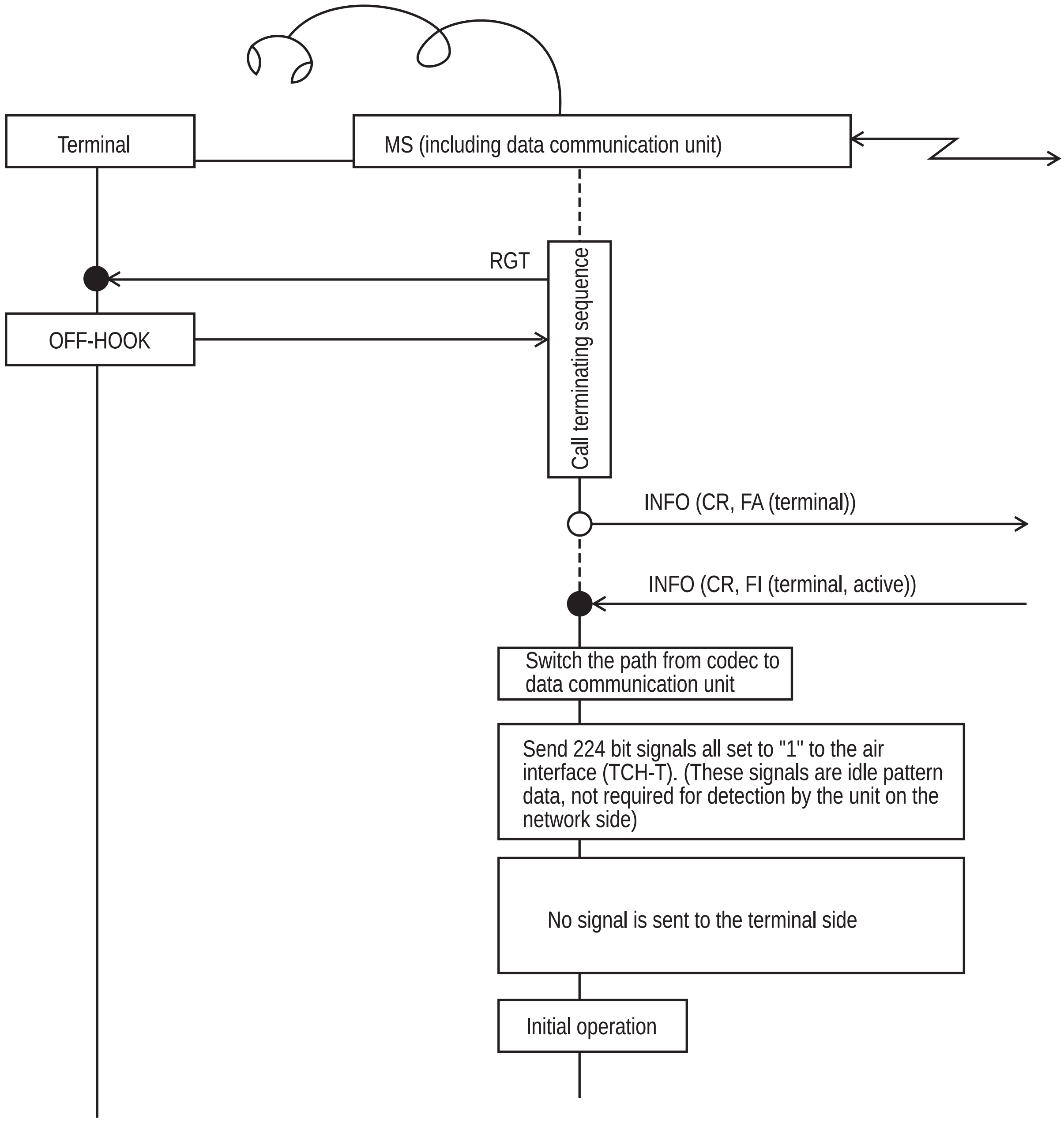


Fig. 2.1.2.1 (4) : Activation sequence for the data communication unit on the MS side (activation type 3)

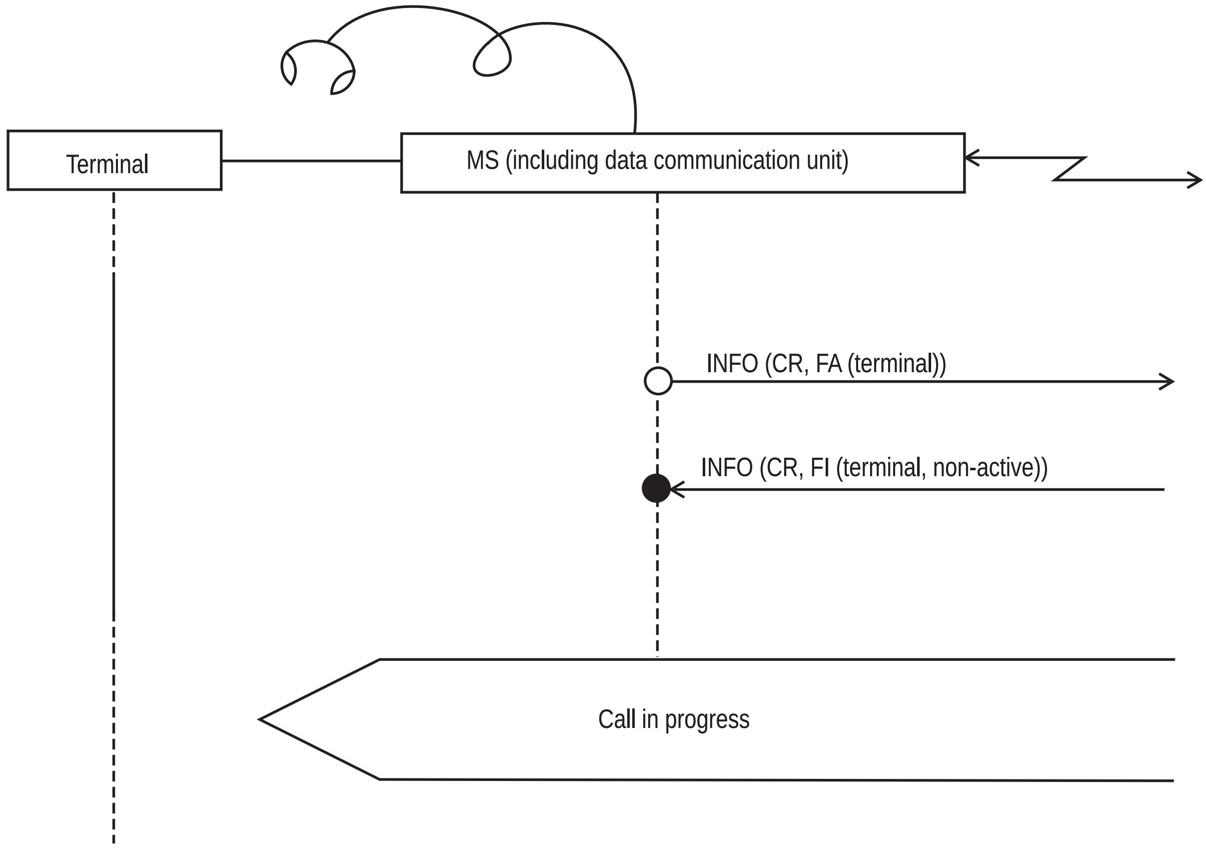


Fig. 2.1.2.1 (5) : Activation sequence for the data communication unit on the MS side (on reception of "NON-ACTIVE")

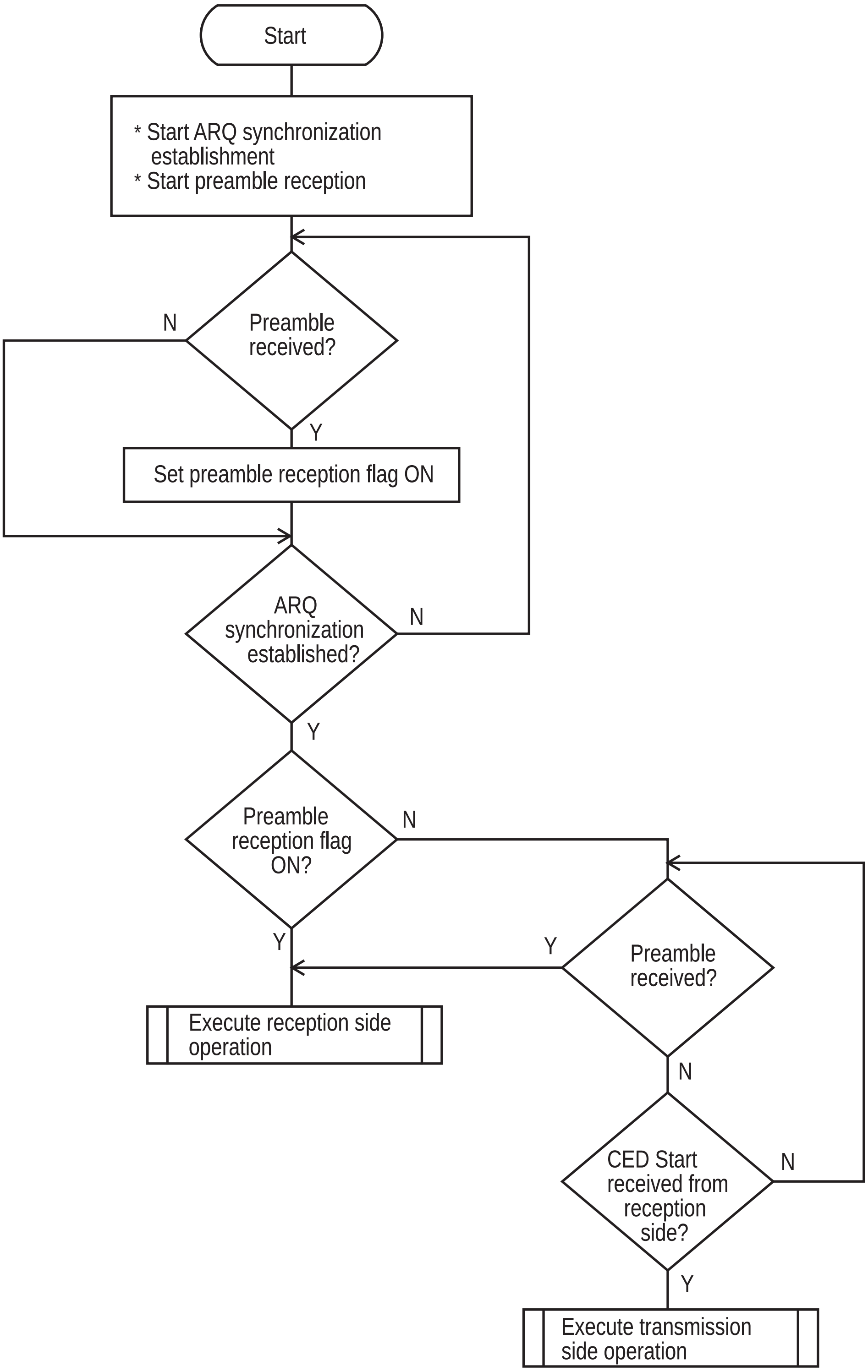


Fig. 2.1.2.2. : Initial operation flow for a facsimile unit

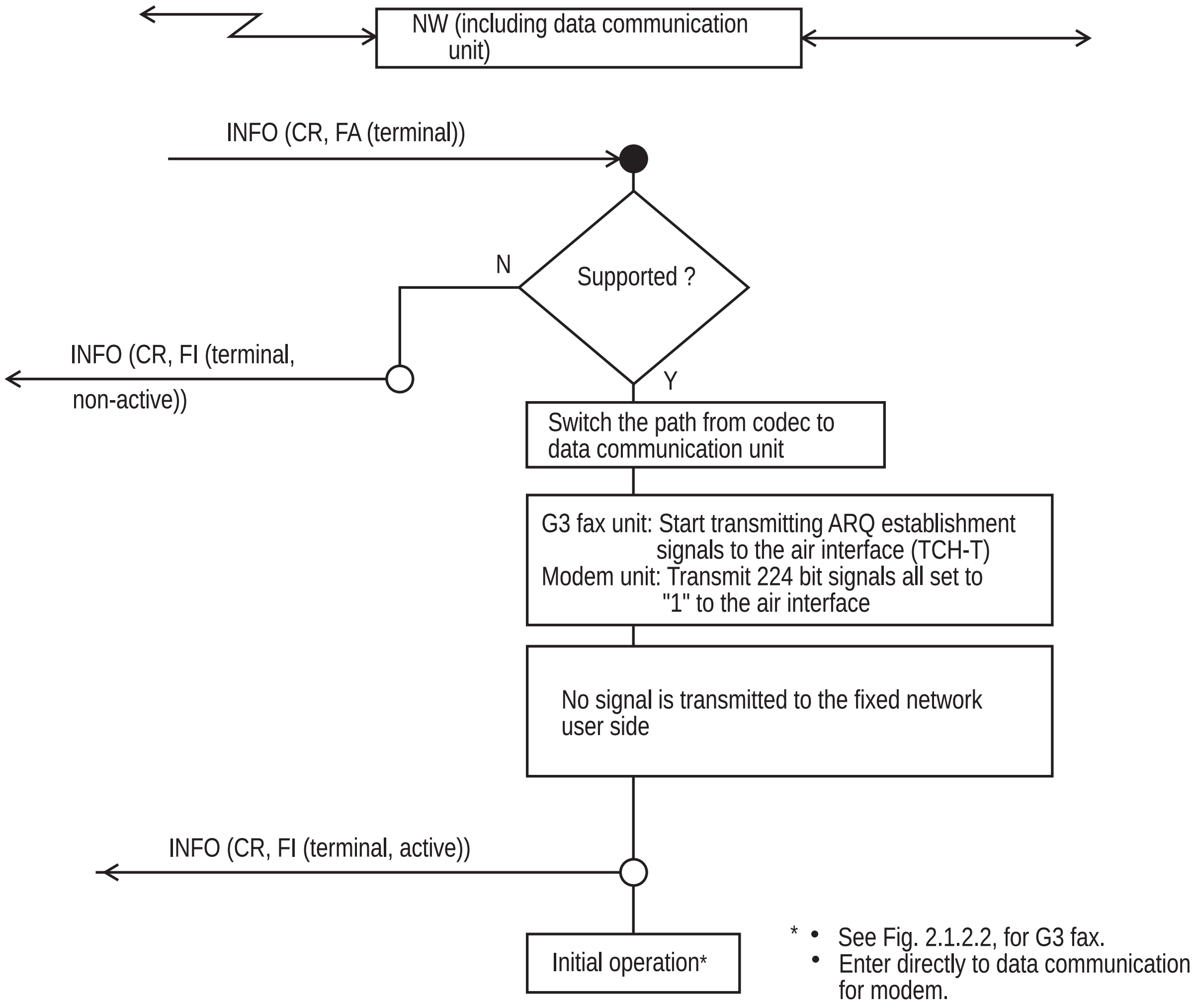


Fig. 2.1.3 : Activation sequence for data communication on the network side

Table 2.2.1 : Deactivation types for a data communication unit on the MS side

	1	2
Deactivation type	Setting to ON-HOOK on MS data terminal	Setting to ON-HOOK on fixed network data terminal

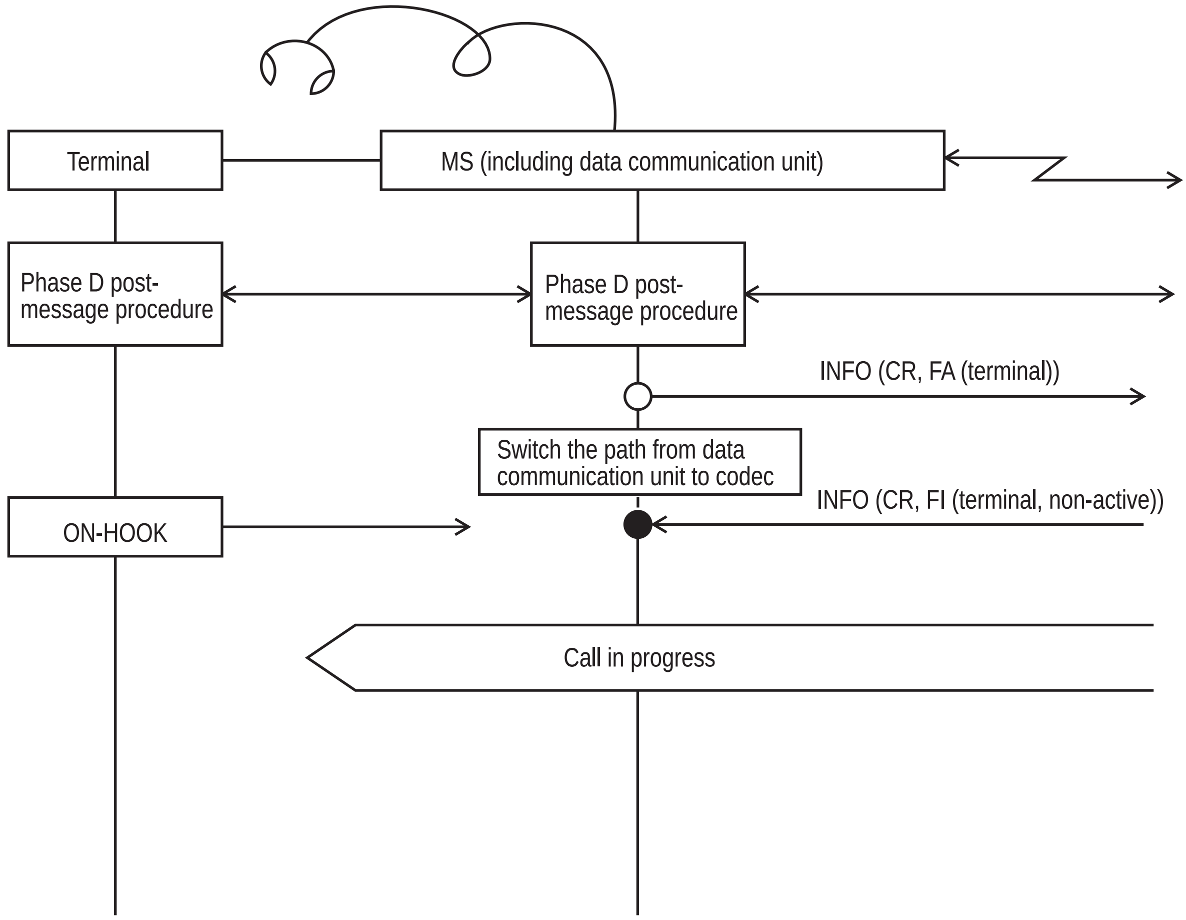


Fig. 2.2.2 (1) : Deactivation sequence for the data communication unit on the MS side (deactivation type 1)

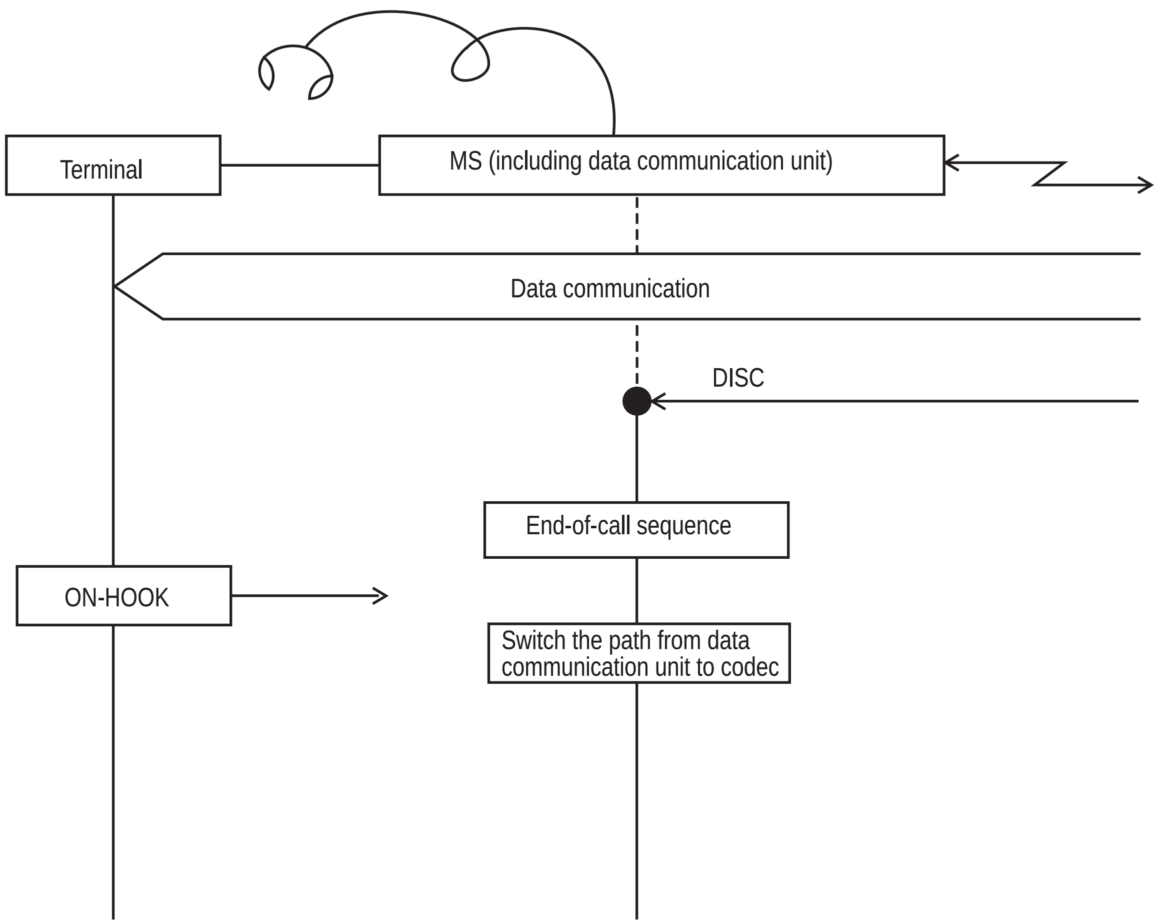


Fig. 2.2.2 (2) : Deactivation sequence for the data communication unit on the MS side (deactivation type 2)

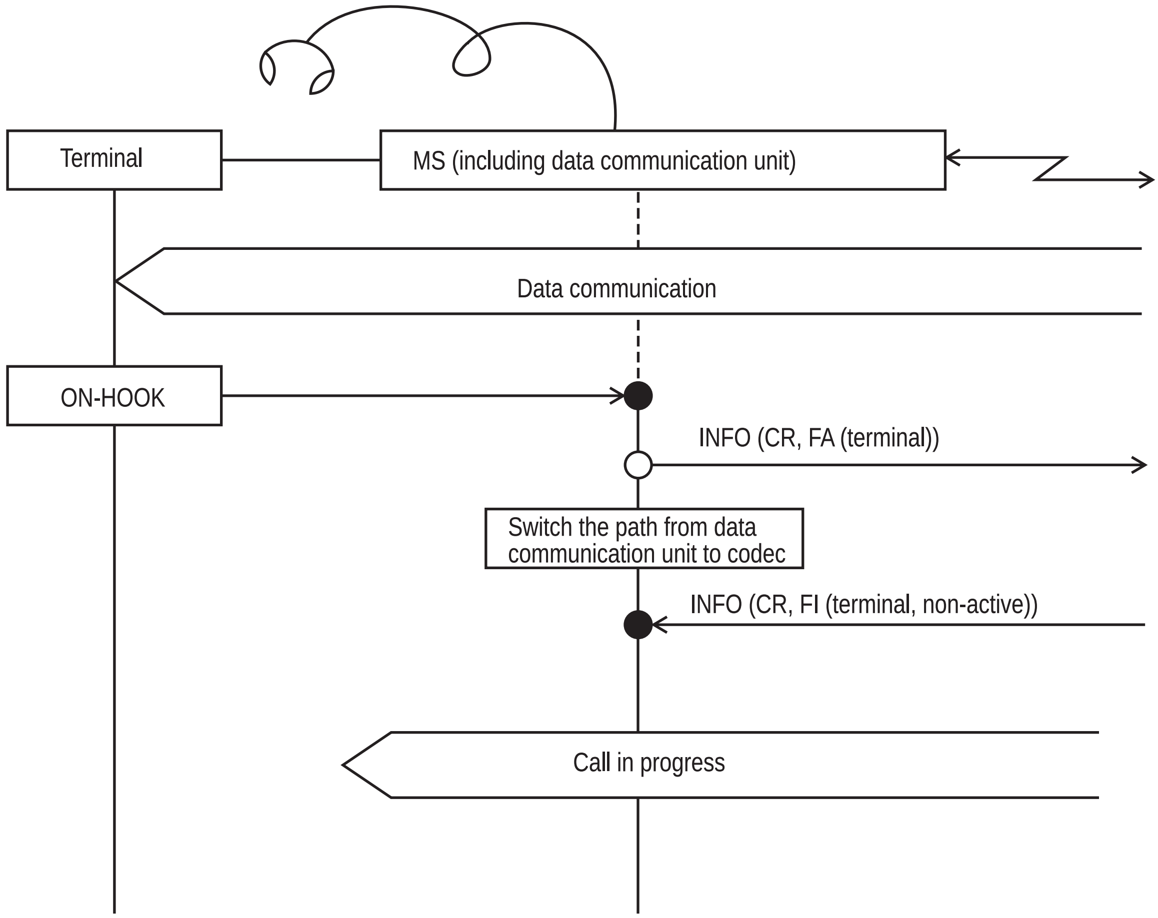


Fig. 2.2.2 (3) : Deactivation sequence for the data communication unit on the MS side (When the data terminal is "set to ON-HOOK" during data communication)

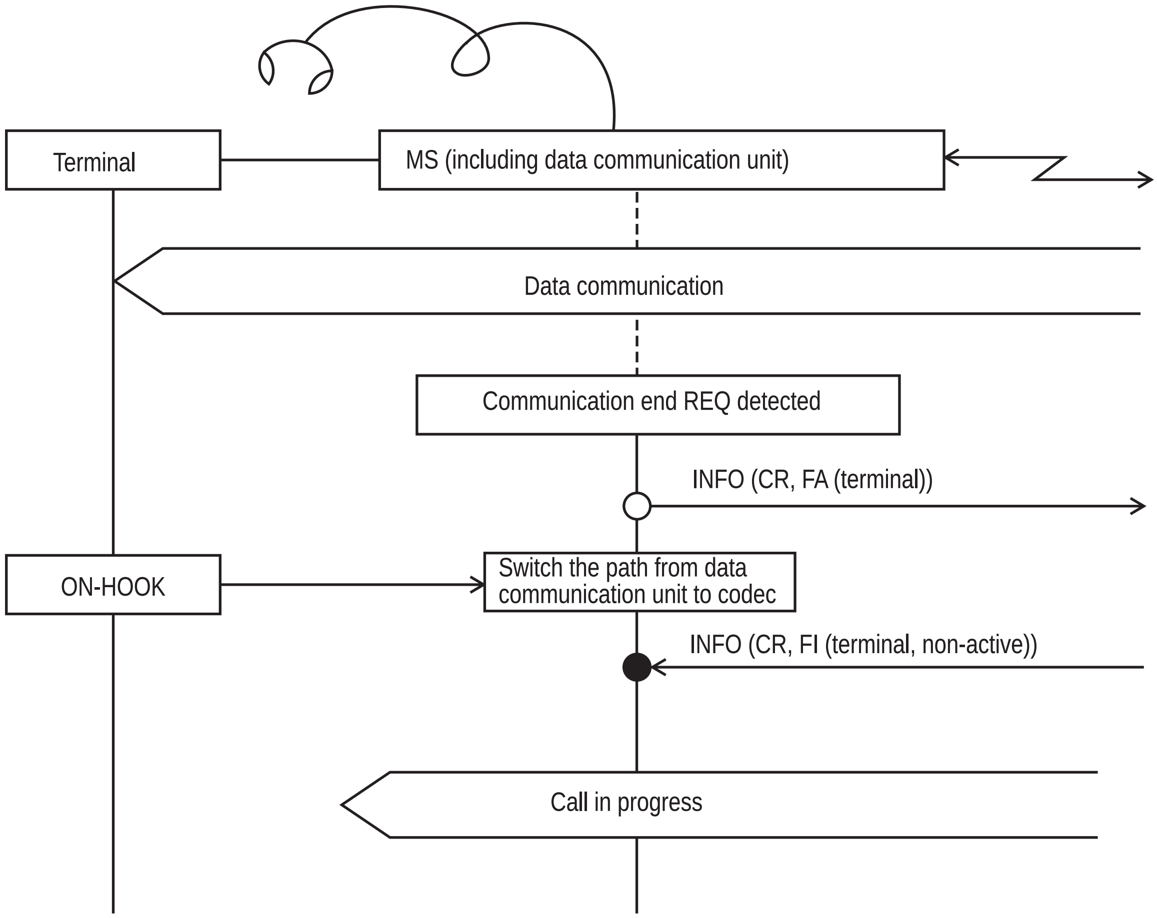


Fig. 2.2.2 (4) : Deactivation sequence for the data communication unit on the MS side (When data communication is ended by operating the handset, etc., during data communication)

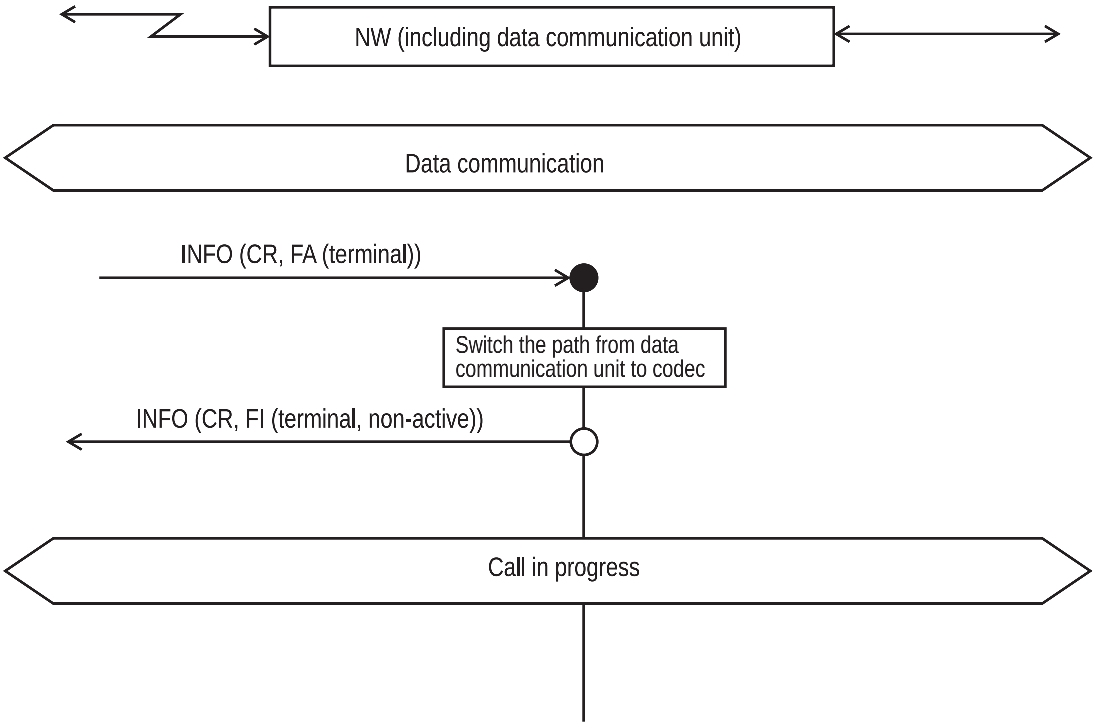


Fig. 2.2.3 (1) : Deactivation sequence for data communications on the network side (Deactivation type 1)

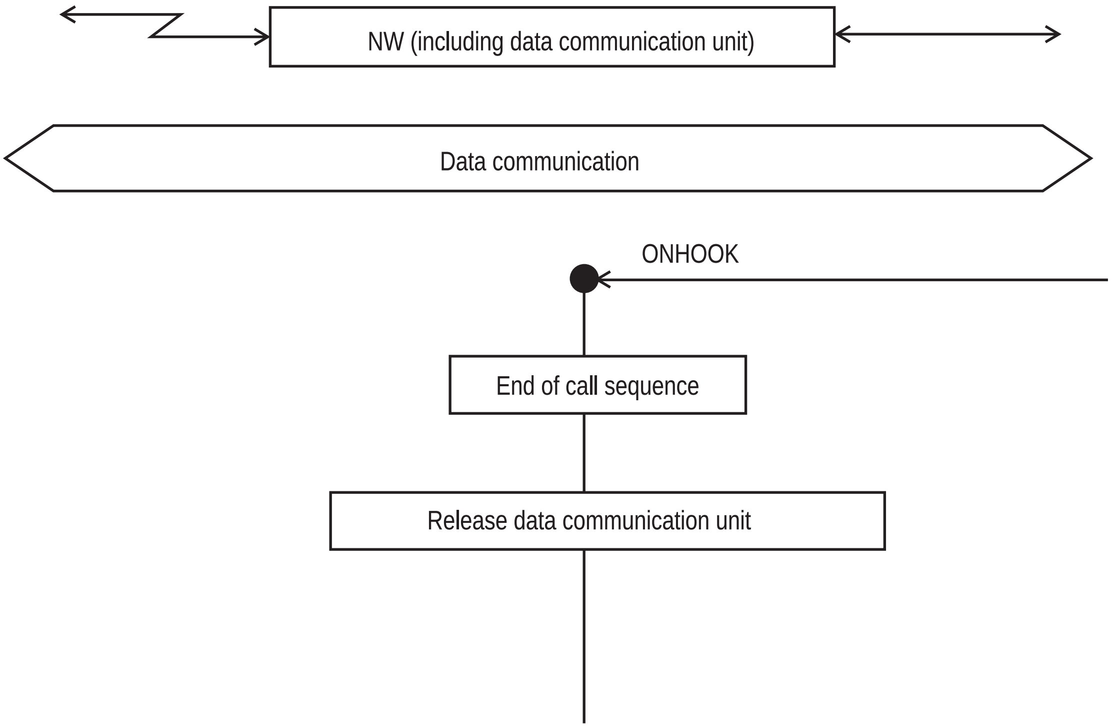


Fig. 2.2.3 (2) : Deactivation sequence for data communications on the network side (Deactivation type 2)

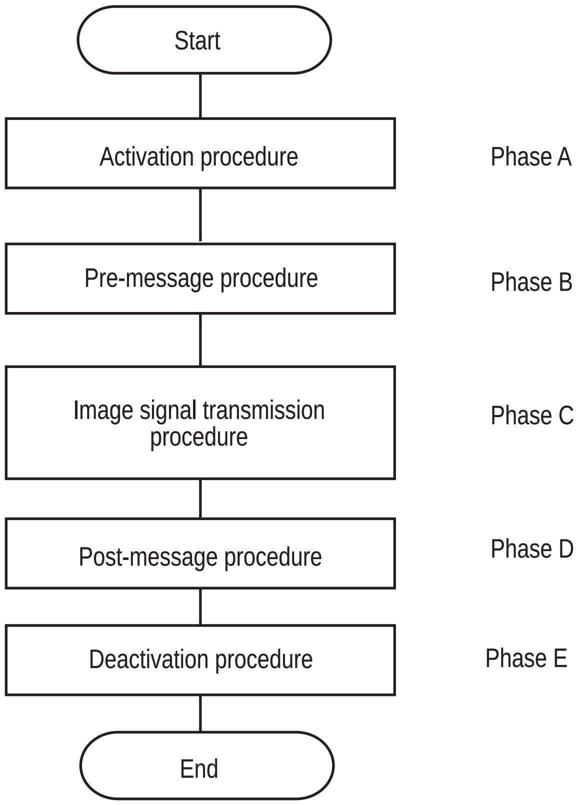


Fig. 3.1.1 : G3 facsimile communication procedures

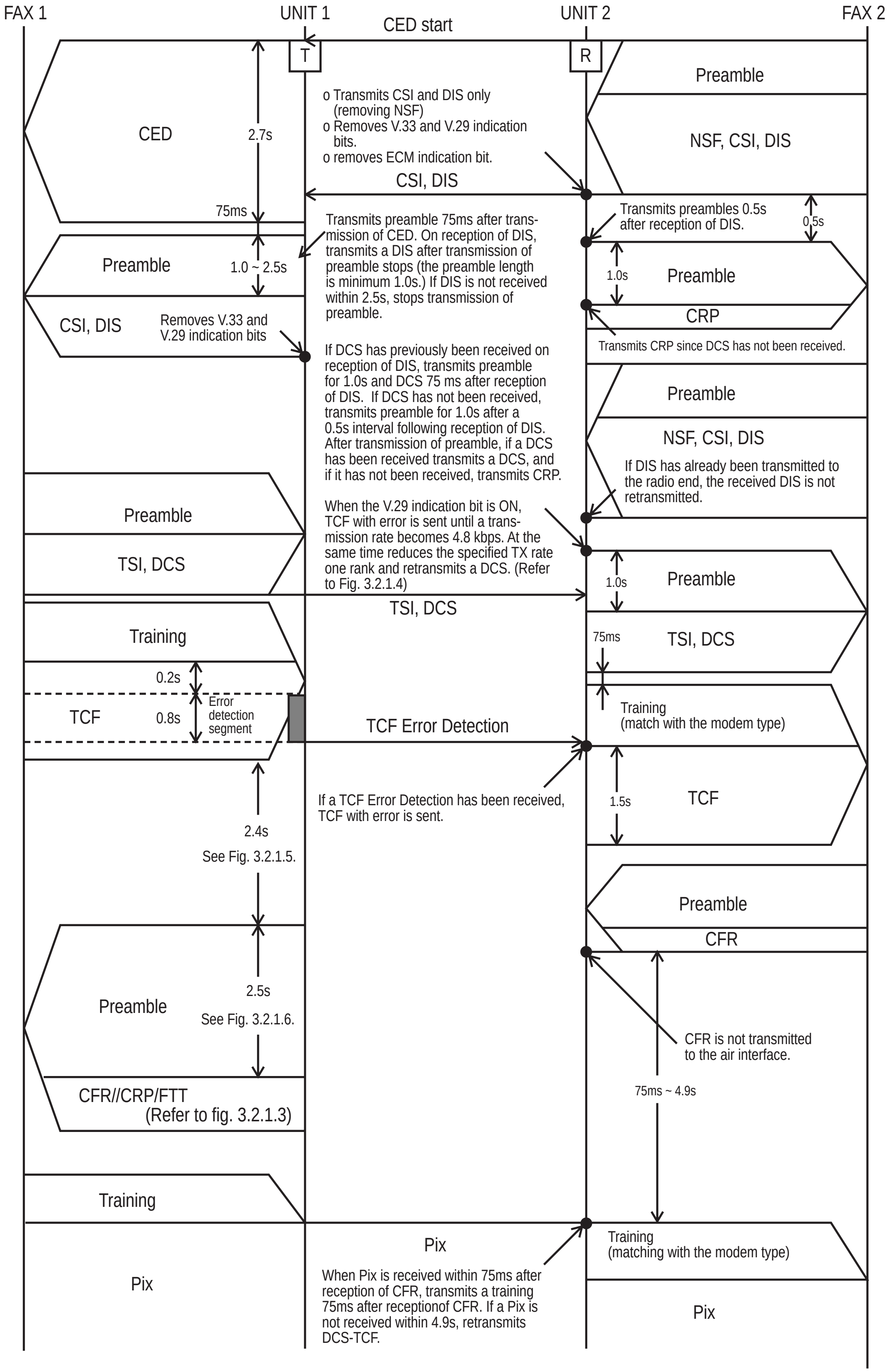


Fig. 3.2.1.1 : Pre-message procedure (Transmission from the activating side)

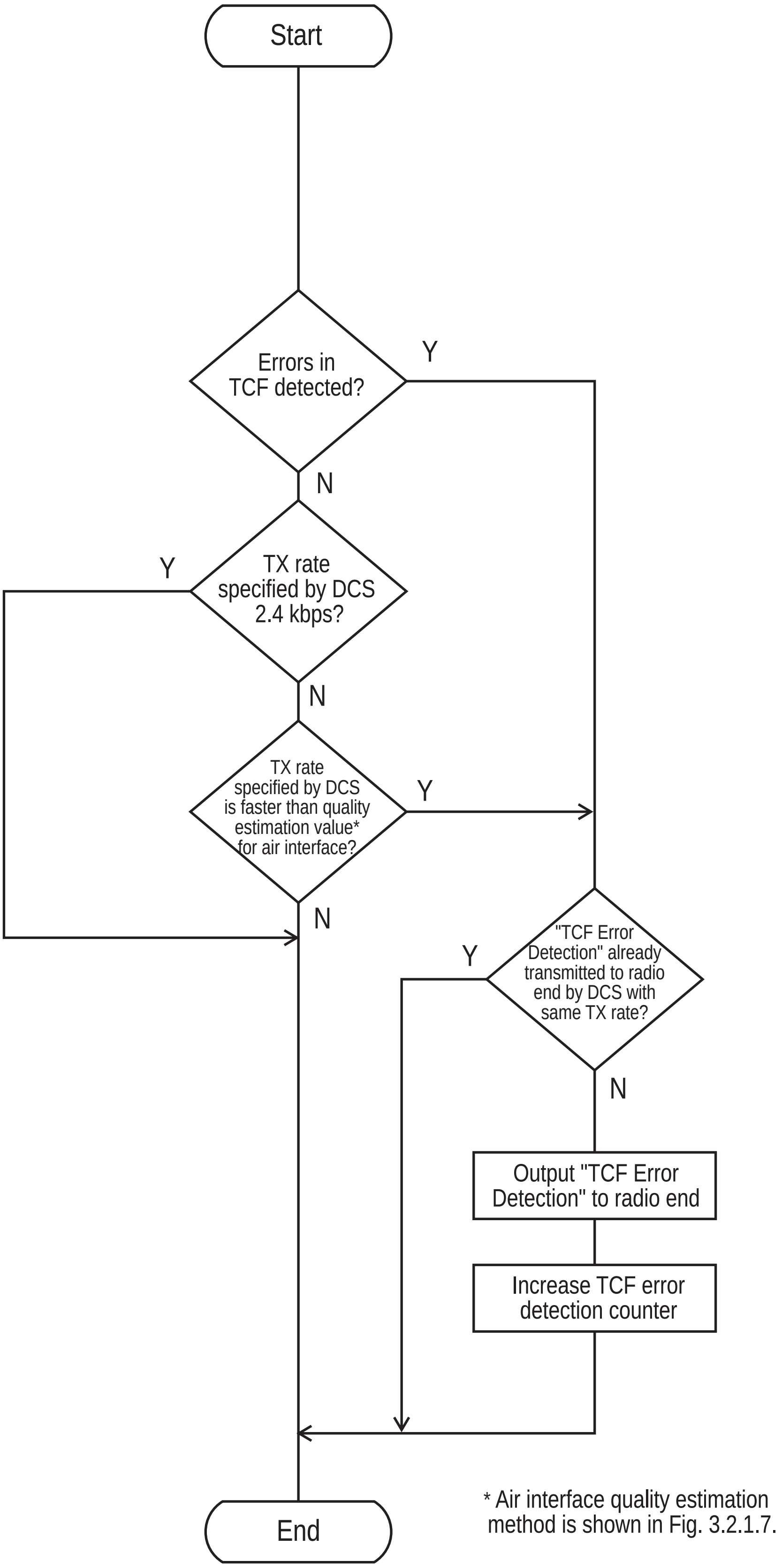


Fig. 3.2.1.2 : Output conditions for "TCF Error Detection"

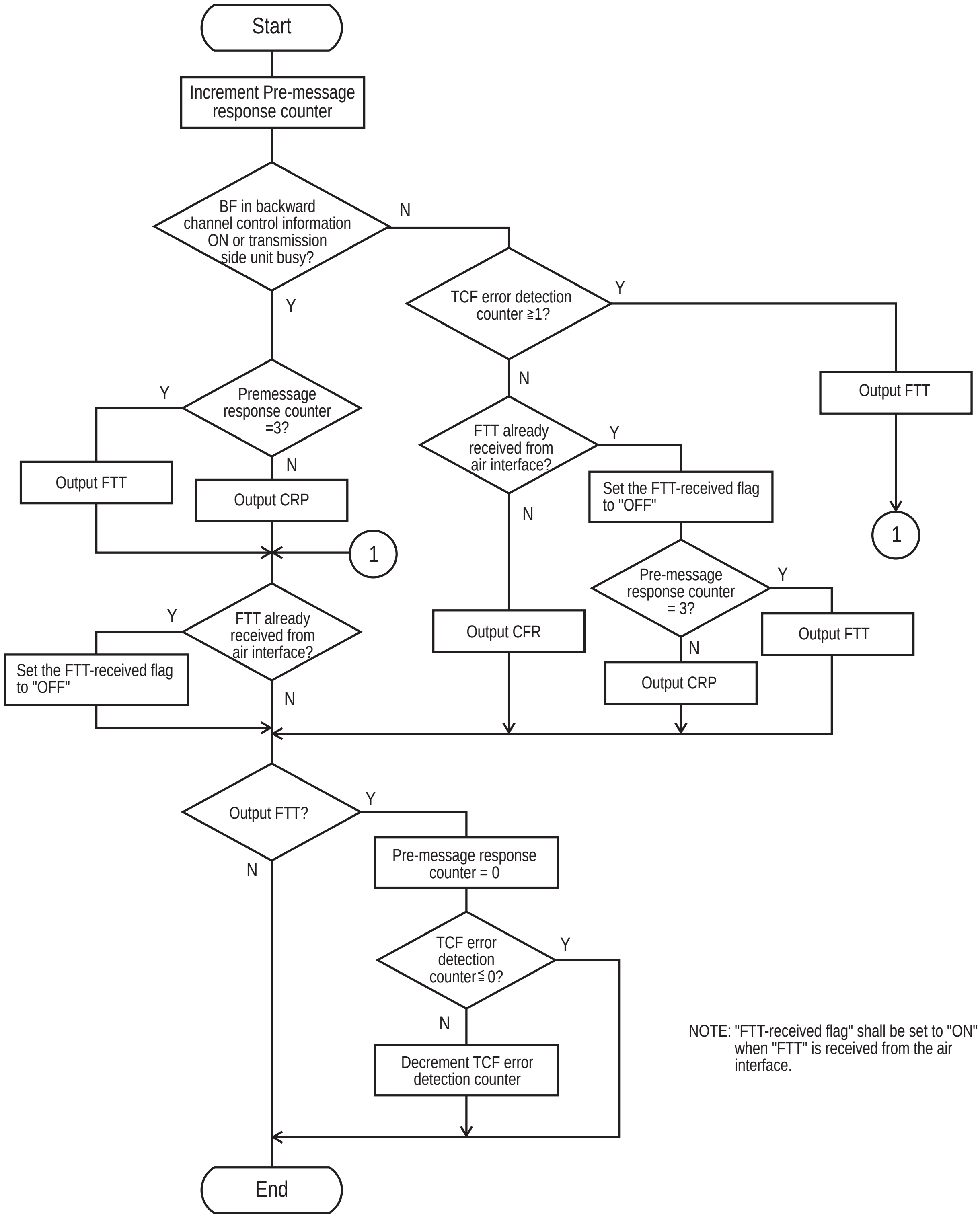


Fig. 3.2.1.3: Selection algorithm for CFR//CRP/FTT

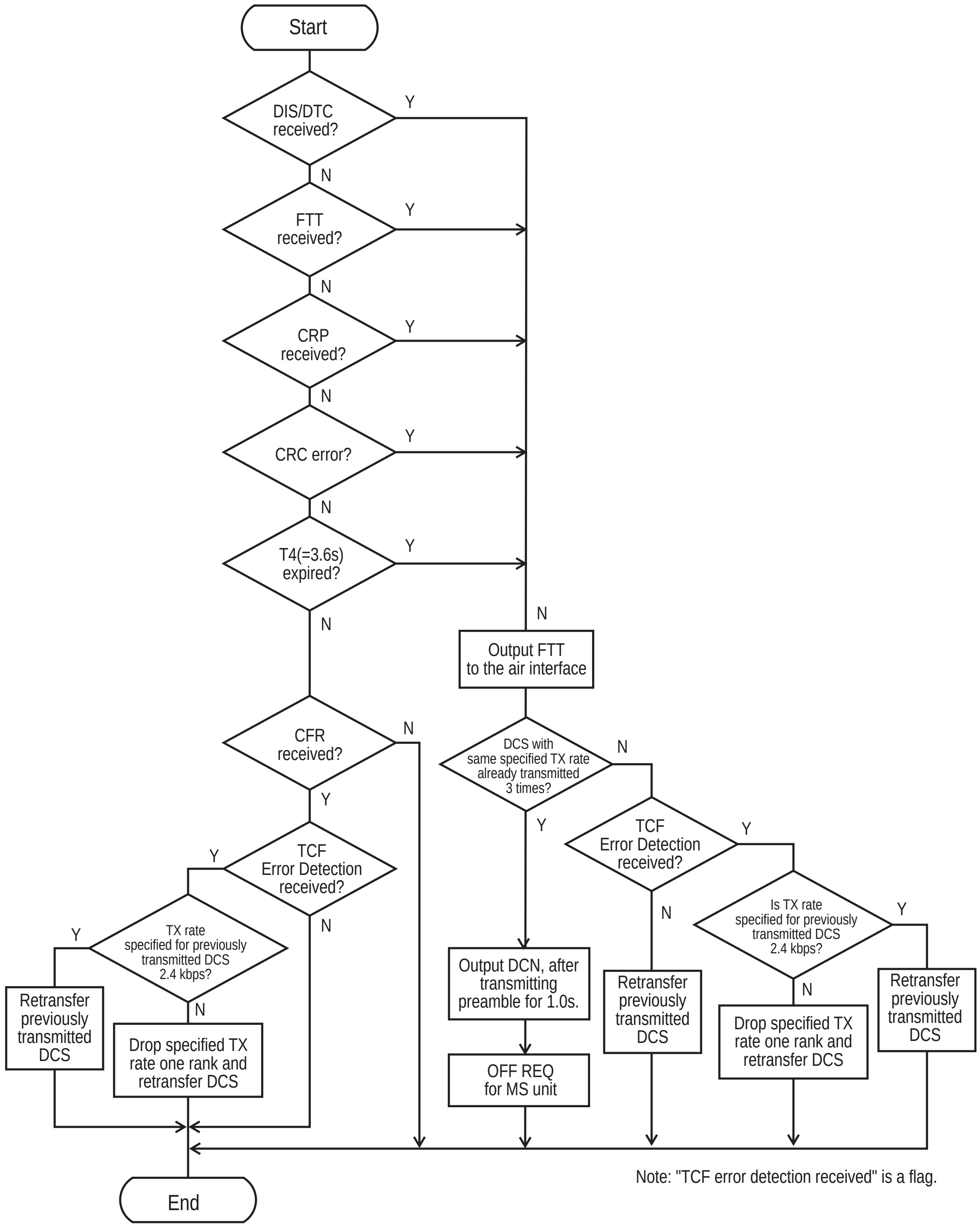


Fig. 3.2.1.4: Output conditions for FTT and specified TX rate decision algorithm for DCS

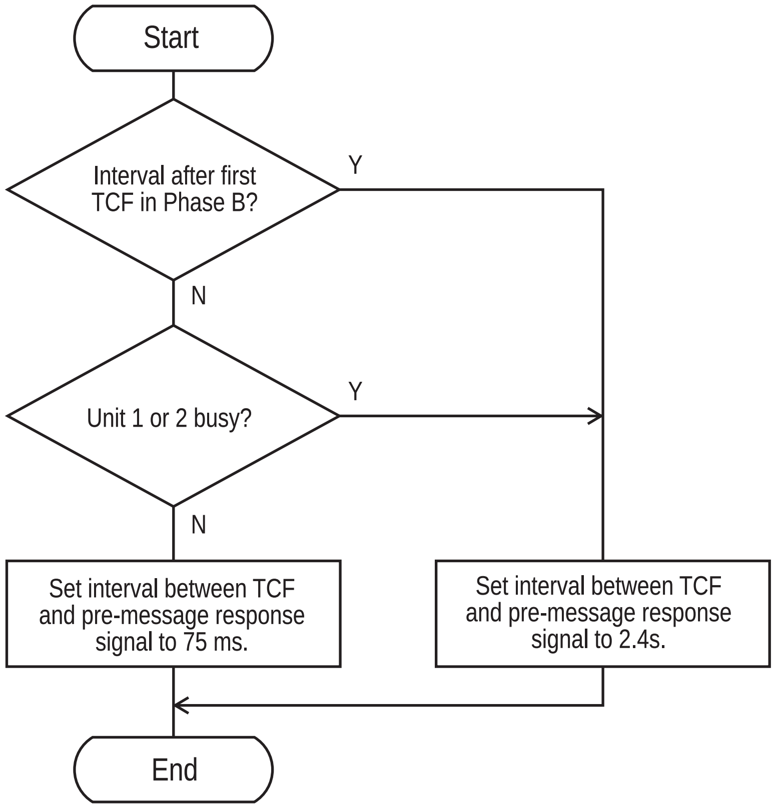


Fig. 3.2.1.5: Interval length decision algorithm for TCF pre-message response signal

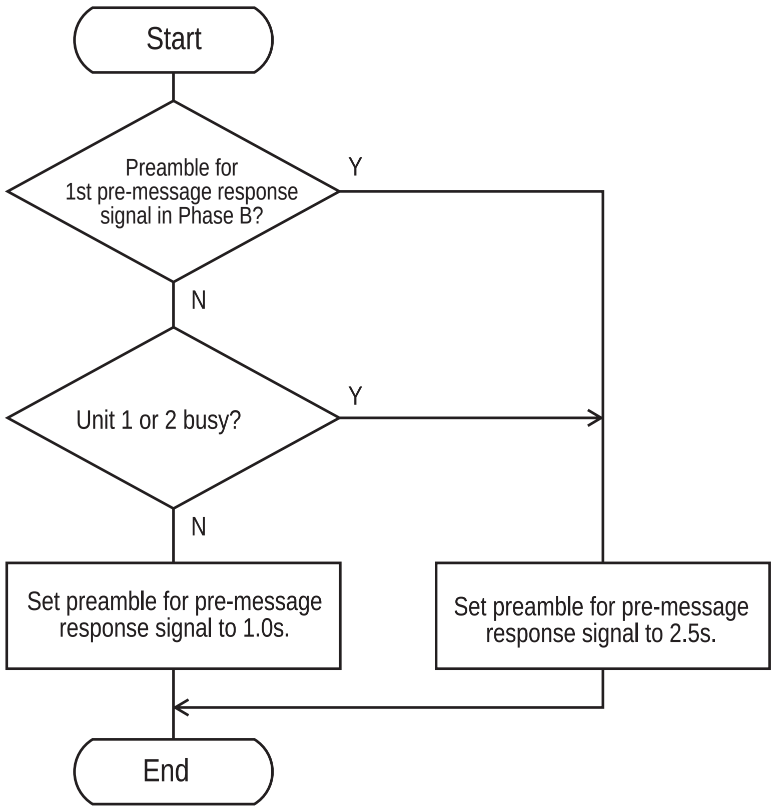
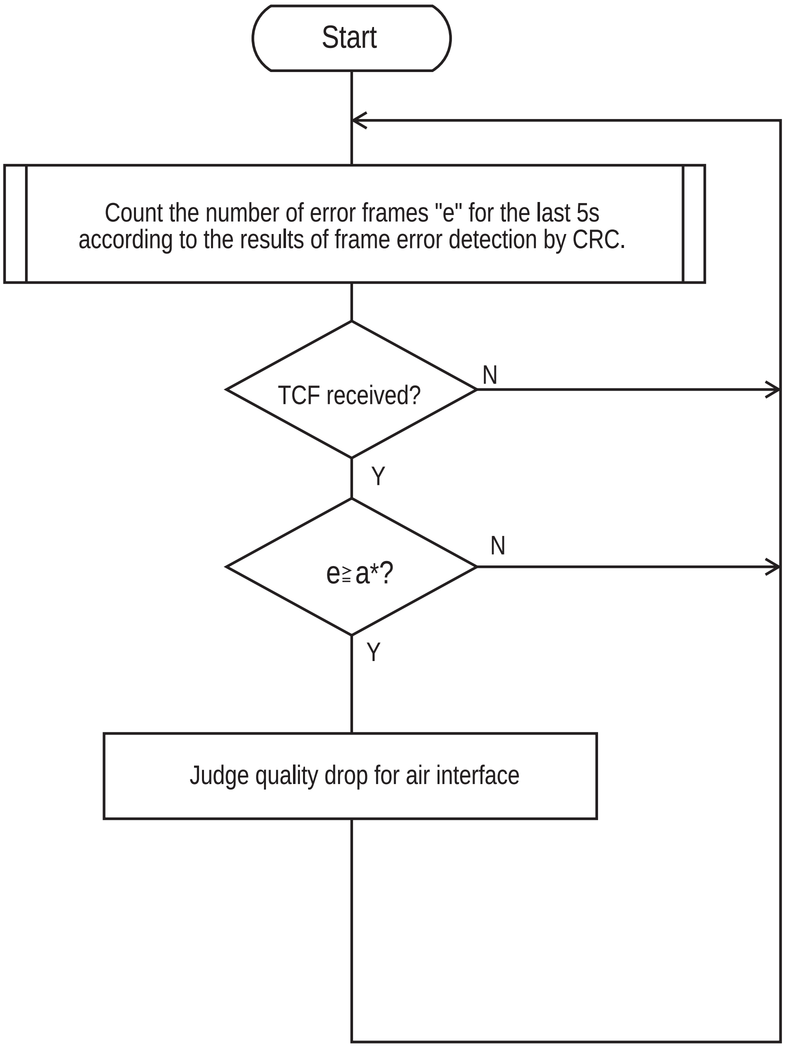


Fig. 3.2.1.6: Preamble length decision algorithm for pre-message response signal



* "a" refers to the number of permissible error frames.

Fig. 3.2.1.7: Air interface quality estimation method

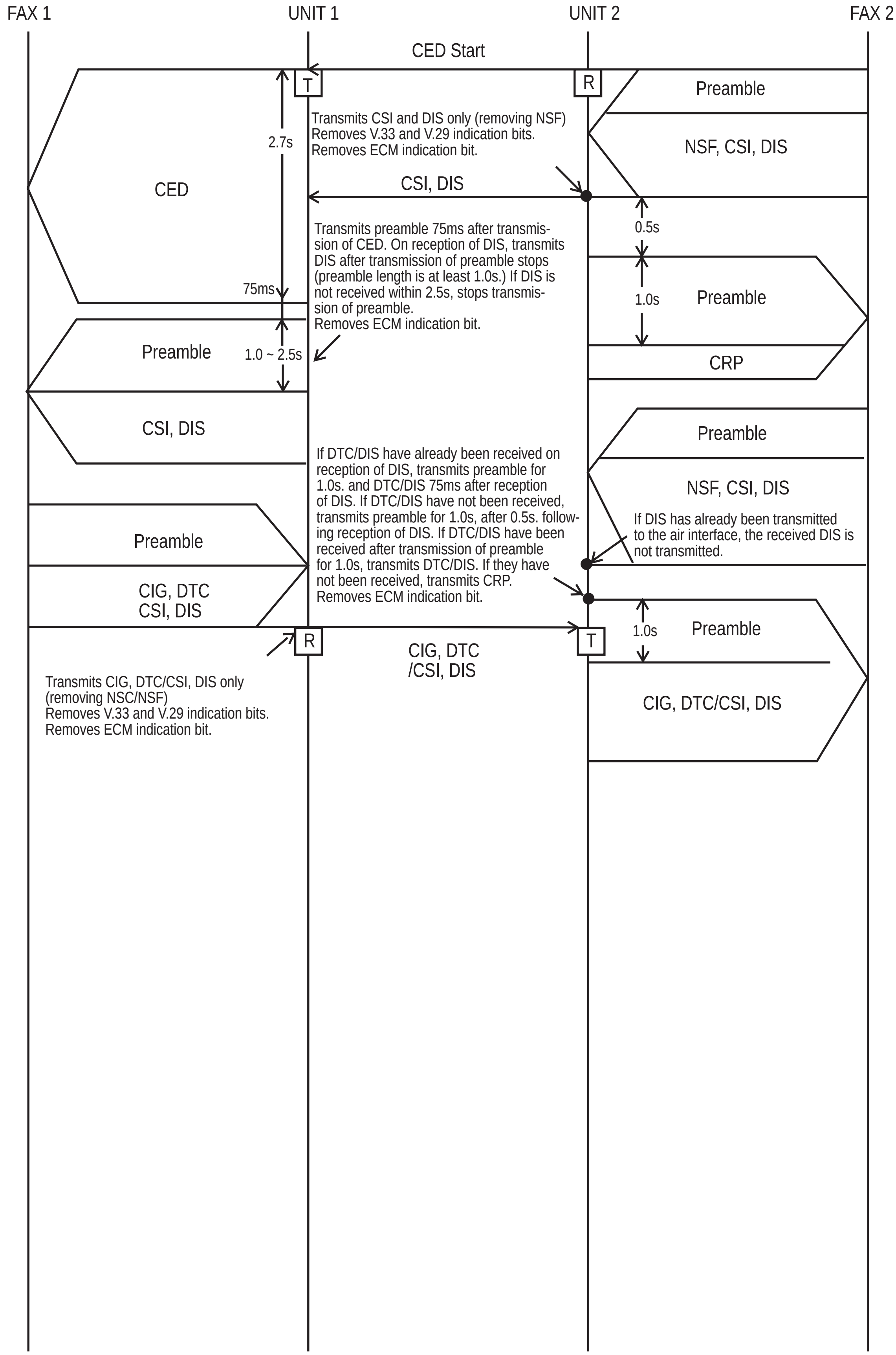


Fig. 3.2.2: Pre-message procedure (reception on the activating side)

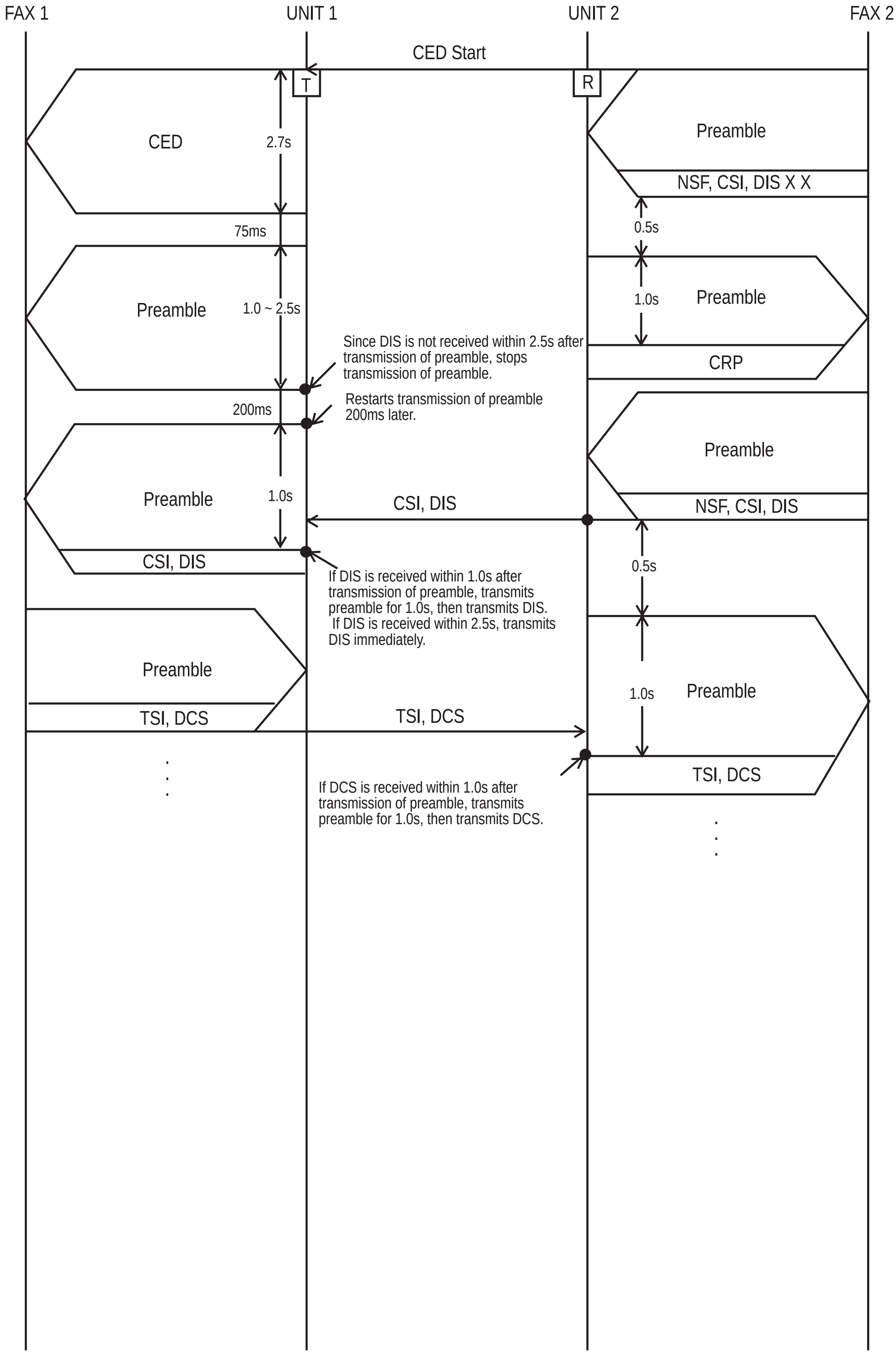


Fig. 3.2.3.1: DIS errors (1)

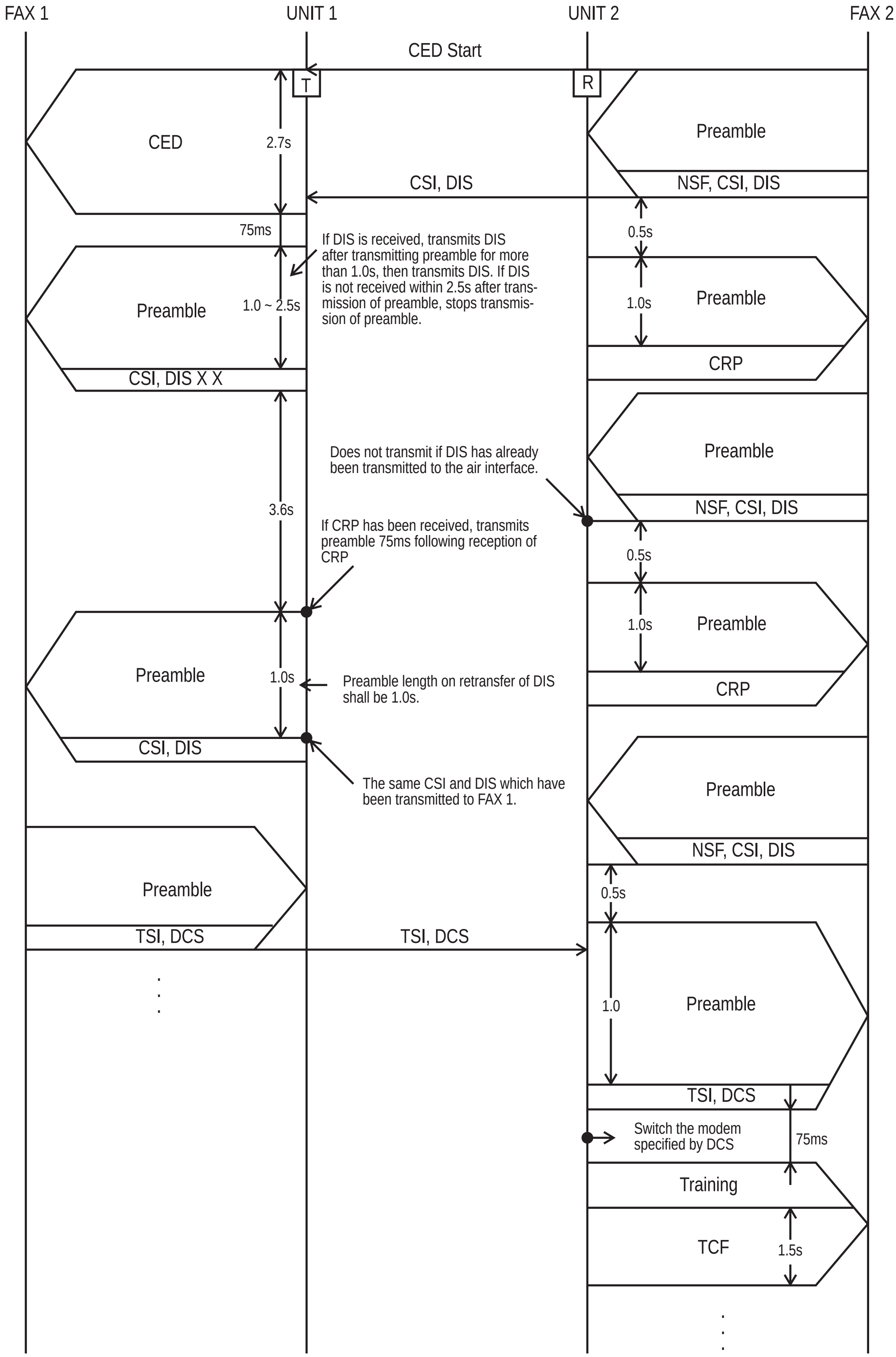


Fig. 3.2.3.2: DIS errors (2)

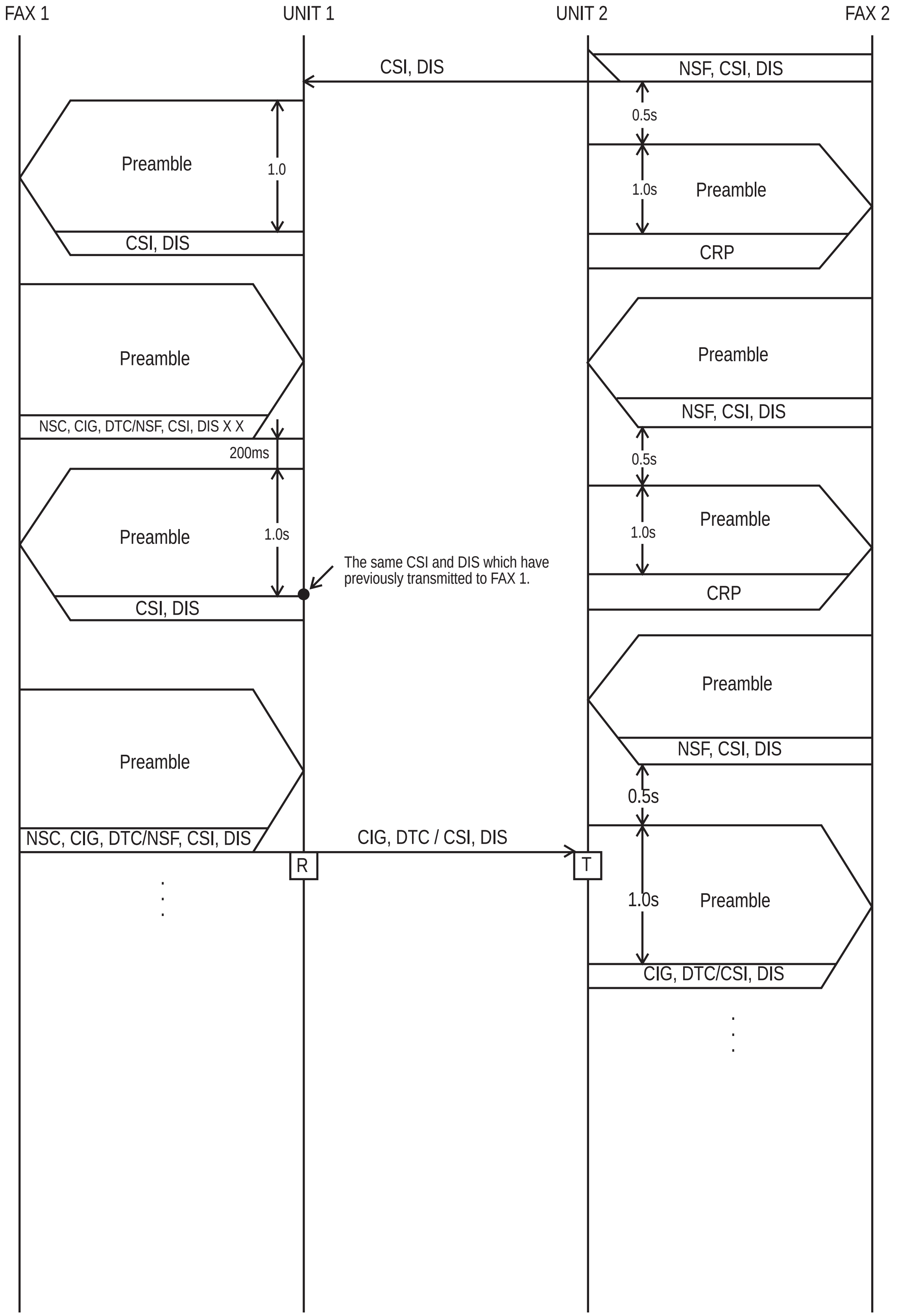


Fig. 3.2.3.3: DTC/DIS errors (1)

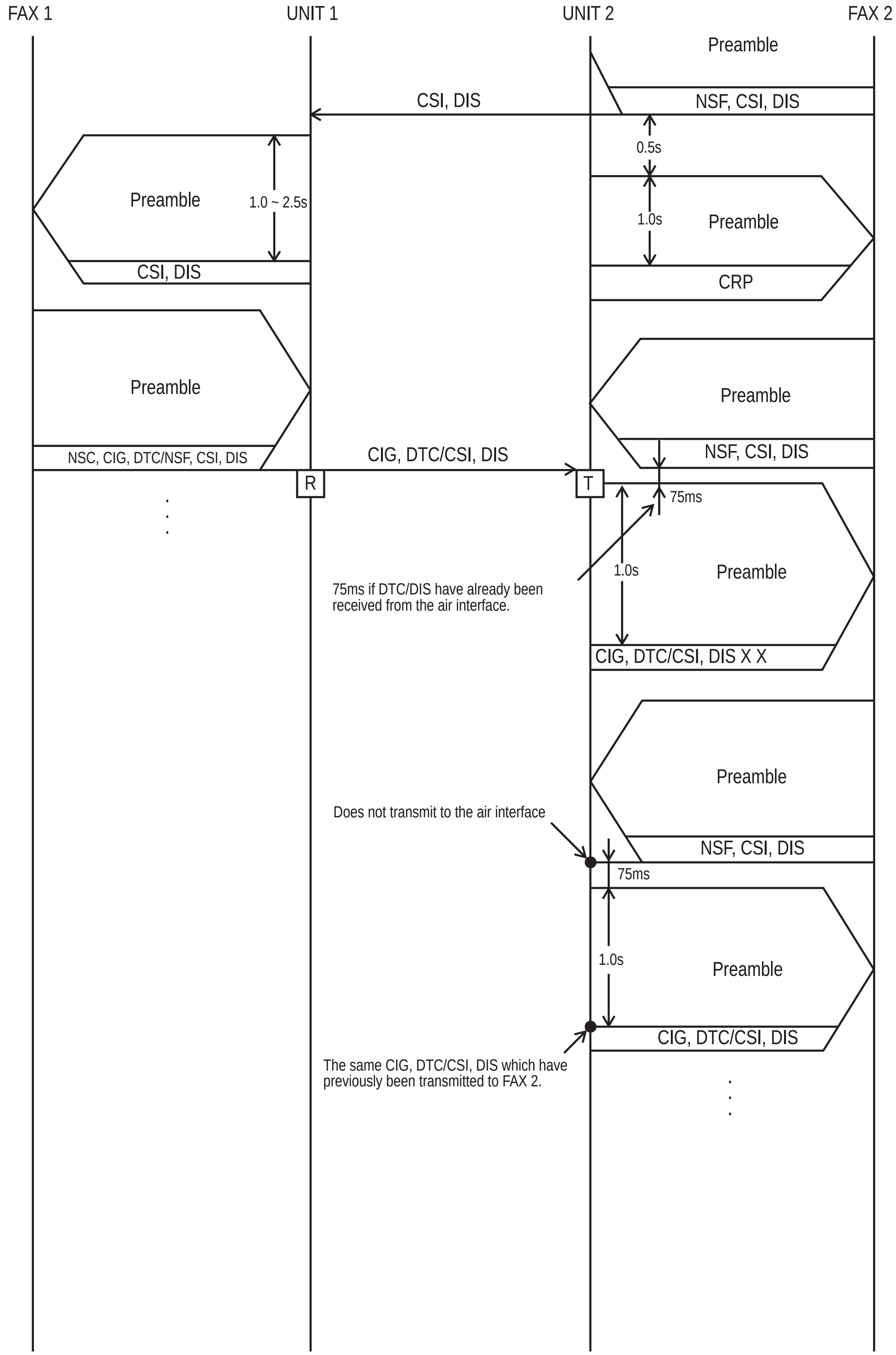


Fig. 3.2.3.4: DTC/DIS errors (2)

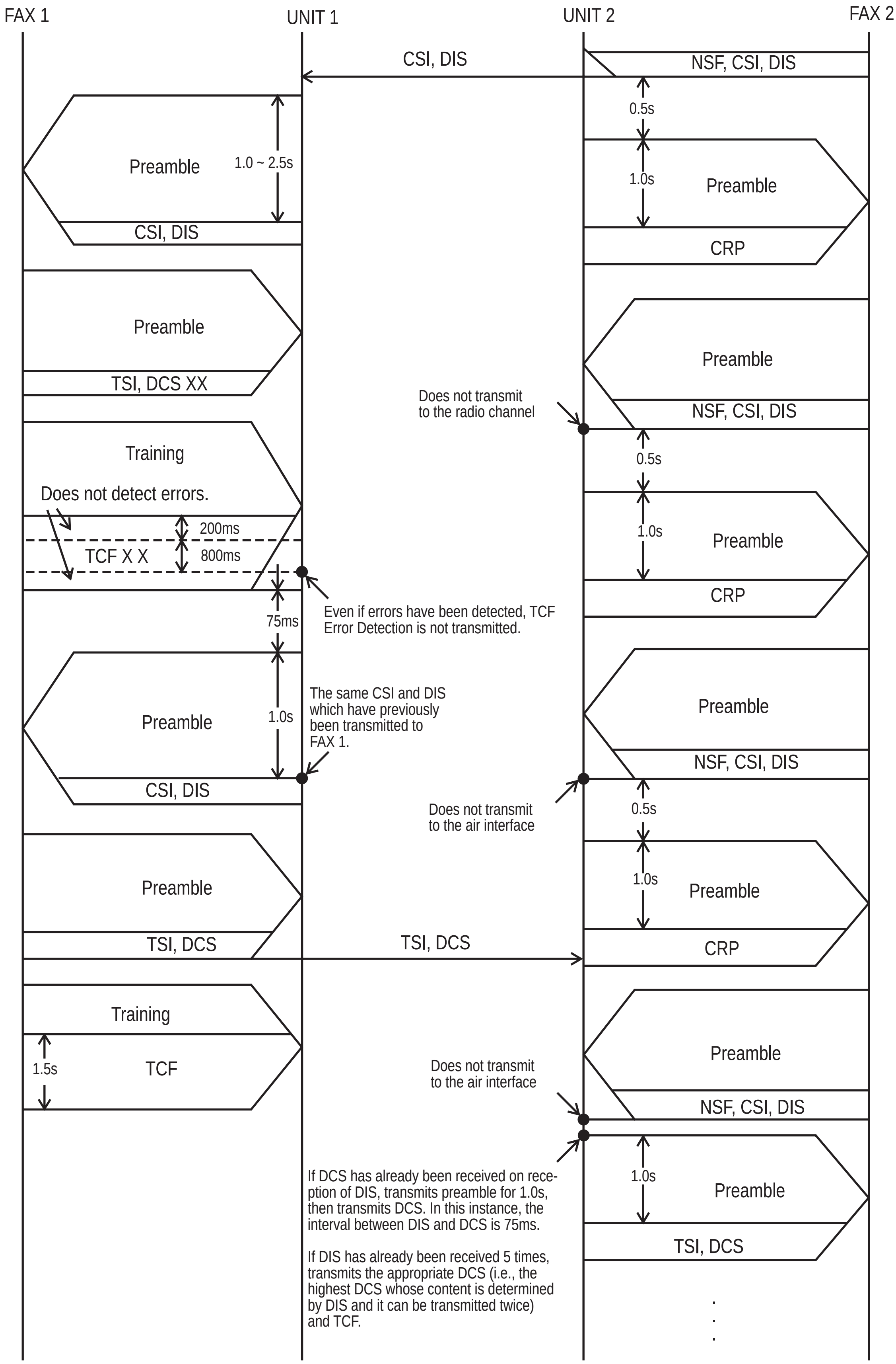


Fig. 3.2.3.5 : DCS errors (1)

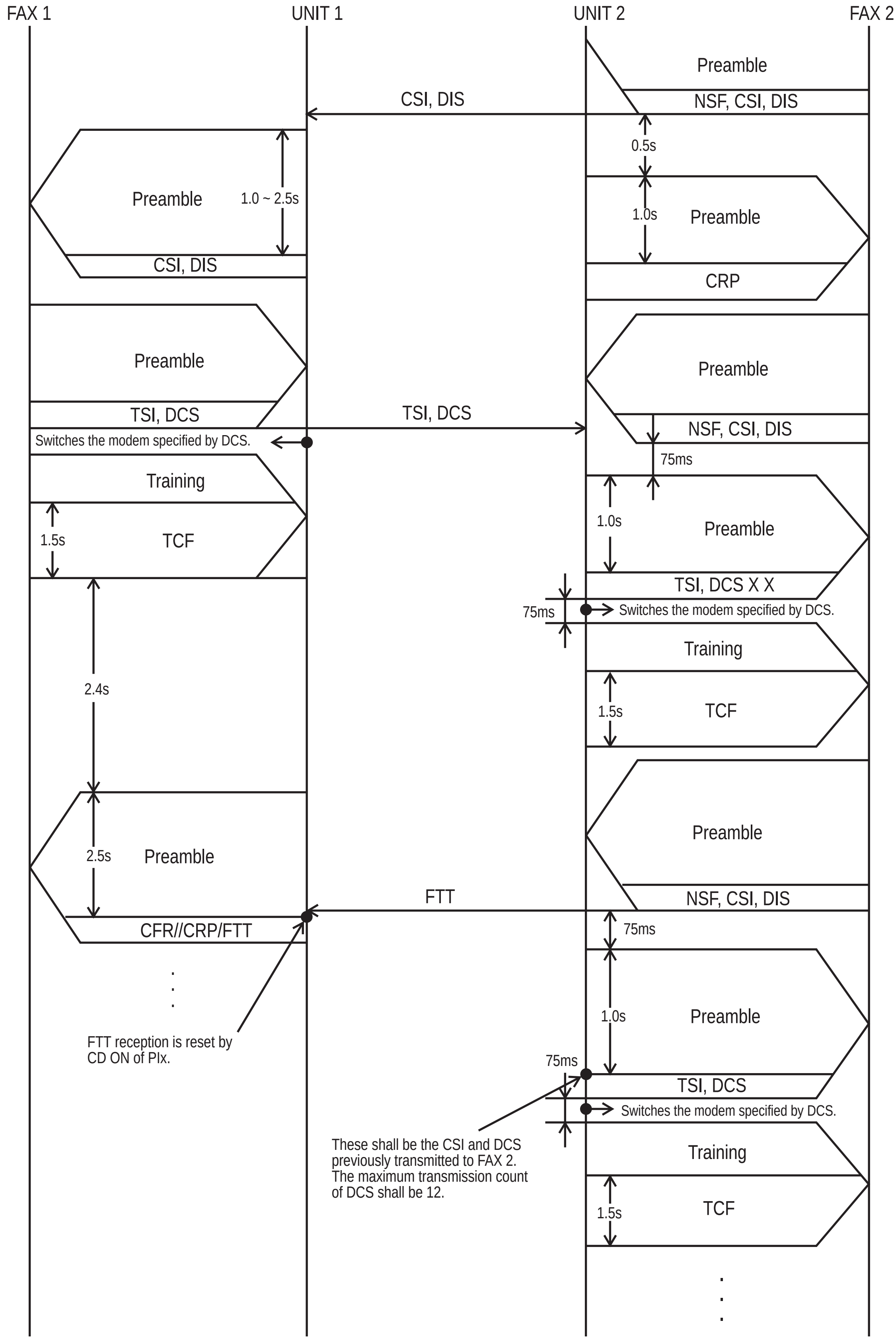


Fig. 3.2.3.6: DCS errors (2)

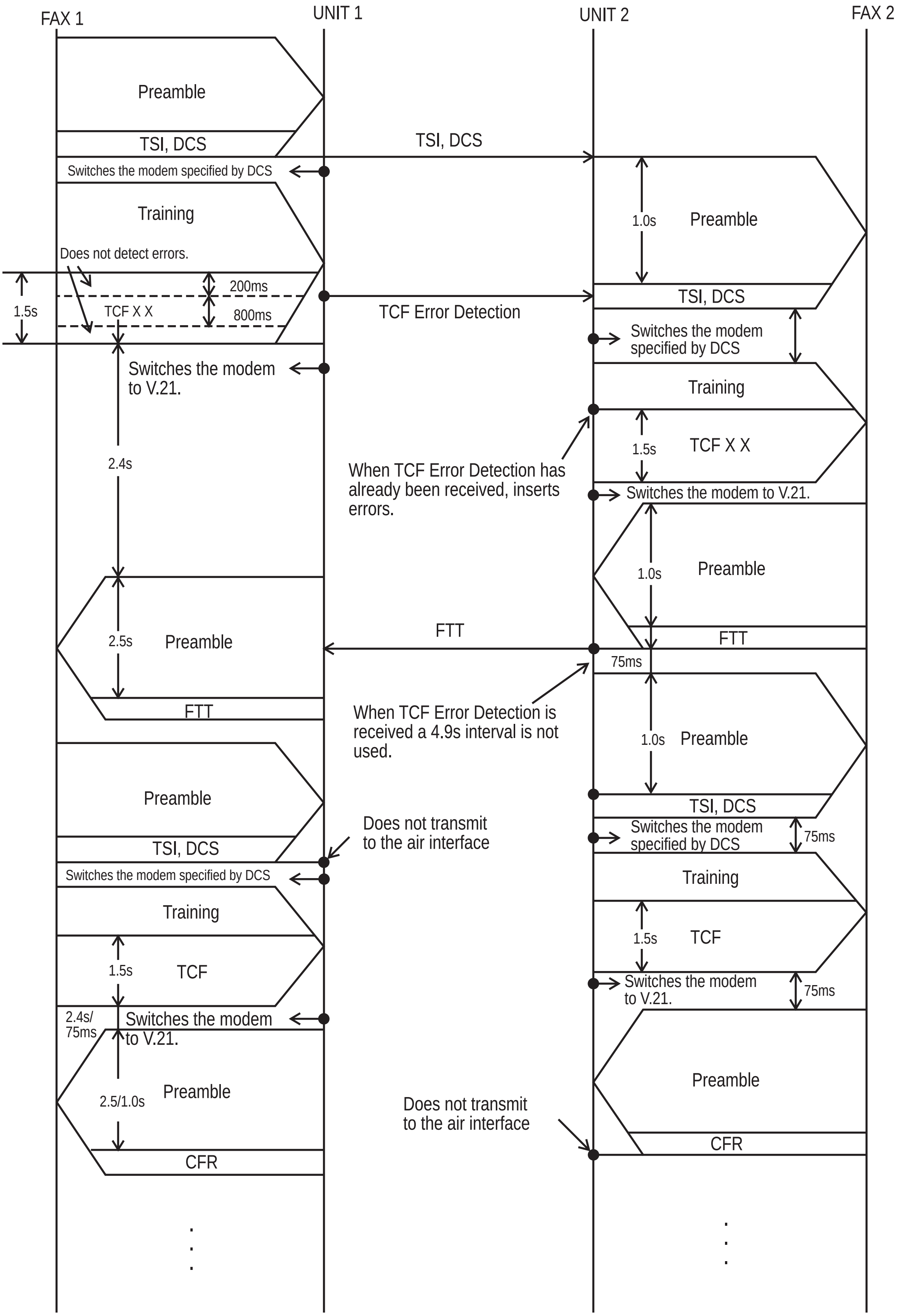


Fig. 3.2.3.7: TCF errors (1)

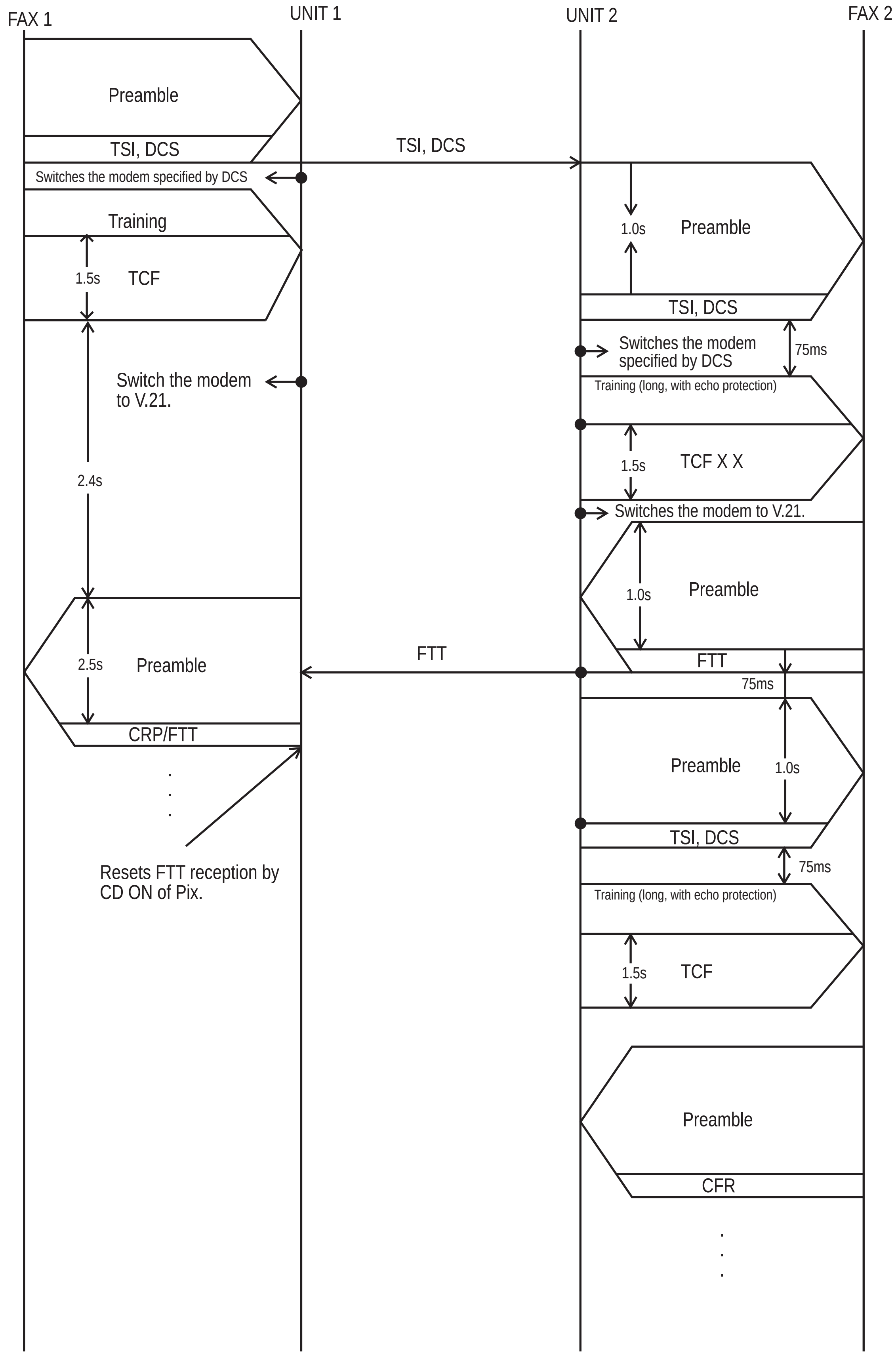


Fig. 3.2.3.8: TCF errors (2)

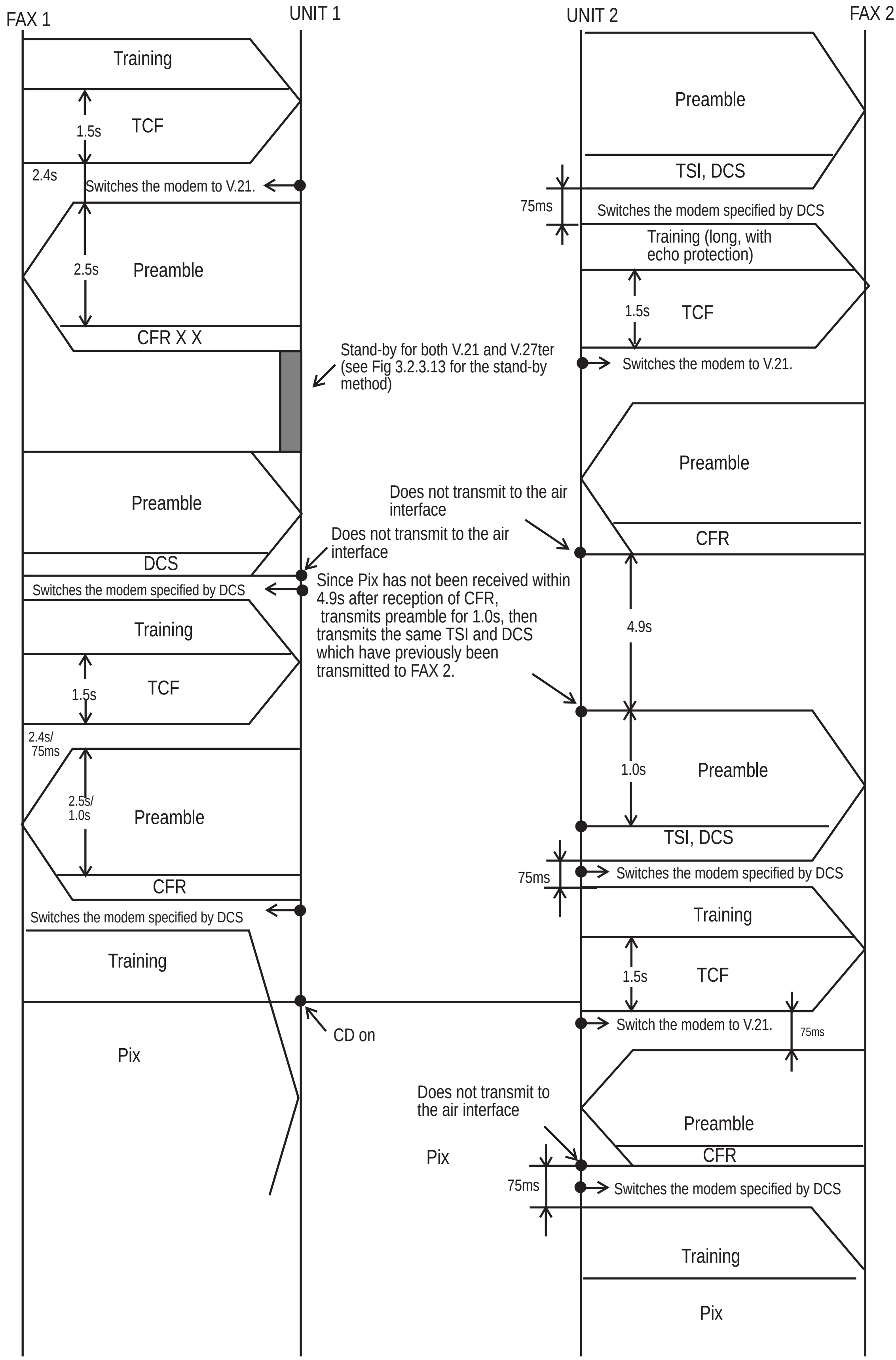


Fig. 3.2.3.9 : CFR errors (1)

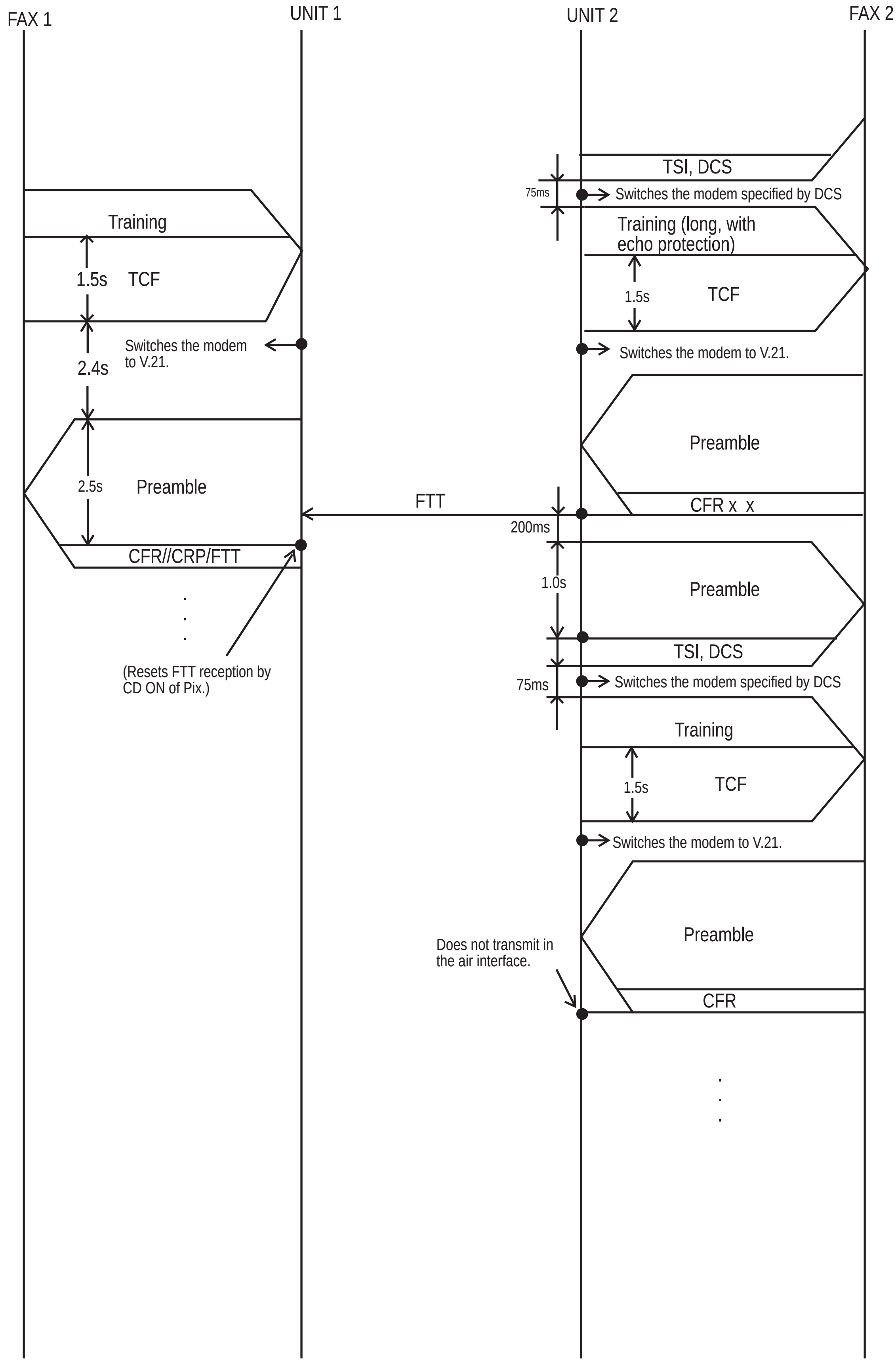


Fig. 3.2.3.10 : CFR errors (2)

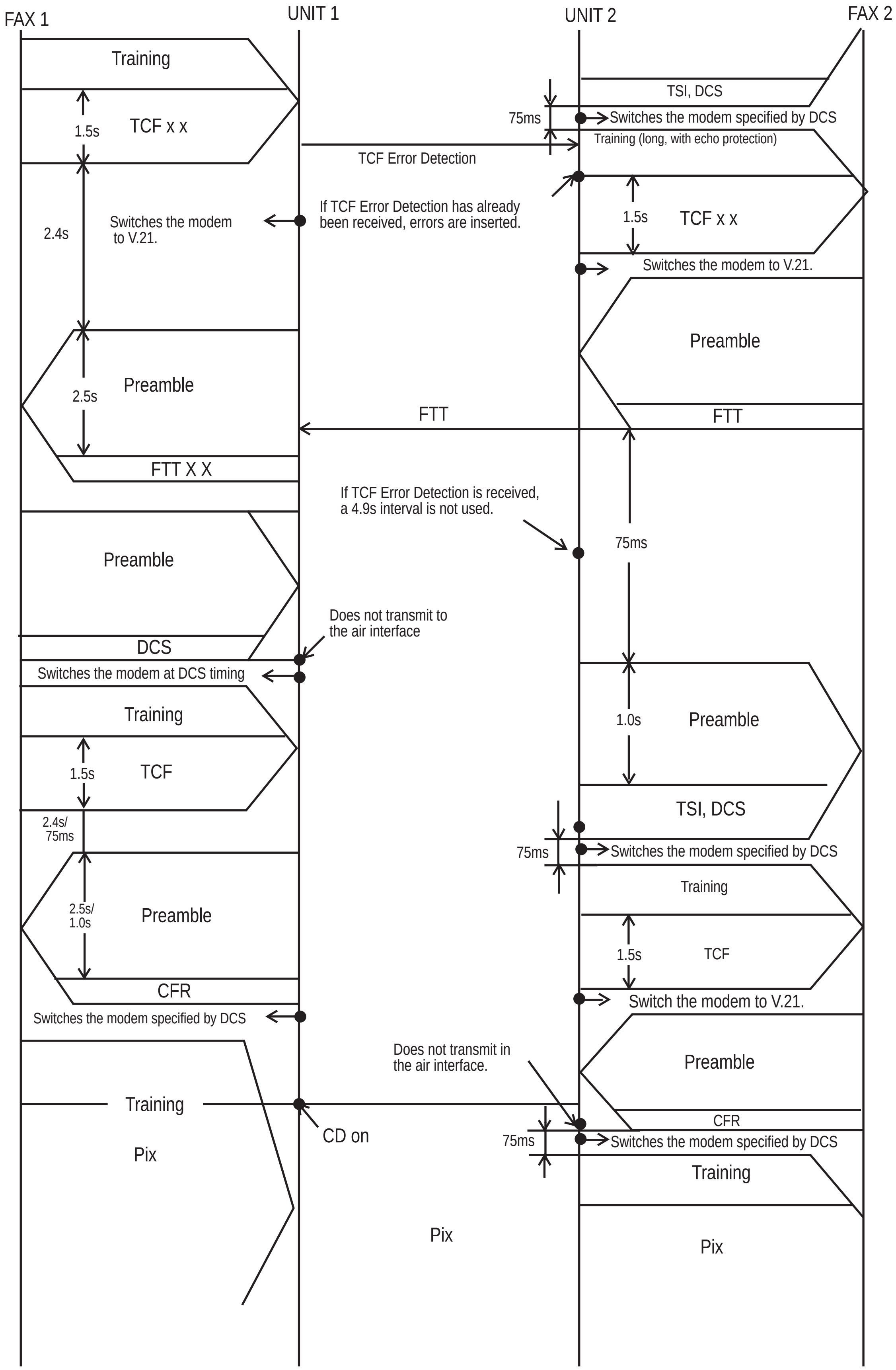


Fig. 3.2.3.11 : FTT errors (1)

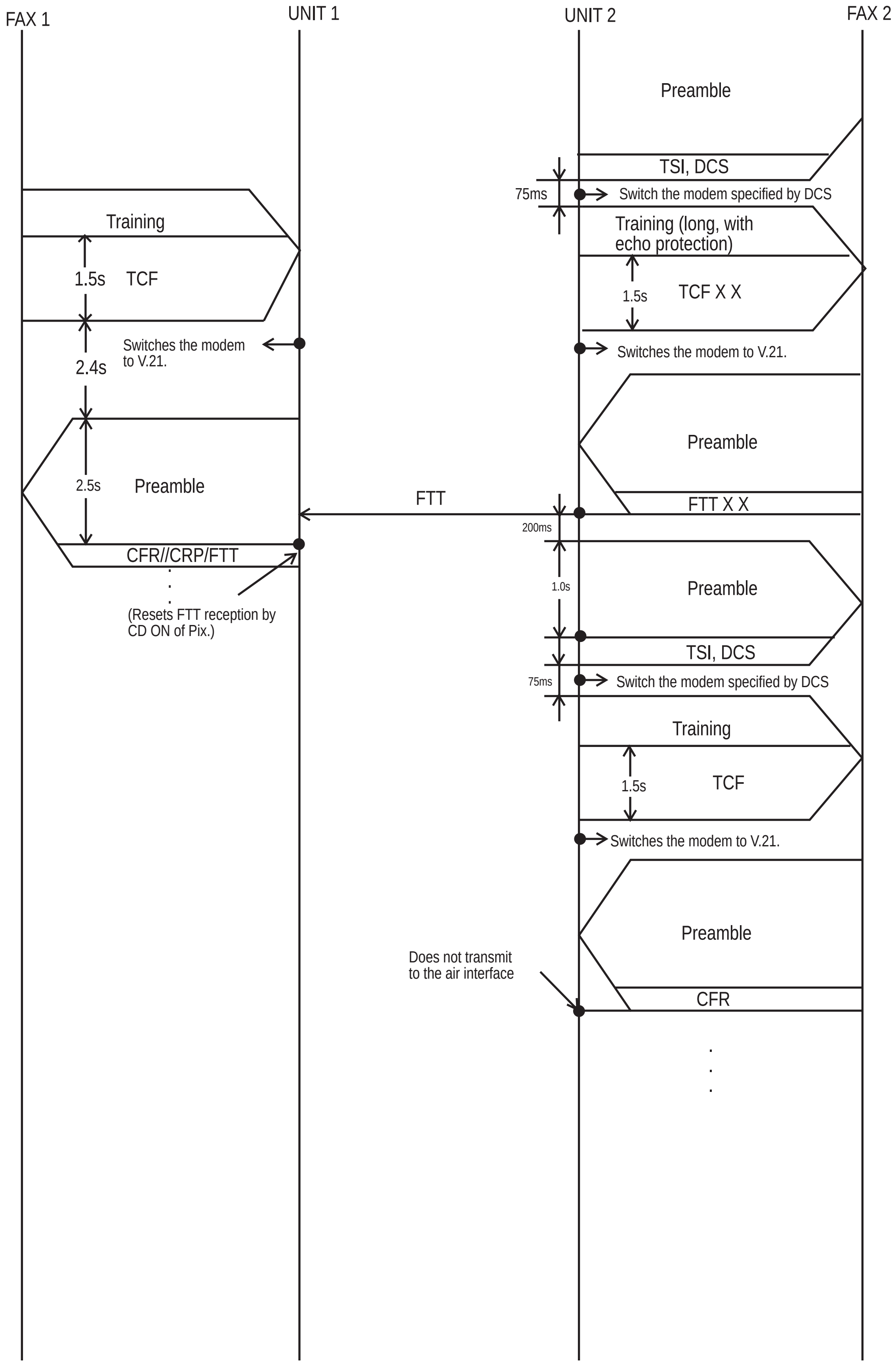


Fig. 3.2.3.12 : FTT errors (2)

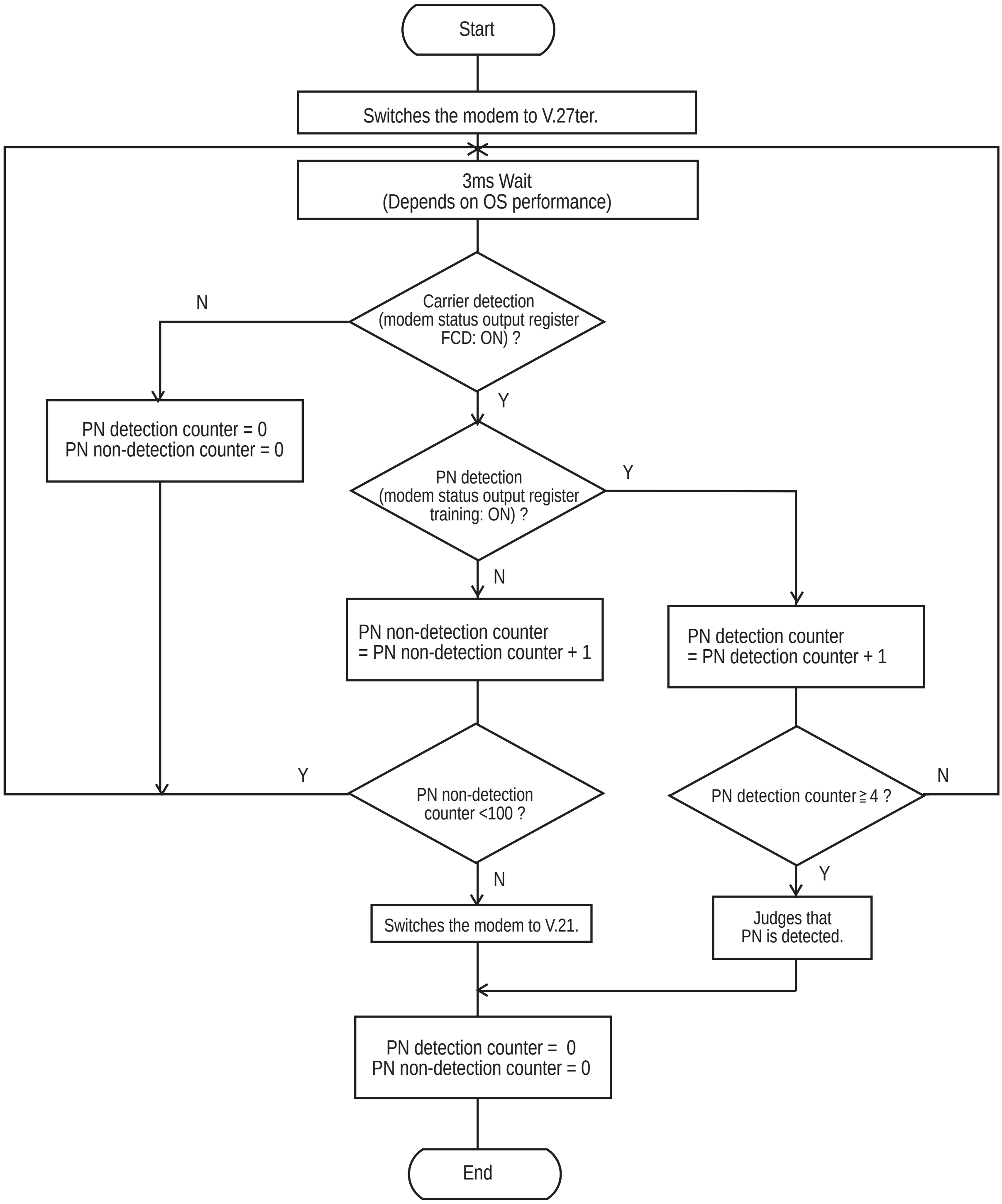


Fig. 3.2.3.13 : Stand-by method for both V.21 and V.27ter

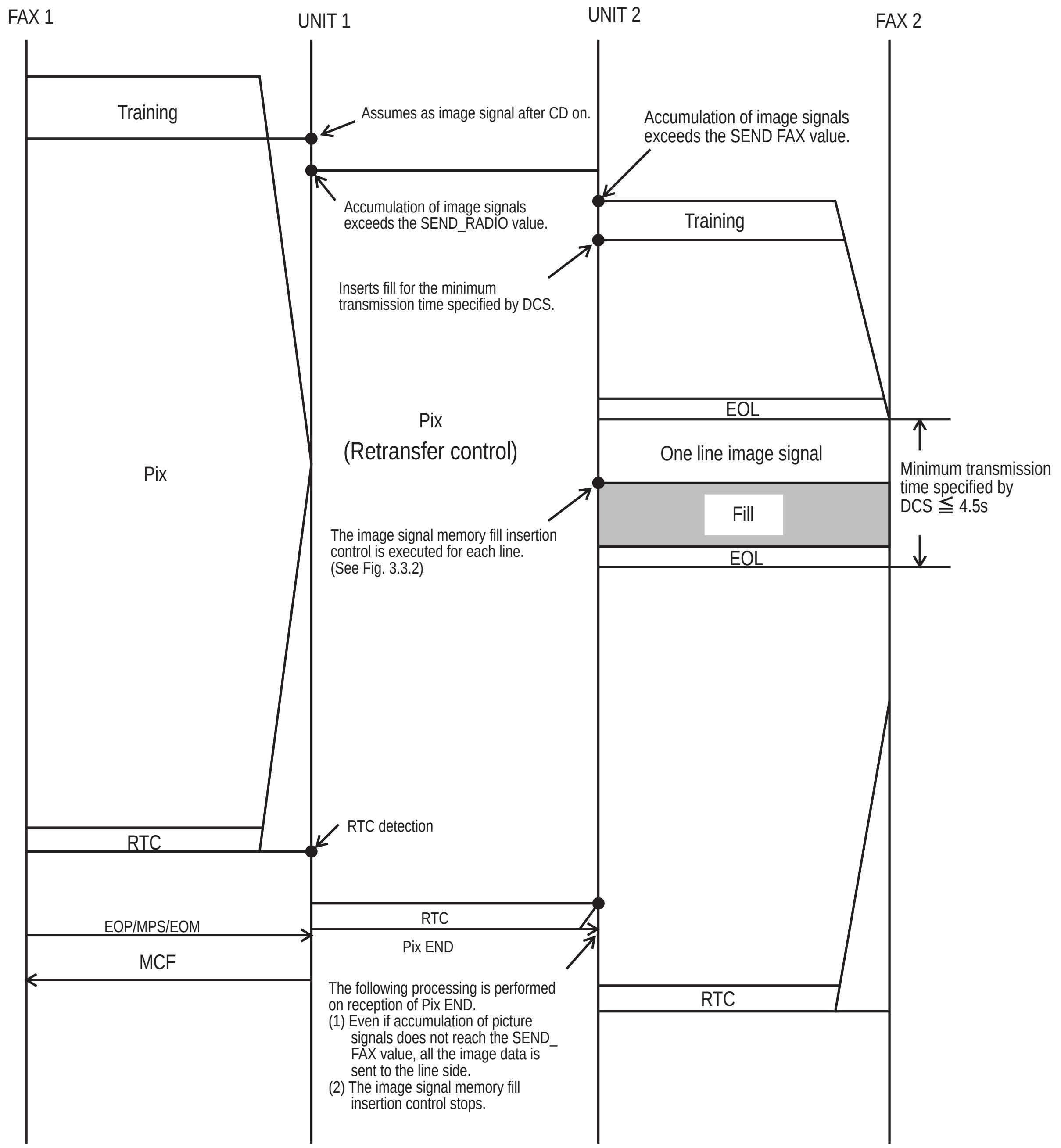


Fig. 3.3.1: Image signal transmission procedure

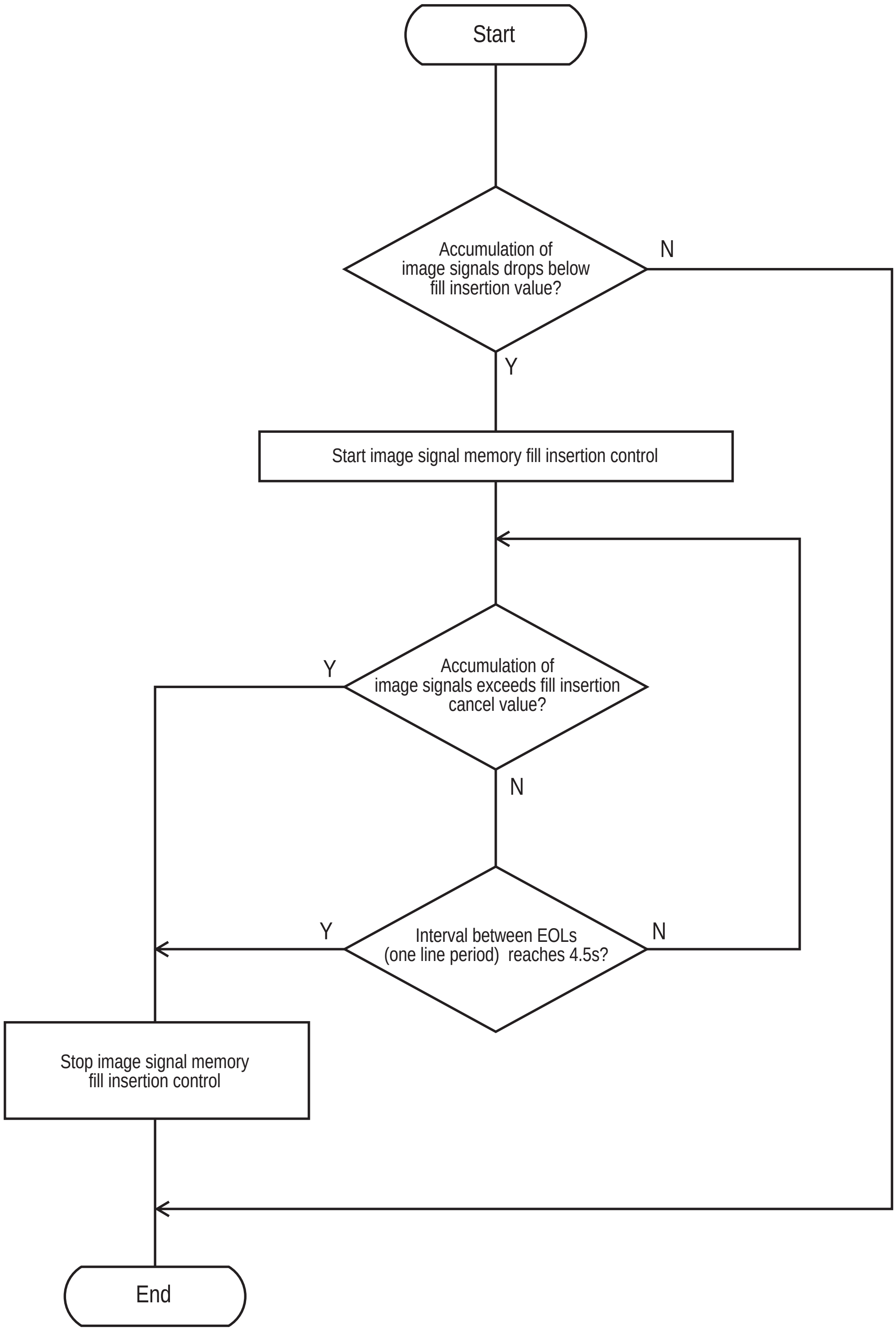


Fig. 3.3.2: Fill insertion control algorithm used for the image signal memory

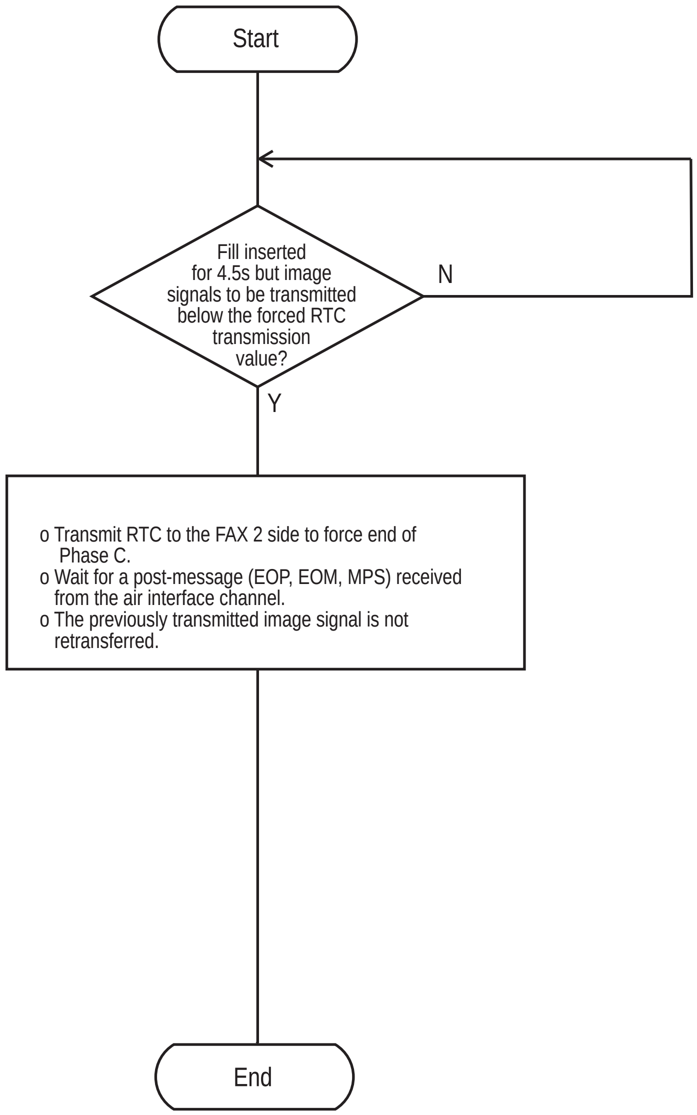


Fig. 3.3.3: Control algorithm for image signal reception side FAX (without transmitted image signal)

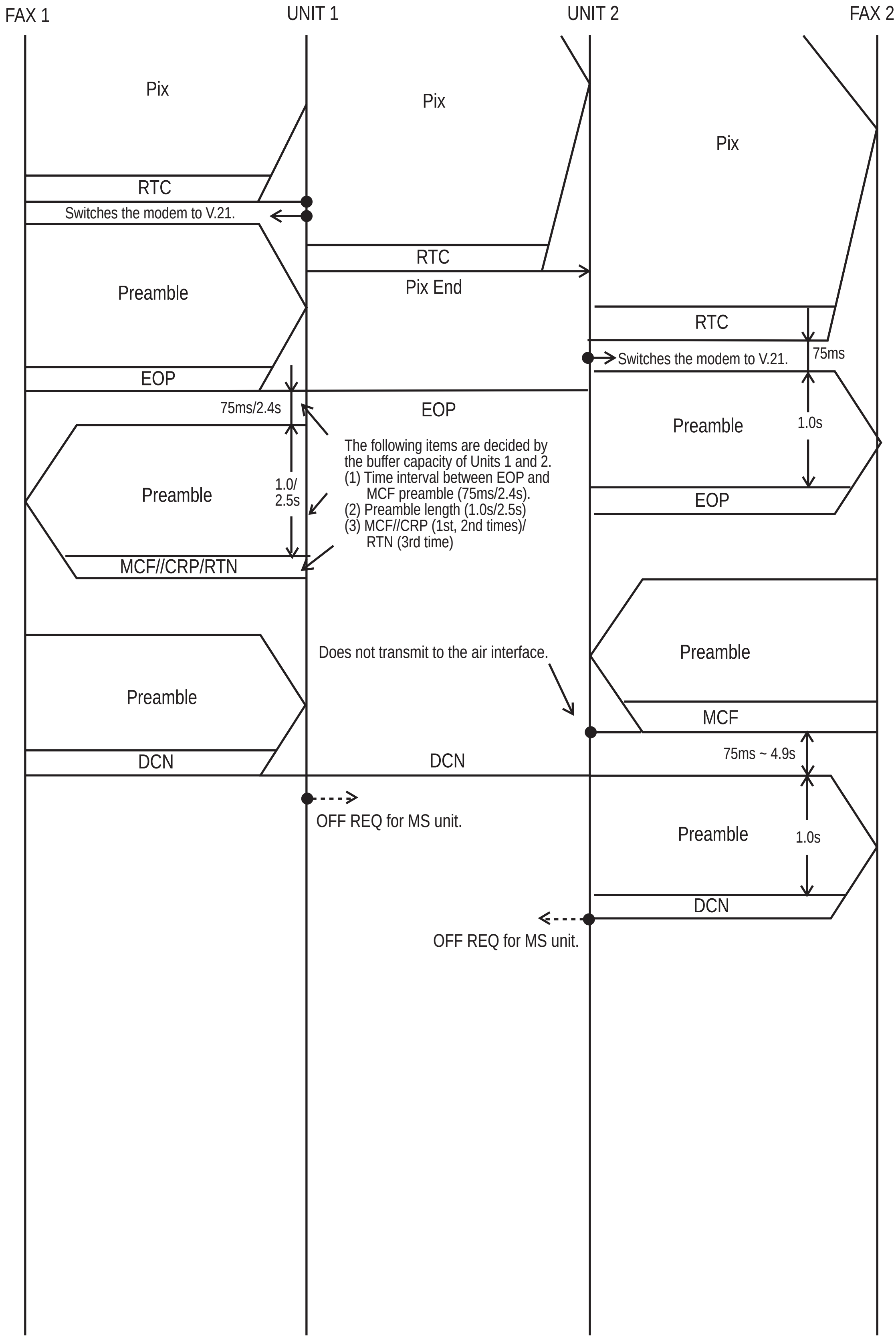


Fig. 3.4.1.1 : End-of-procedure control basic sequence

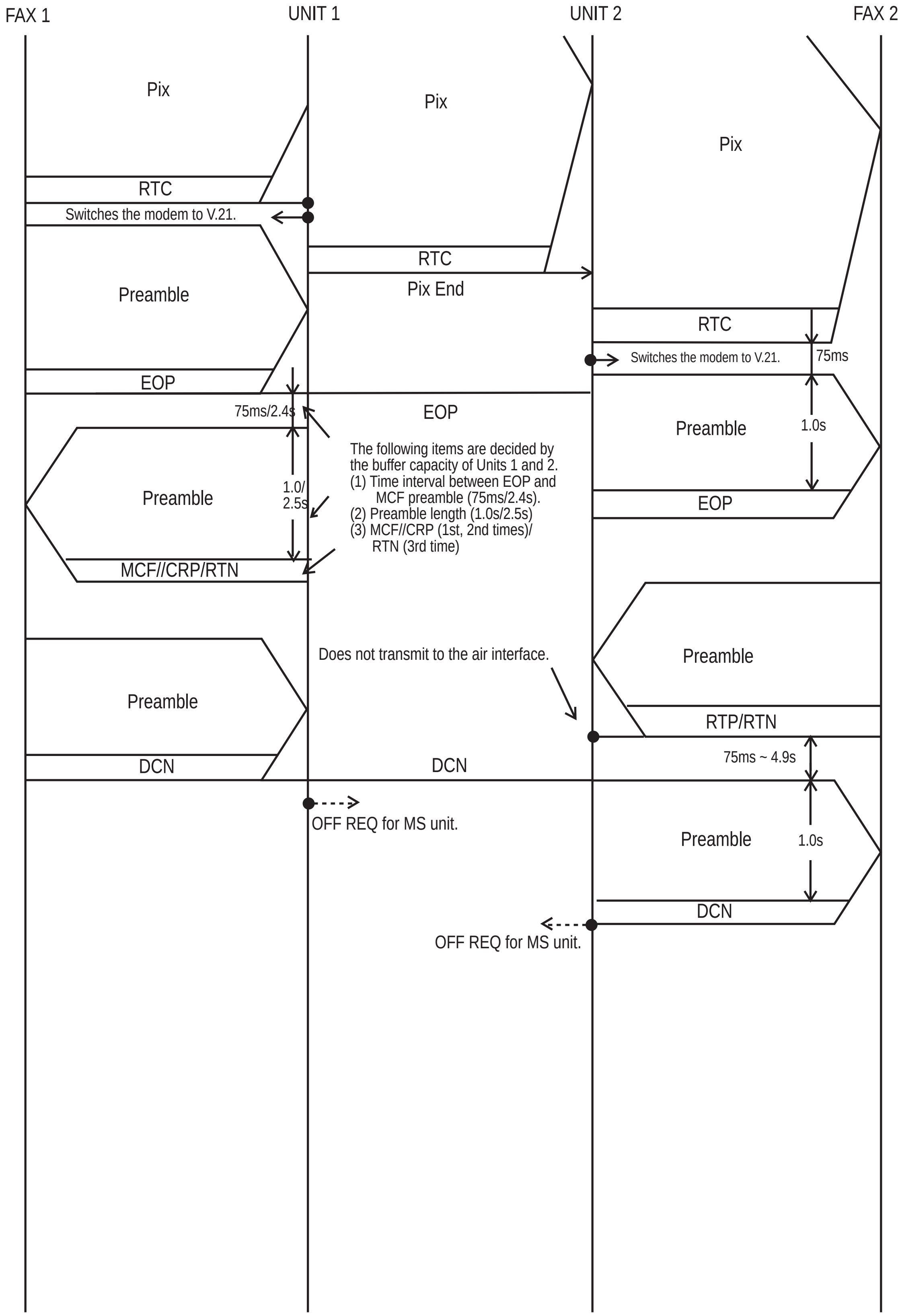


Fig. 3.4.1.2 : End-of-procedure control basic sequence
(when the response to EOP is RTP or RTN)

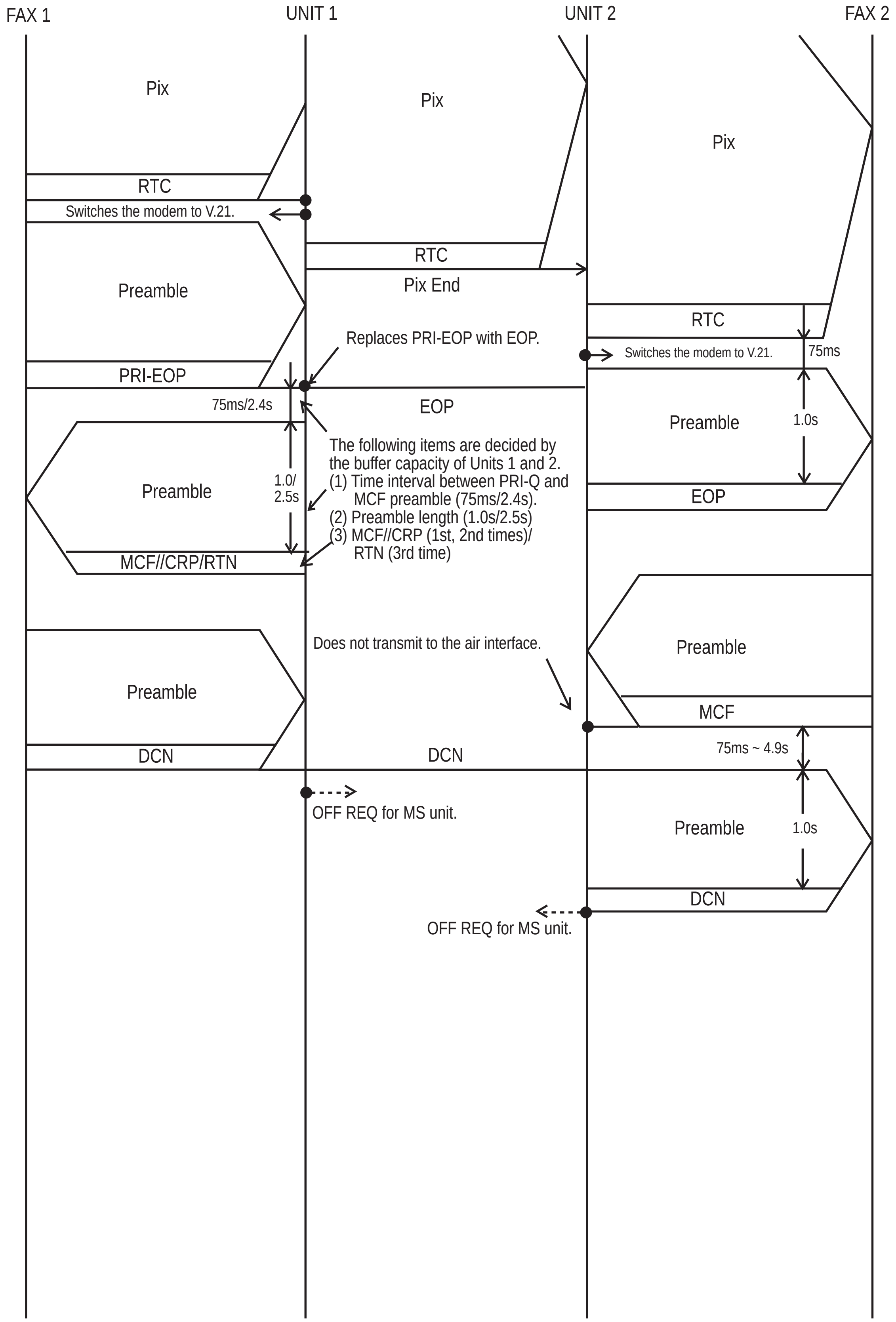


Fig. 3.4.1.3 : End-of-procedure control sequence (for PRI-EOP)

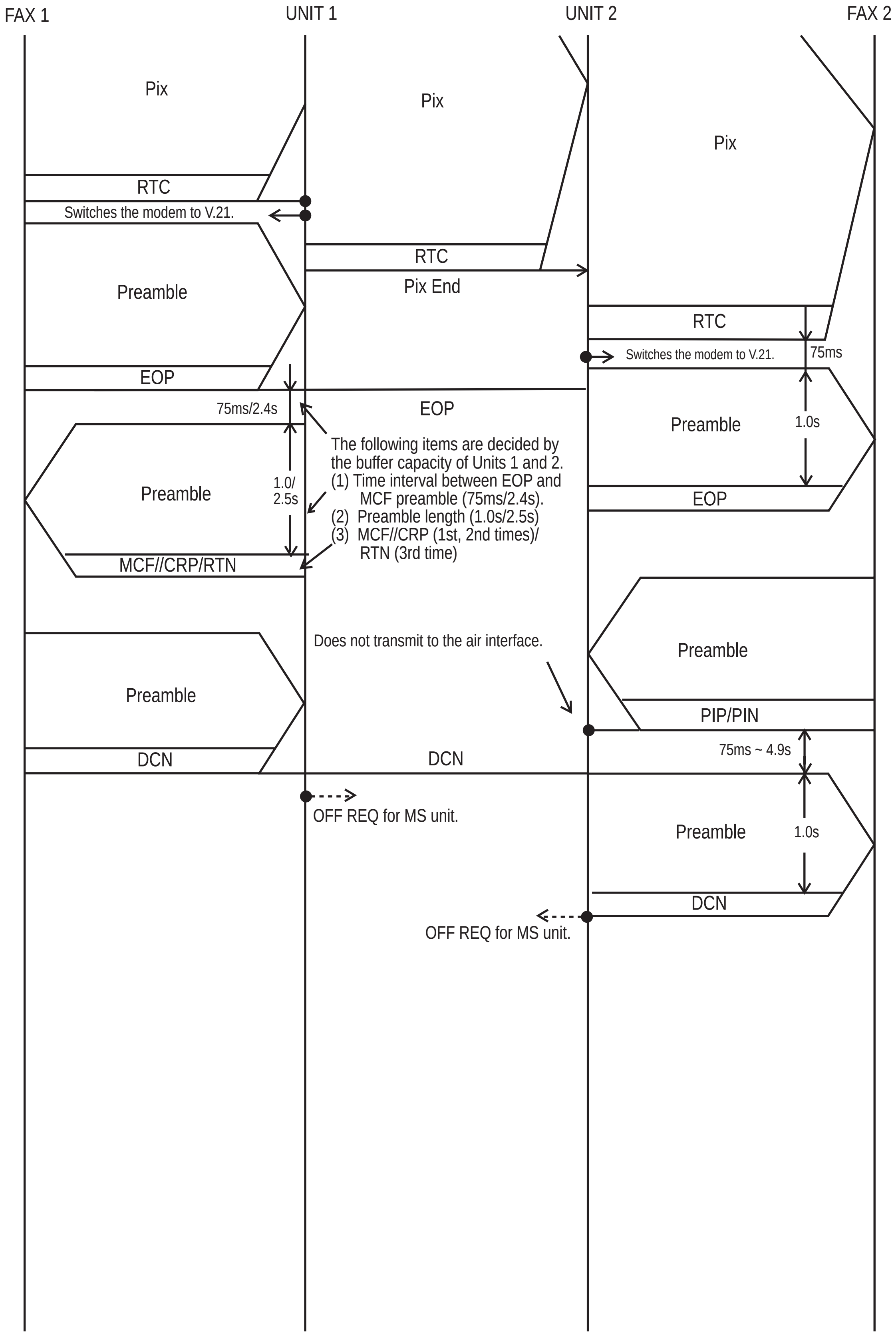


Fig. 3.4.1.4 : End-of-procedure control basic sequence (when the response to EOP is PIP or PIN)

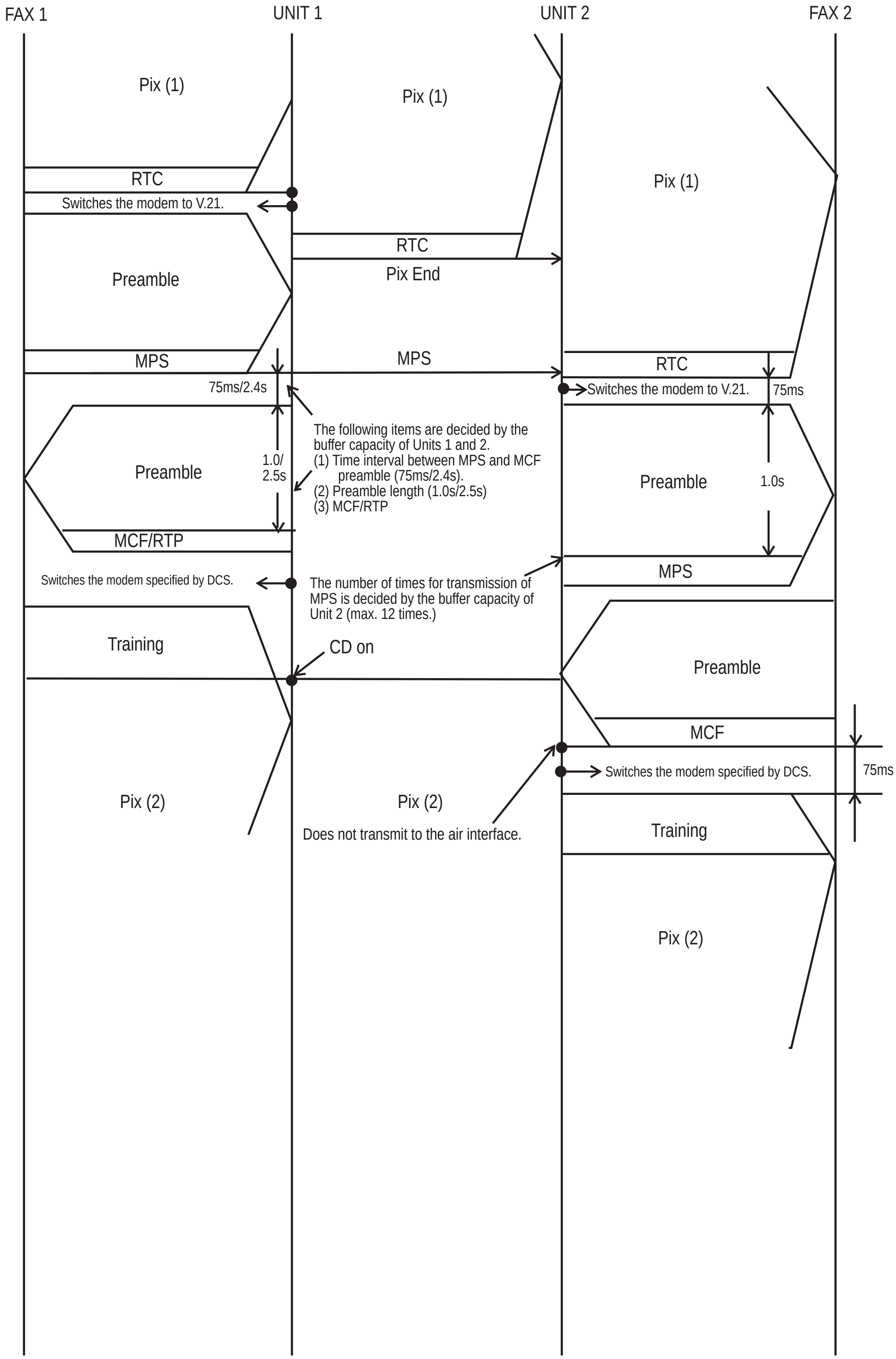


Fig. 3.4.2.1 : Multi-page control basic sequence

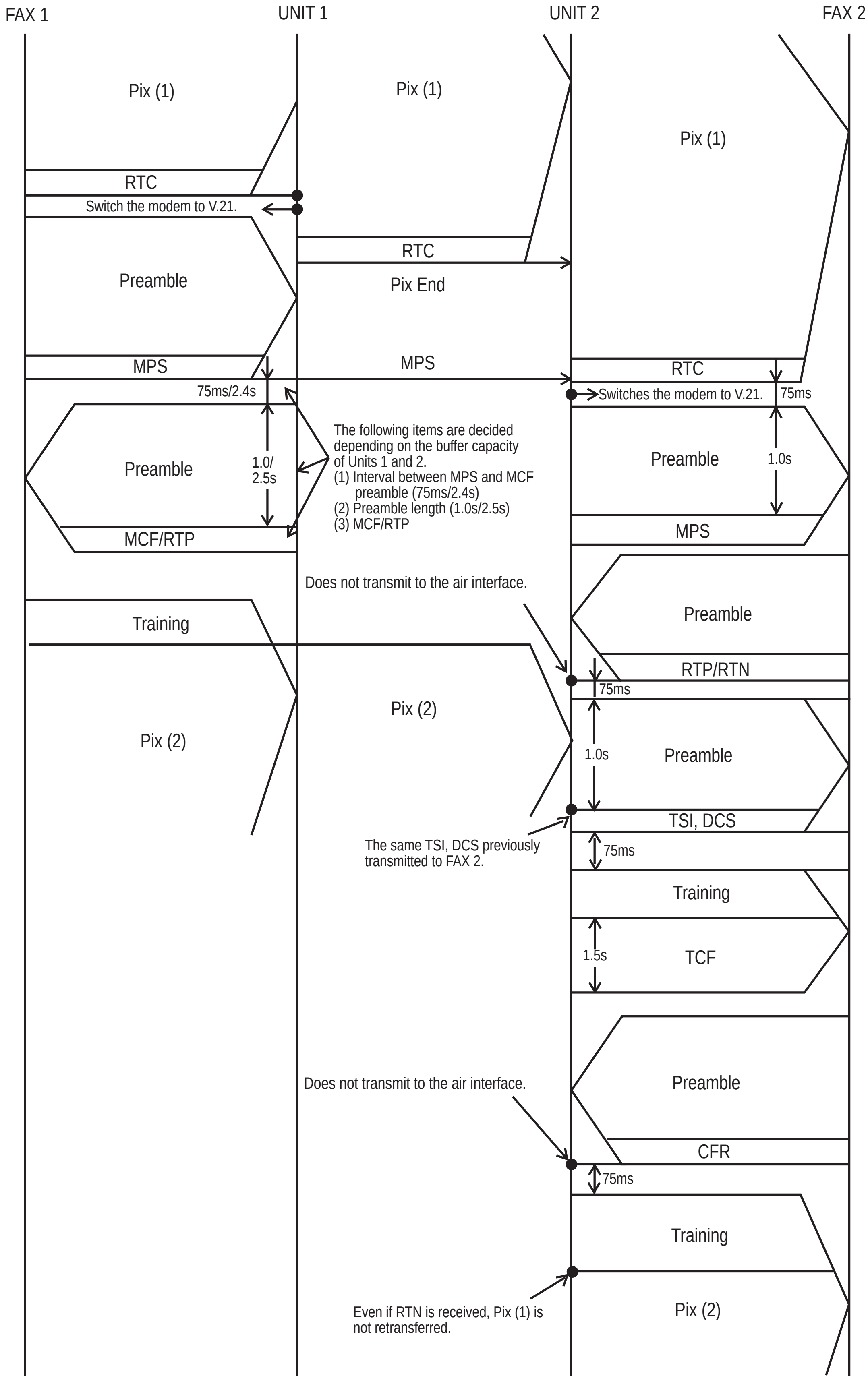


Fig. 3.4.2.2: Multi-page control sequence (when the response to MPS is RTP or RTN)

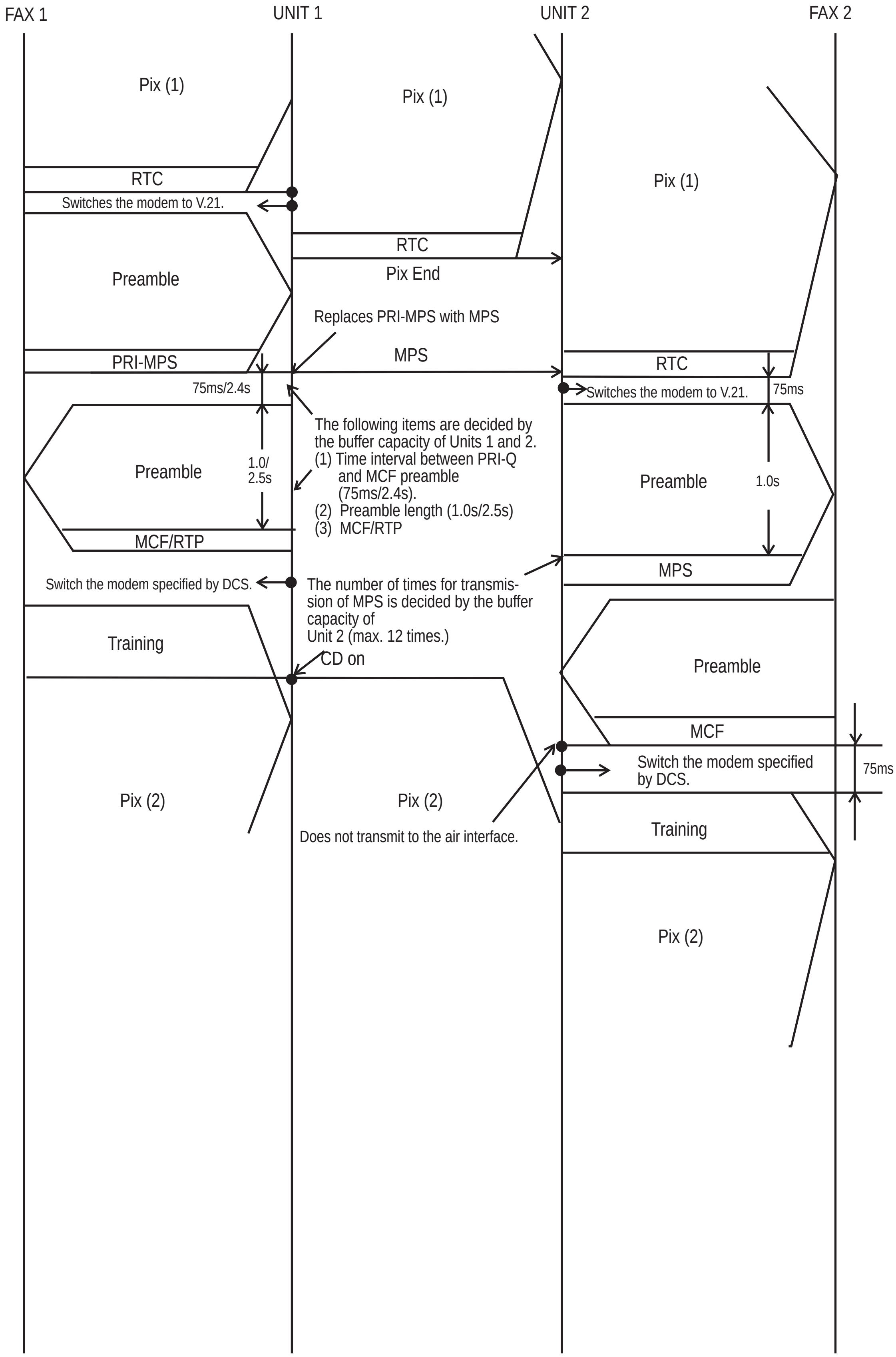


Fig. 3.4.2.3 : Multi-page control sequence (for PRI-MPS)

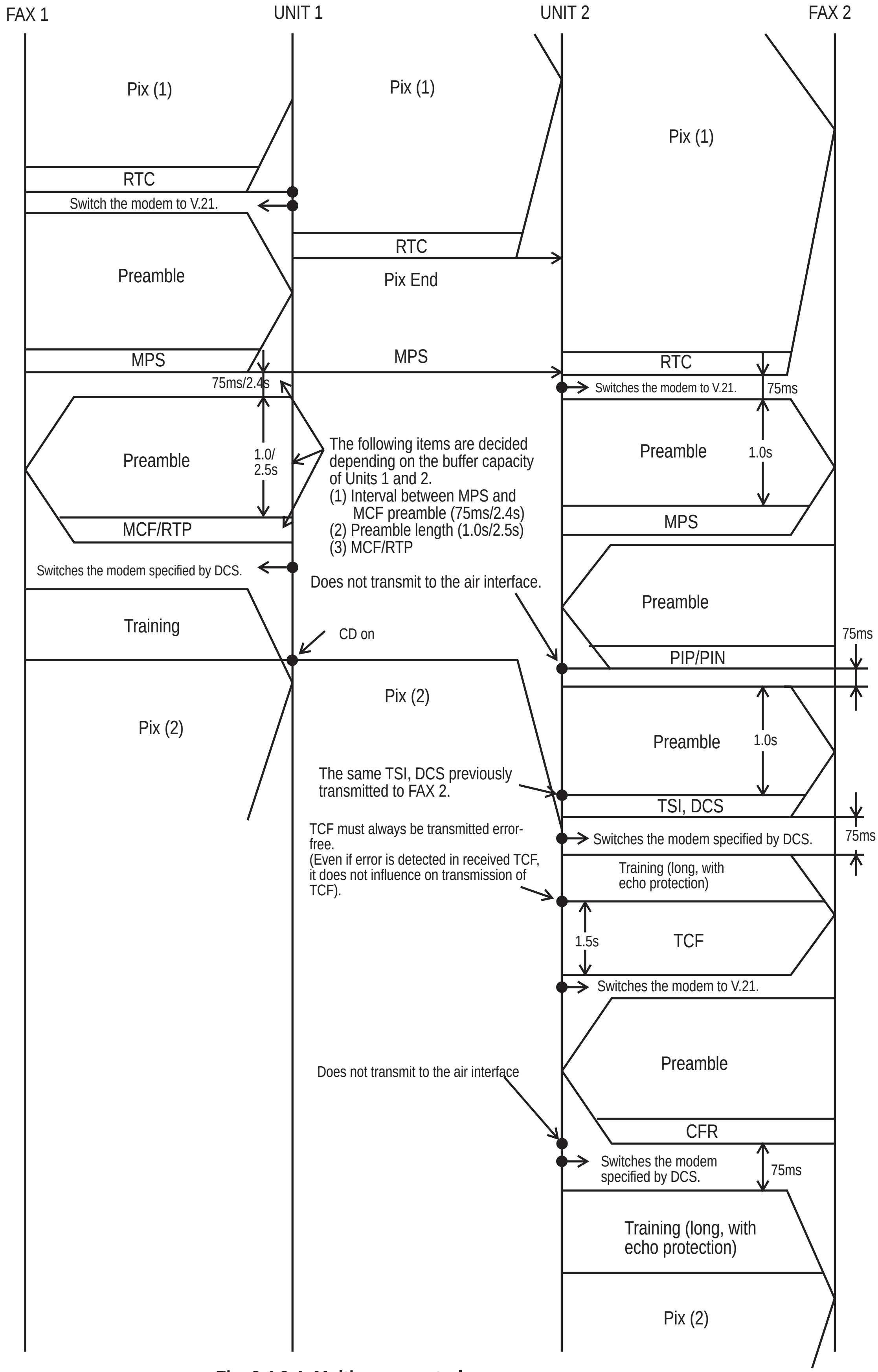


Fig. 3.4.2.4: Multi-page control sequence
(when the response to MPS is PIP or PIN)

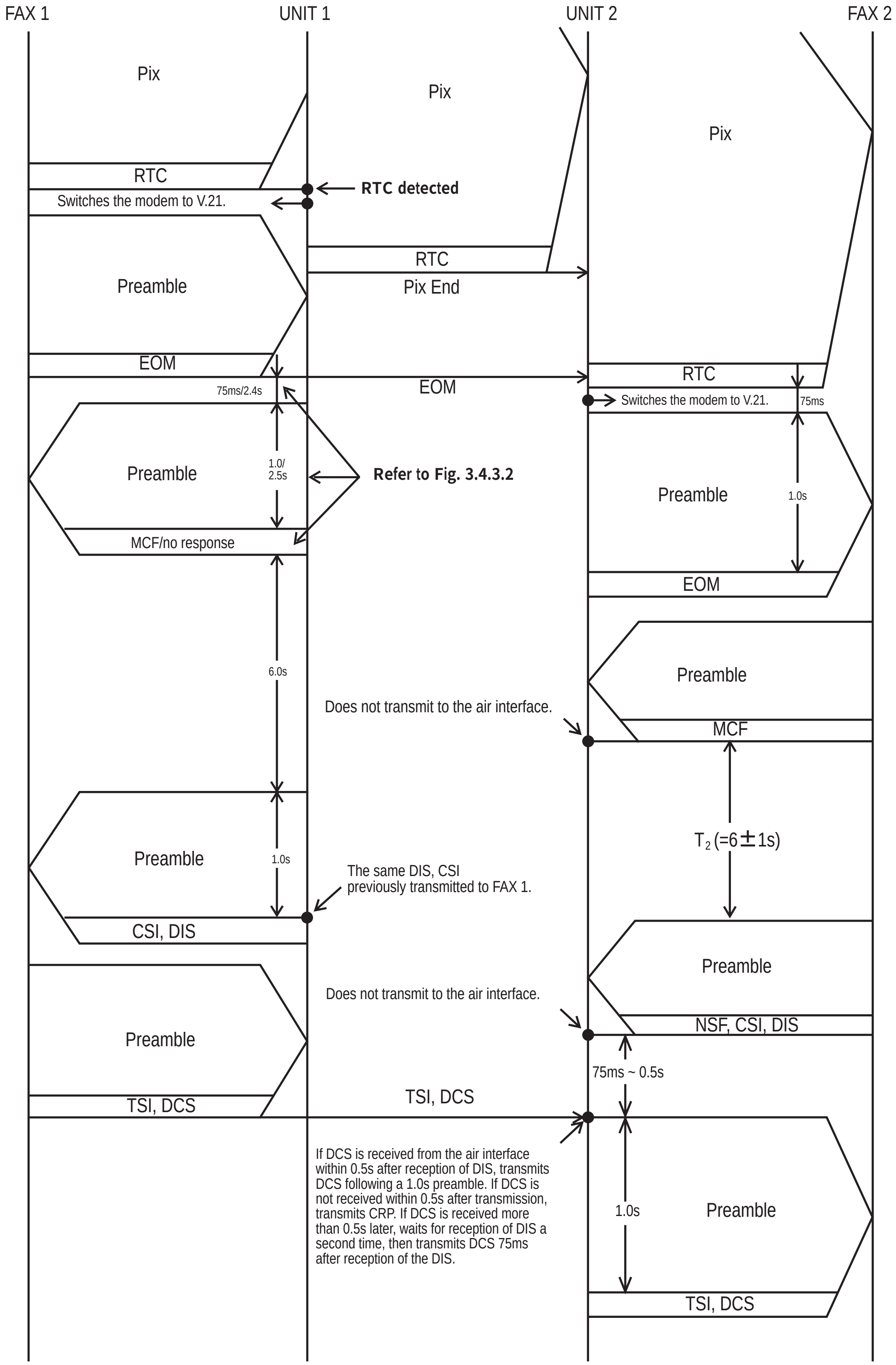


Fig. 3.4.3.1: End-of-message control basic sequence

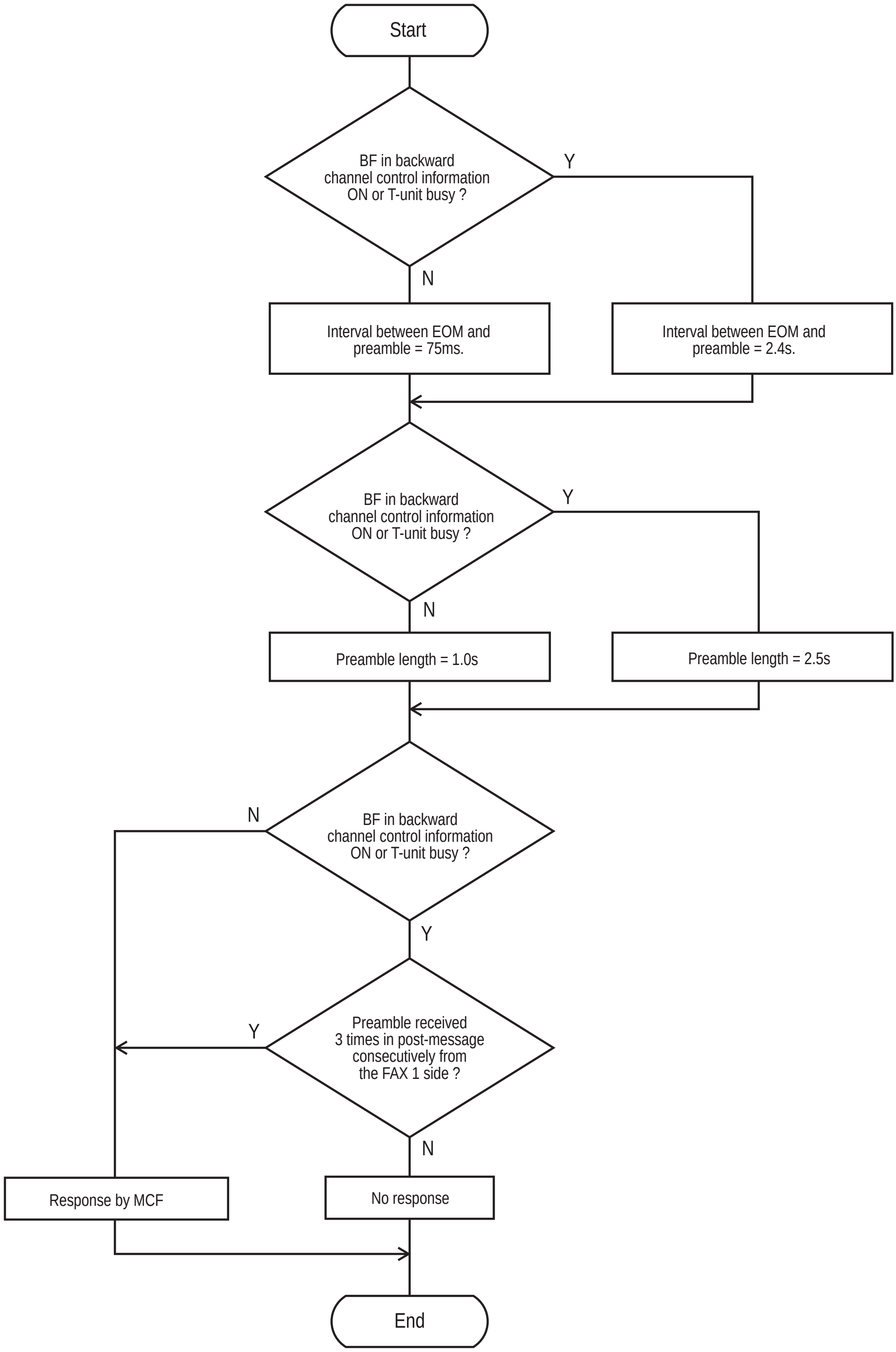


Fig. 3.4.3.2: Algorithm for EOM Response selection for unit 1

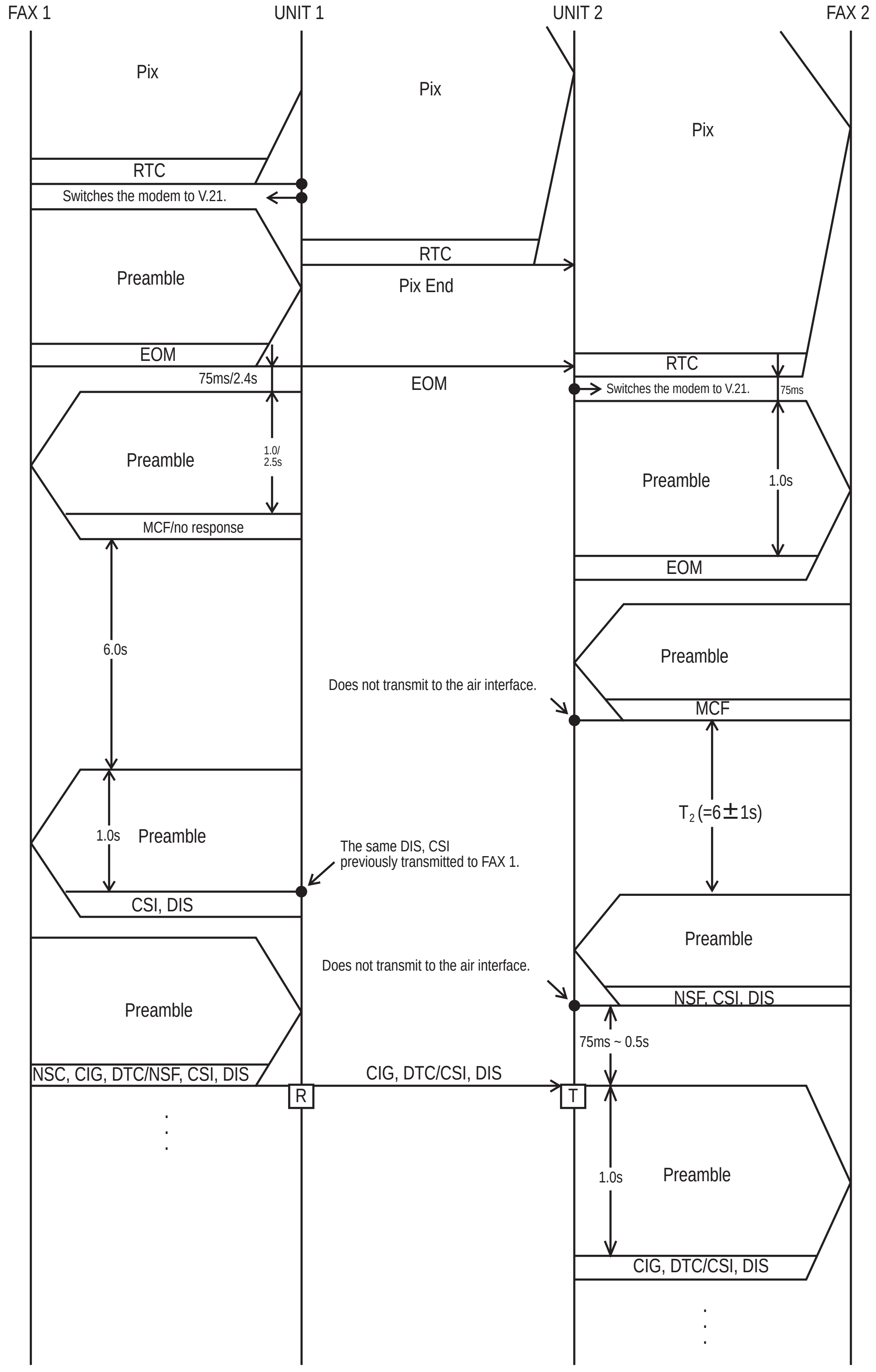


Fig. 3.4.3.3: End-of-message control sequence (for reception on the activating side)

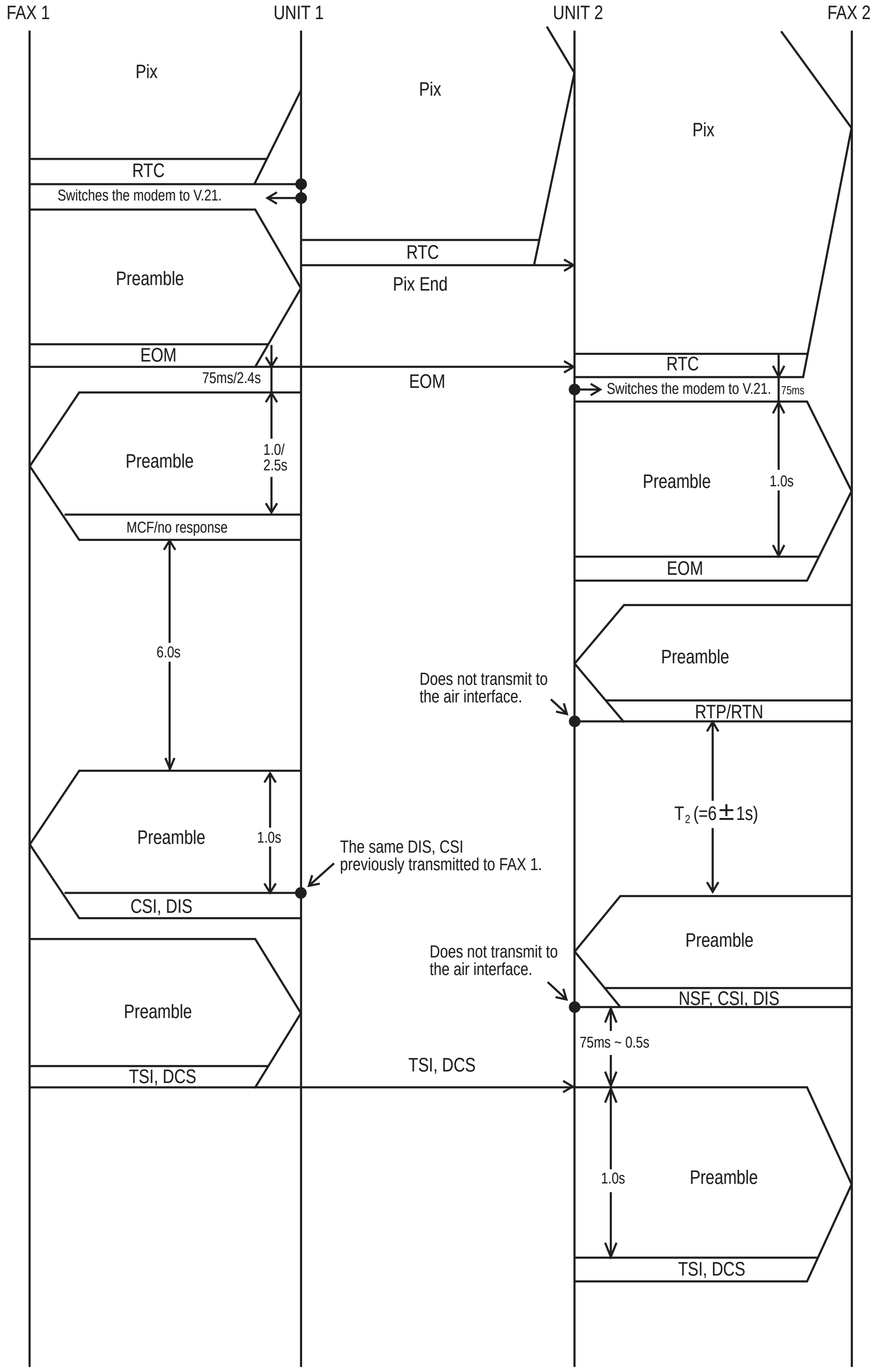


Fig. 3.4.3.4: End-of-message control sequence (when the response to EOM is RTP or RTN)

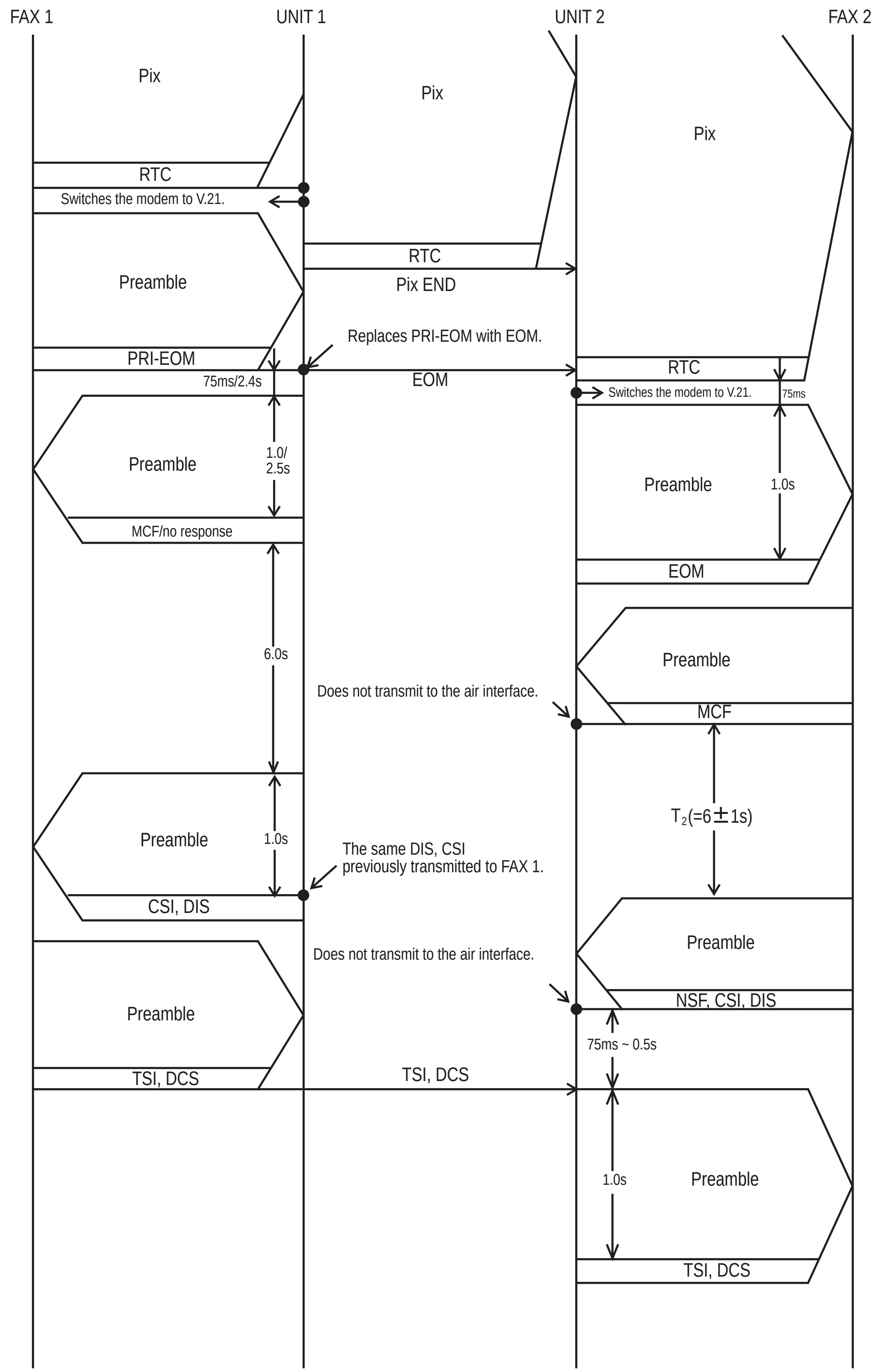


Fig. 3.4.3.5: End-of-message control sequence (for PRI-EOM)

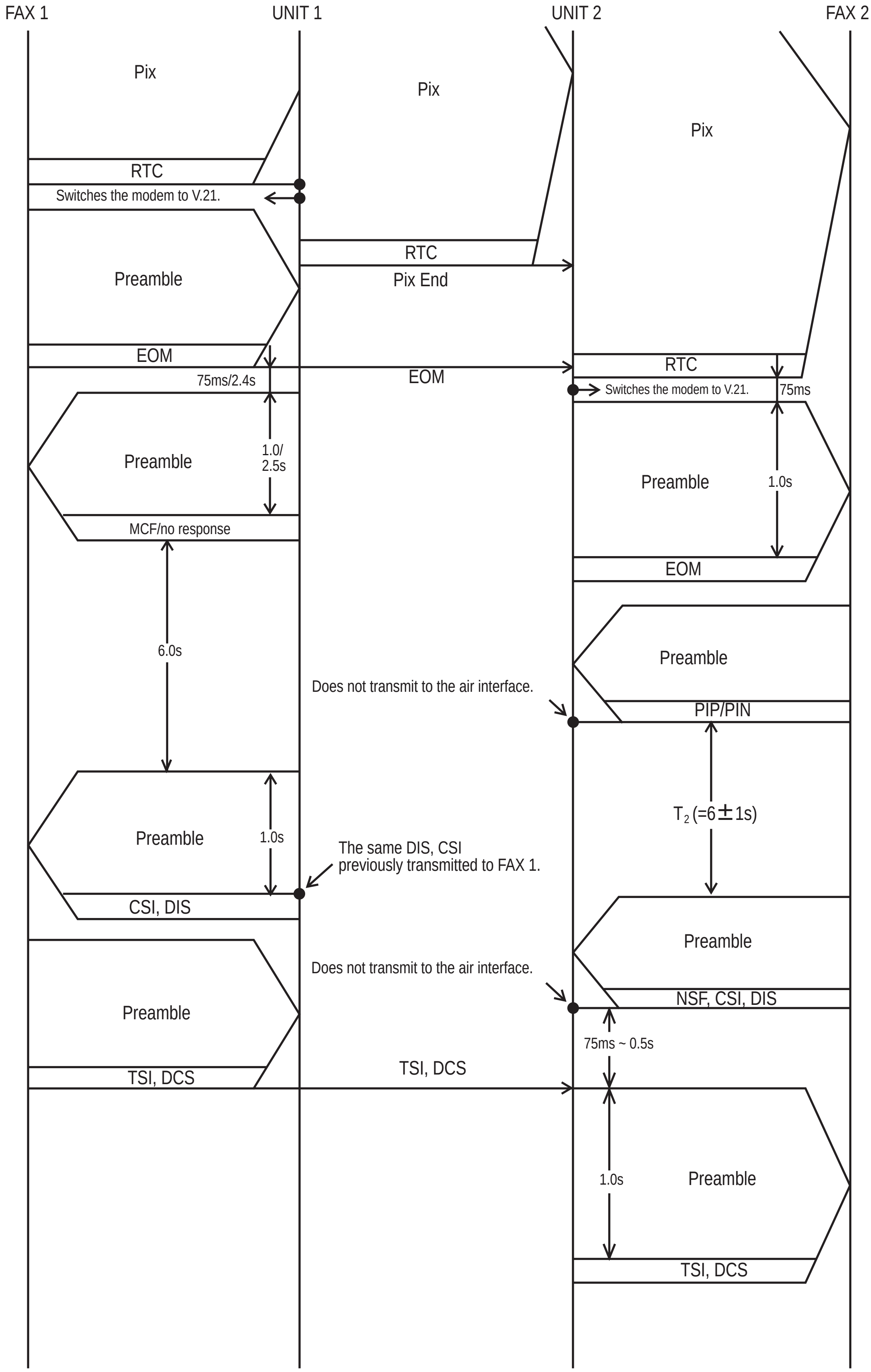


Fig. 3.4.3.6: End-of-message control sequence (when the response to EOM is PIP or PIN)

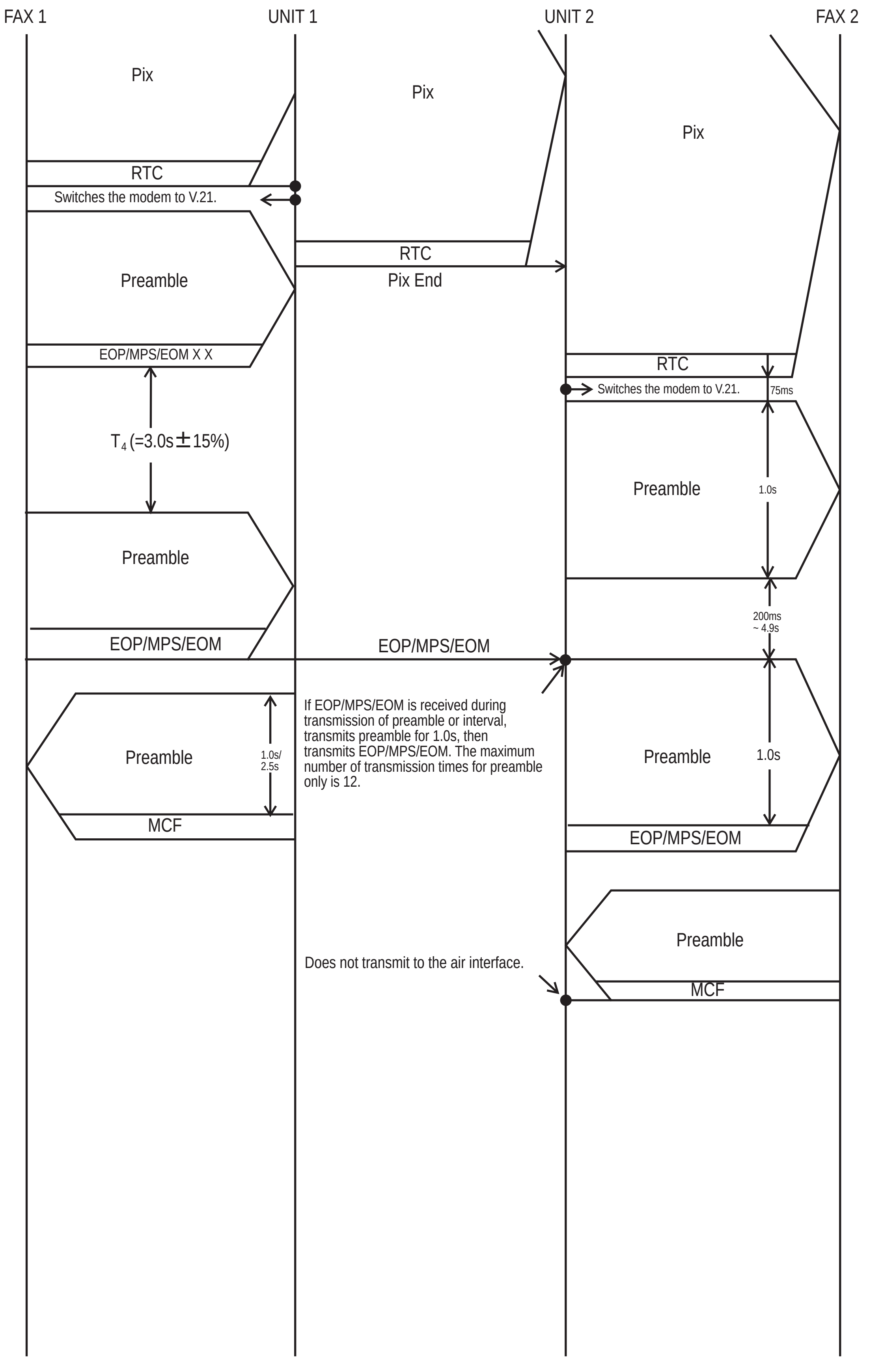


Fig. 3.4.4.1: EOP/MPS/EOM errors (1)

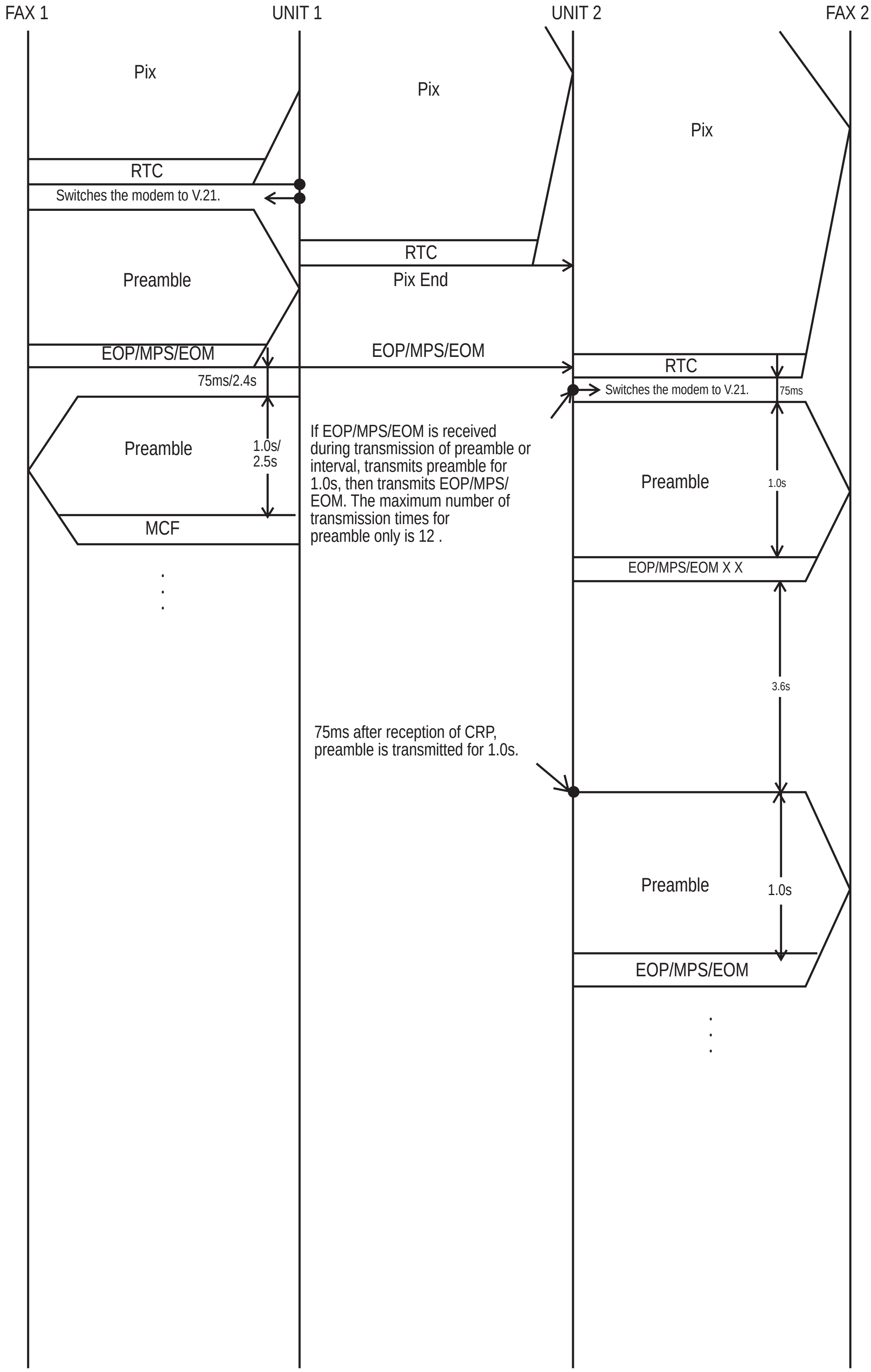


Fig. 3.4.4.2 : EOP/MPS/EOM errors (2)

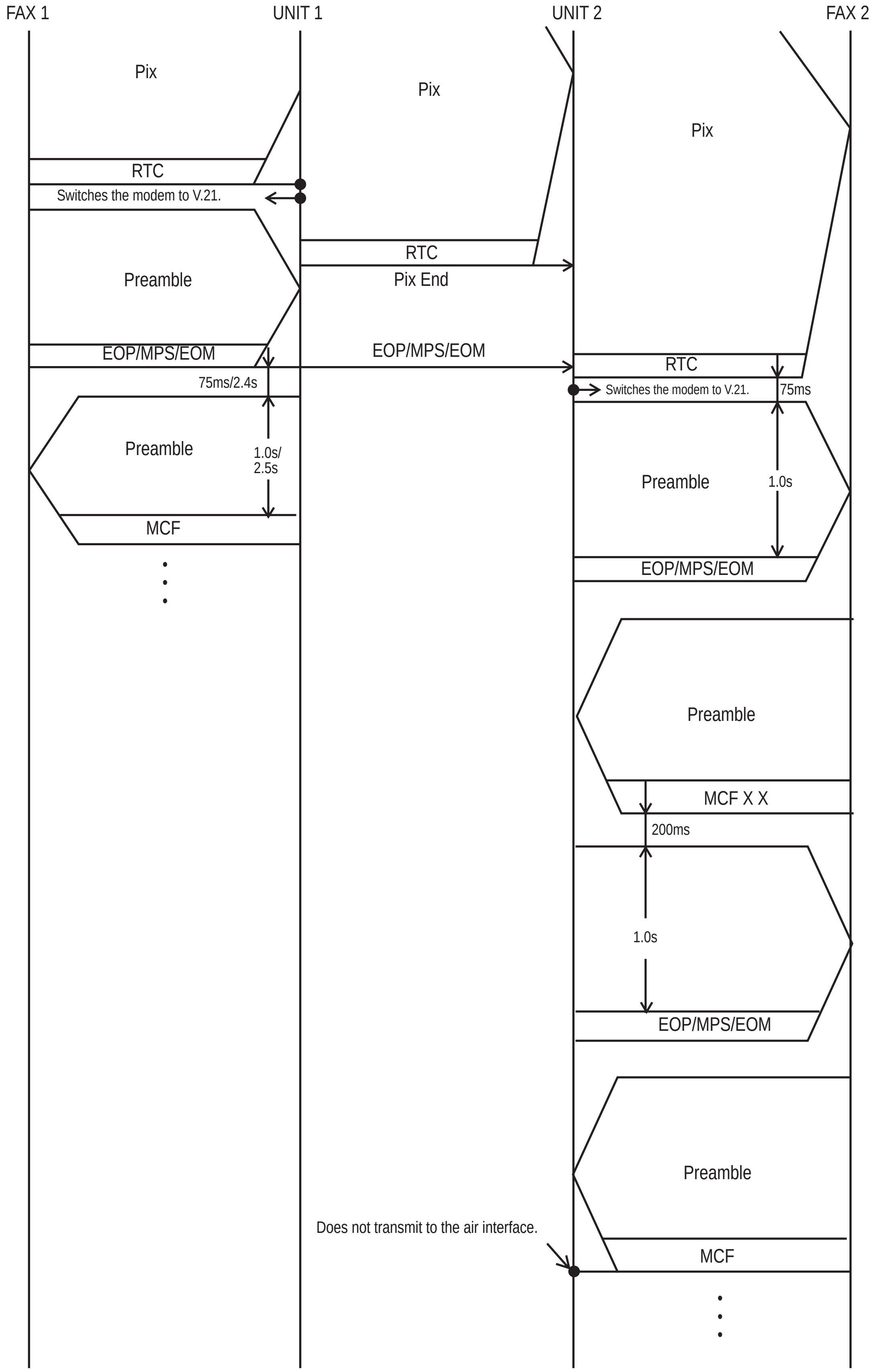


Fig. 3.4.4.3 : MCF errors (1)

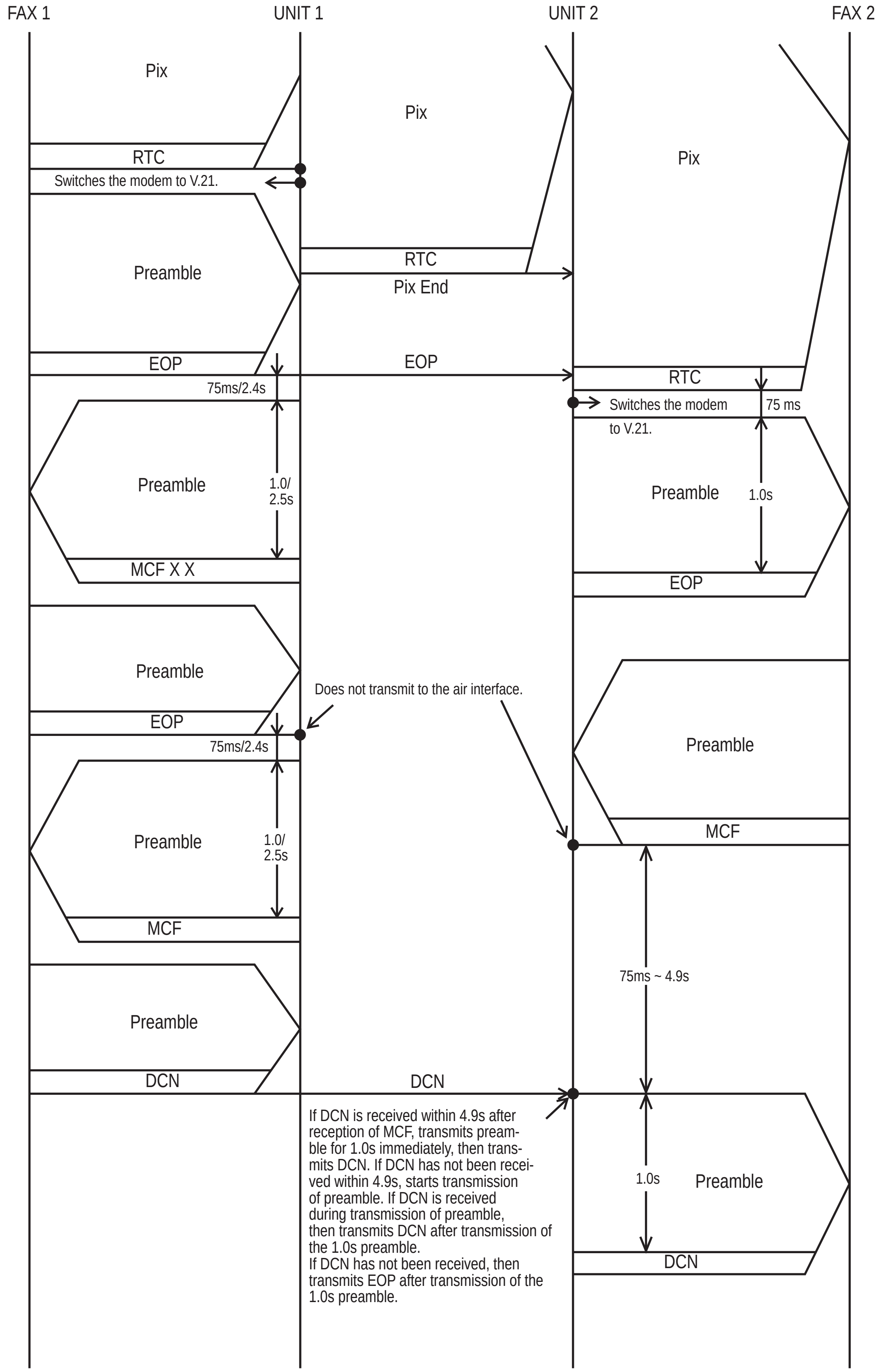


Fig. 3.4.4.4: MCF errors (2)

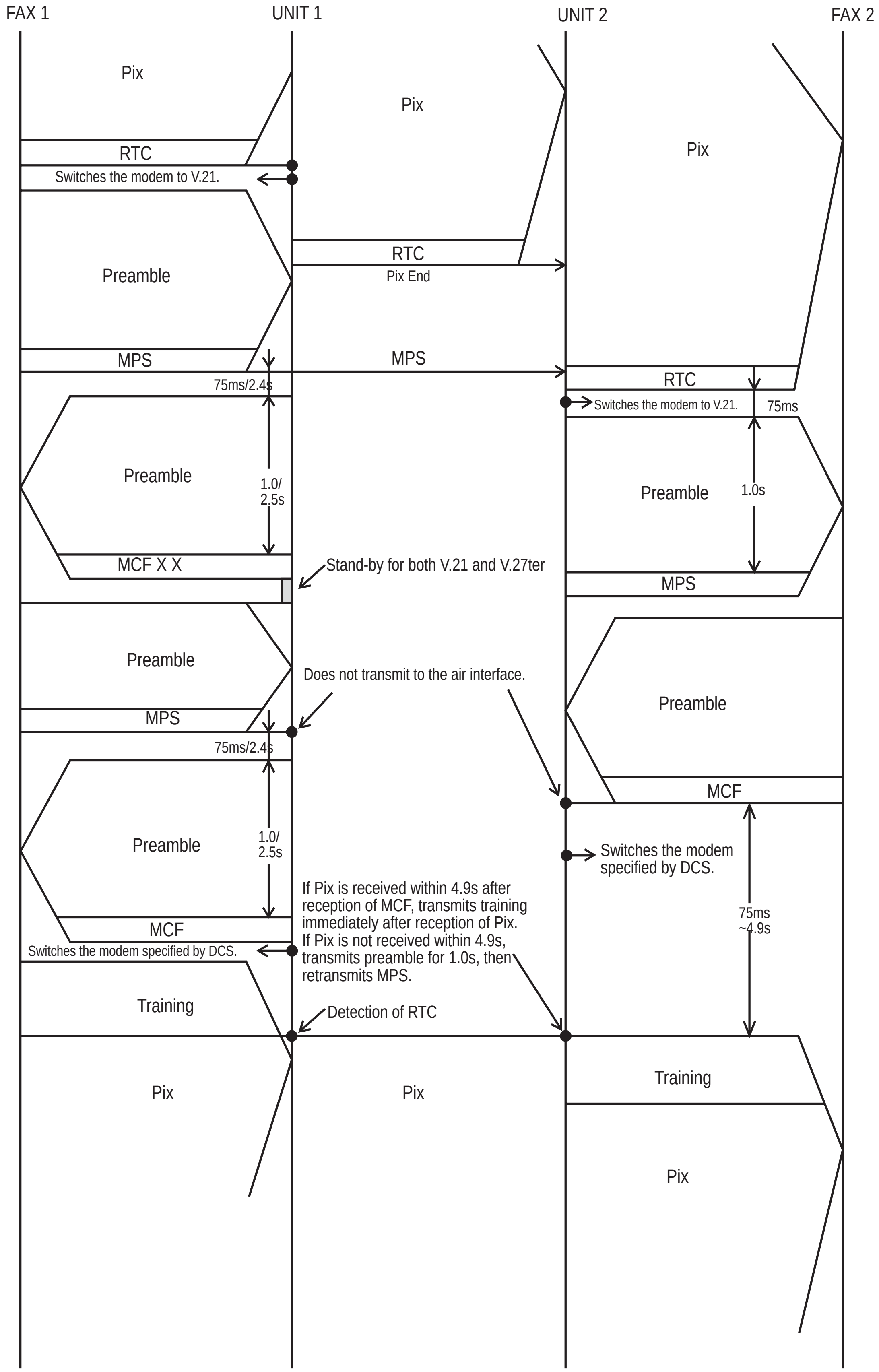


Fig 3.4.4.5: MCF errors (3)

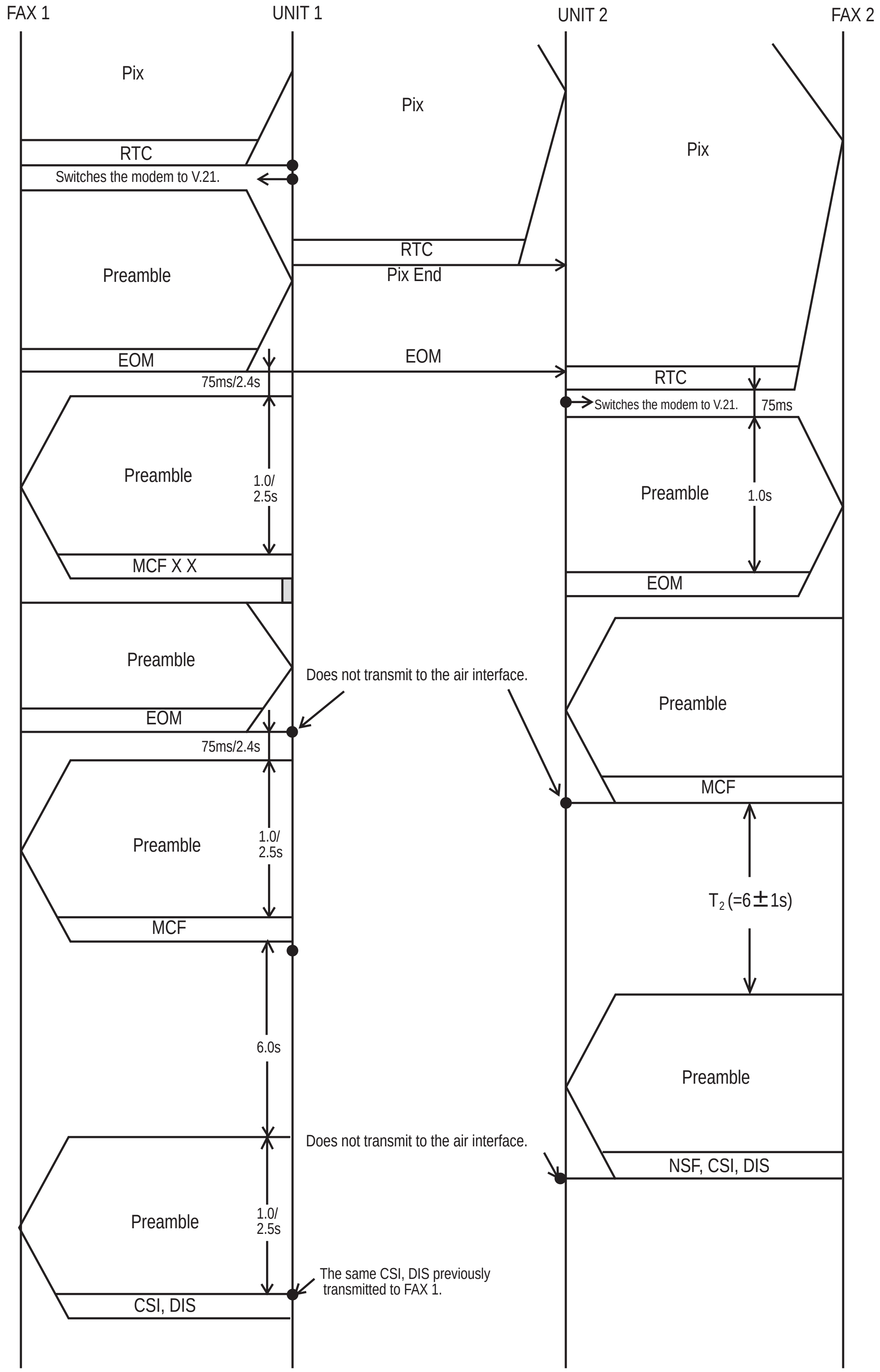


Fig 3.4.4.6 : MCF errors (4)

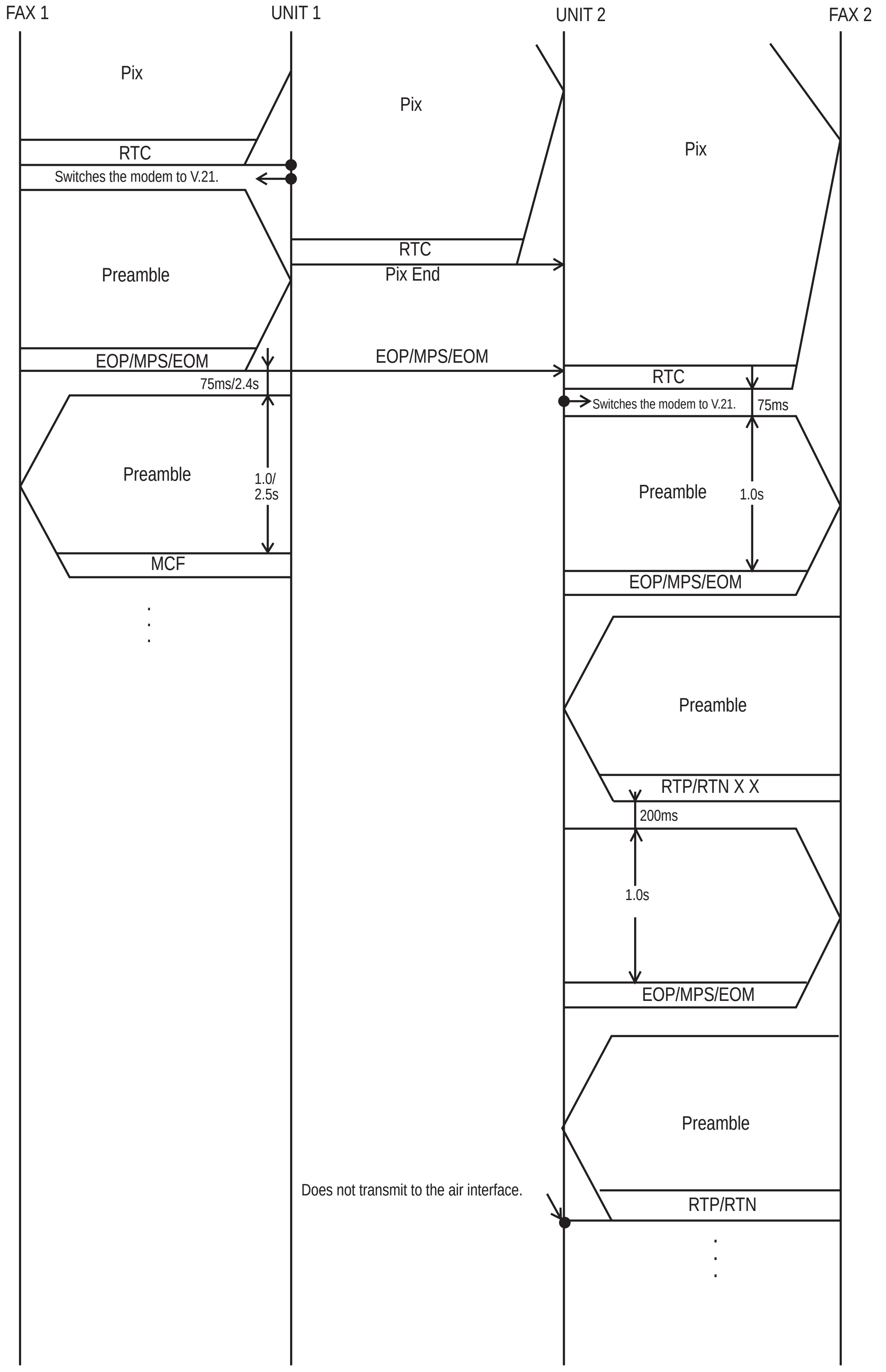


Fig 3.4.4.7 : RTP/RTN errors

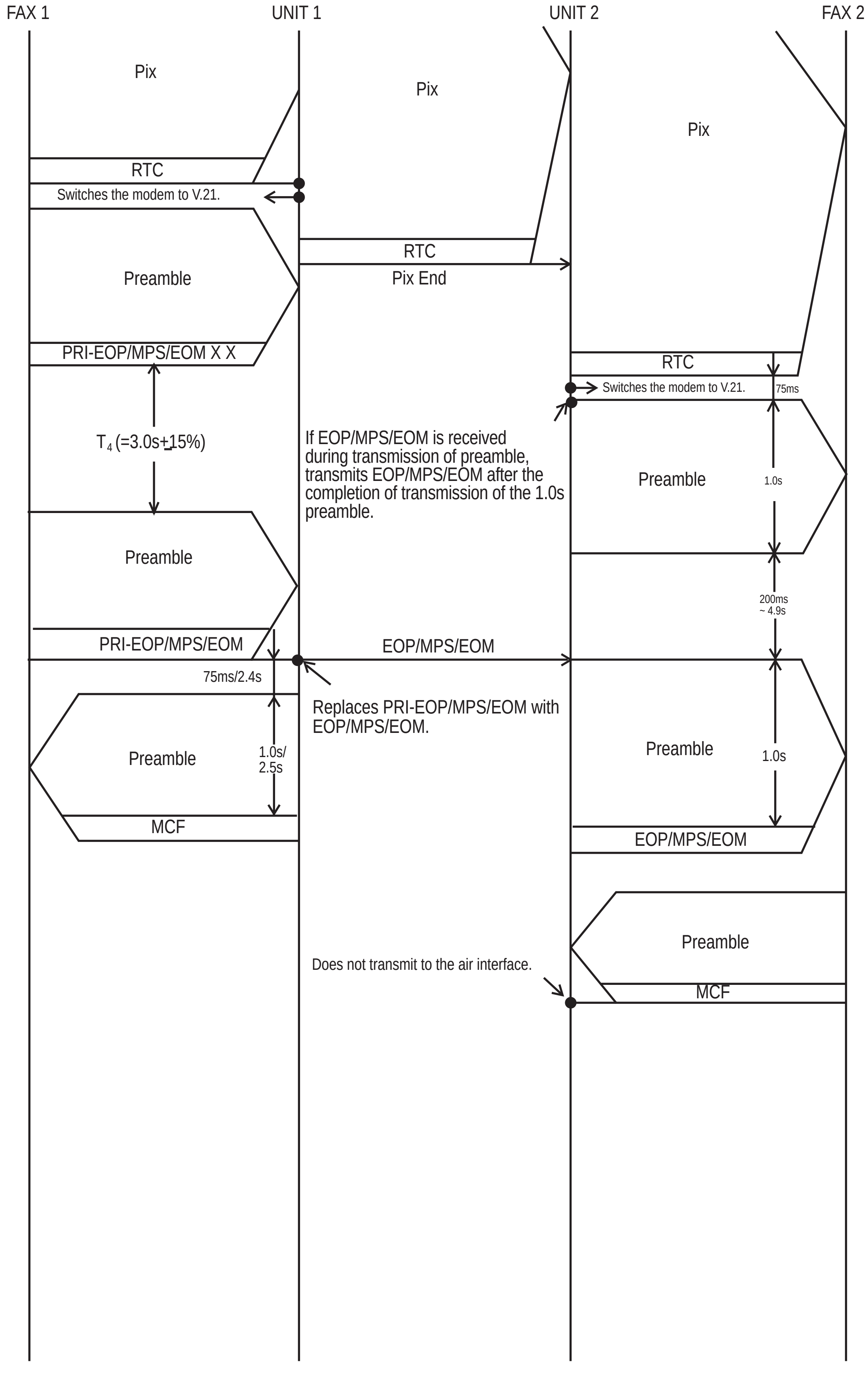


Fig. 3.4.4.8 : PRI-EOP/MPS/EOM errors

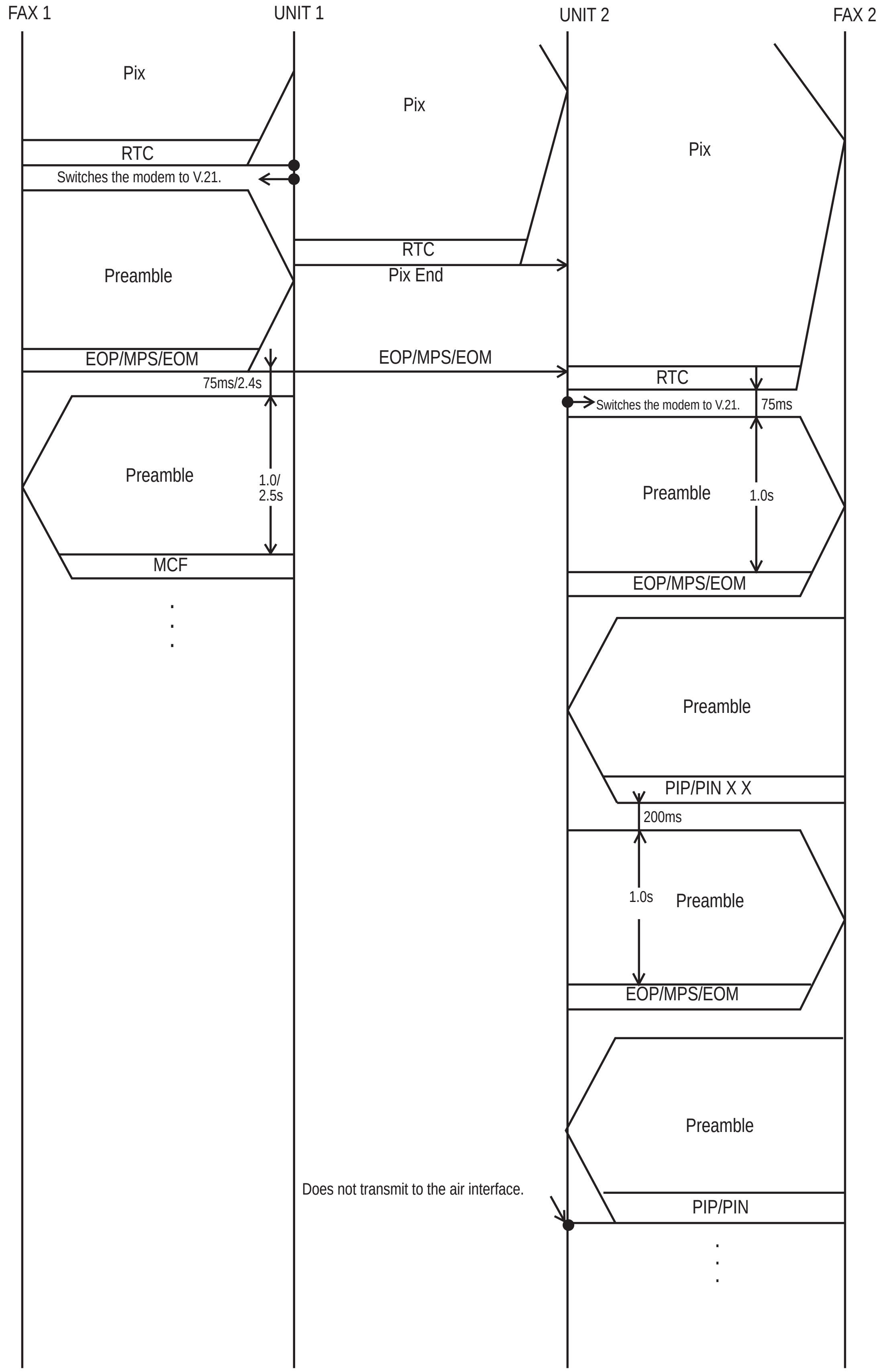


Fig 3.4.4.9 : PIP/PIN errors

Table 3.5 : Threshold values in the sequences

No.	Name	Meaning	Value
1	Pix memory overflow value [OVF]	Memory usable area value for which Pix data accumulated in the Pix memory of the image transmission unit (T) or the image reception (R) have overflown and at which OFF REQ is transmitted.	Pix memory usable area is 5 bytes or less.
2	Unit (RX) busy value [BUSY_R]	Accumulated area value for which Pix data in the Pix memory of the image reception unit (R) have increased and at which the backward channel information is set to "1".	Pix memory accumulation area is 0.7kbytes or more.
3	Unit (RX) non-busy value [FREE_R]	Accumulated area value for which Pix data in the Pix memory of the image reception unit (R) have decreased and at which the backward channel information busy flag is switched from "1" to "0".	Pix memory accumulation is 0.3 kbytes or less.
4	Unit (TX) busy value [BUSY_T]	Accumulated area value for which the reception in the image transmission unit (T) of Pix signals from FAX can not be started.	Pix memory accumulation are is 0.7 kbytes or more.
5	Unit (TX) non-busy value [FREE_T]	Accumulated area value for which the reception in the image transmission unit (T) of Pix signals from FAX can be started.	Pix memory accumulation area is 0.3 kbytes or less.
6	Fill insertion value [FILL_IN]	Accumulated area value for which Pix data in the Pix memory of the image reception unit (R) are insufficient and at which insertion of fill in the Pix signals transmitted to FAX is started.	Pix memory accumulation area is 0.28 kbytes or less.
7	Fill insertion cancel value [FILL_OUT]	Accumulated area value for which Pix data in the Pix memory for the image reception unit (R) have increased and the insertion of fill is canceled.	Pix memory accumulation area is 0.6 kbytes or more.
8	Transmission start (radio) value [SEND_RADIO]	Accumulated area value at which Pix signals are transmitted from the image transmission unit (T) to the air interface.	Pix memory accumulation area is 24 bytes or more.
9	Transmission start (FAX) value [SEND_FAX]	Accumulated area value at which training signals are transmitted to FAX from the image signal transmission modem of the image reception unit (R).	Pix memory accumulation area is 24 bytes or more.
10	Forced RTC transmission value [RTC_IN]	Number of accumulated image bytes at which an RTC signal is transmitted to FAX from the image reception unit (R) and the image is forcibly terminated.	Number of accumulated image bytes in Pix memory is 7 or less.
11	Modulo number [M]	――――――	32
12	Outstanding number [N]	――――――	31

Table 3.6.1.1 : Air interface signals

Signal	Bit format
TCF Error Detection	01100000
CED Start	01100010
Pix End	01100001

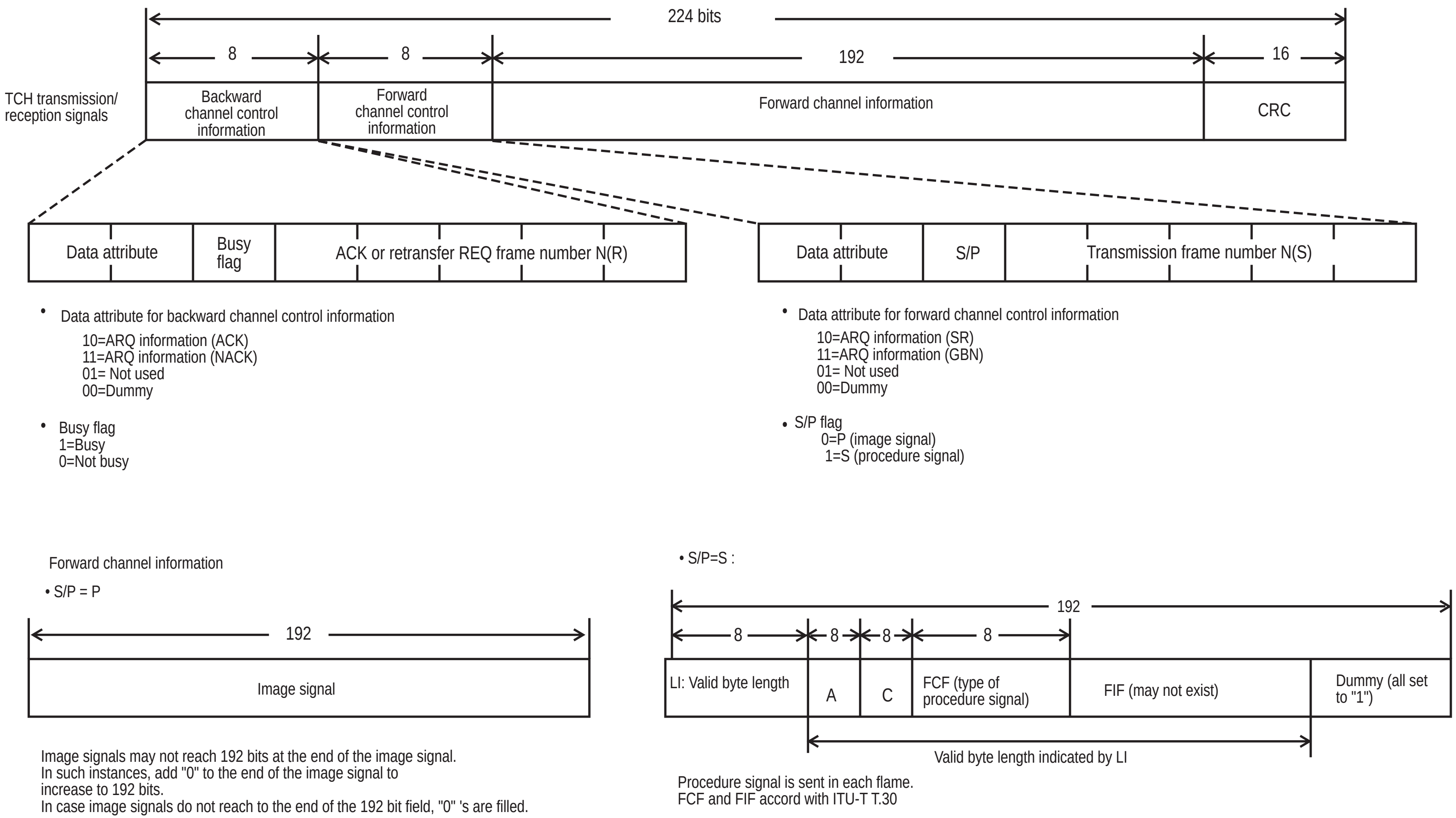


Fig. 3.6.1.1 : ARQ frame structure

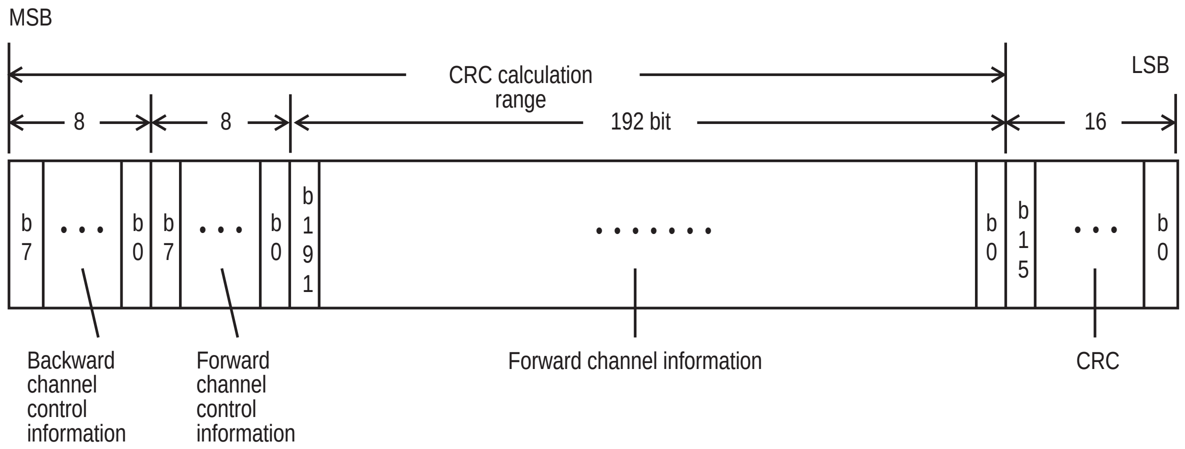


Fig. 3.6.1.2.1 : Structure of one frame

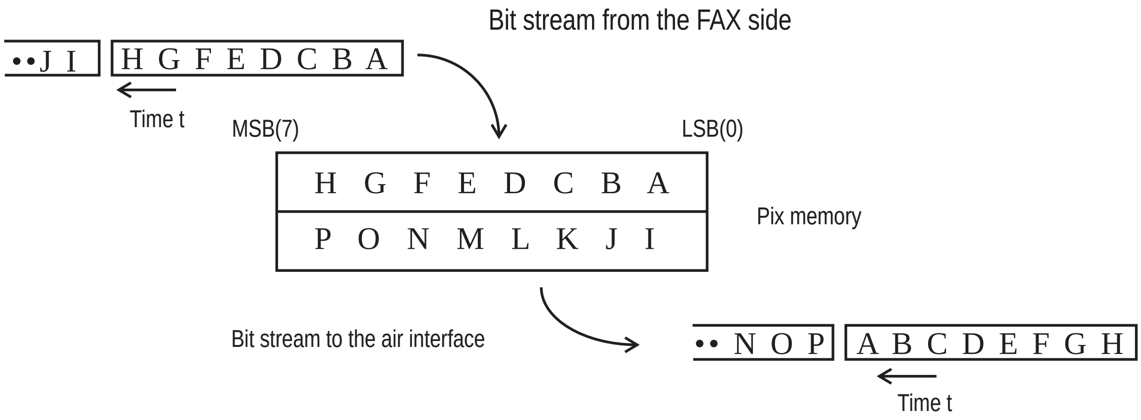


Fig. 3.6.1.2.2.1 : Image signal bit transmission order

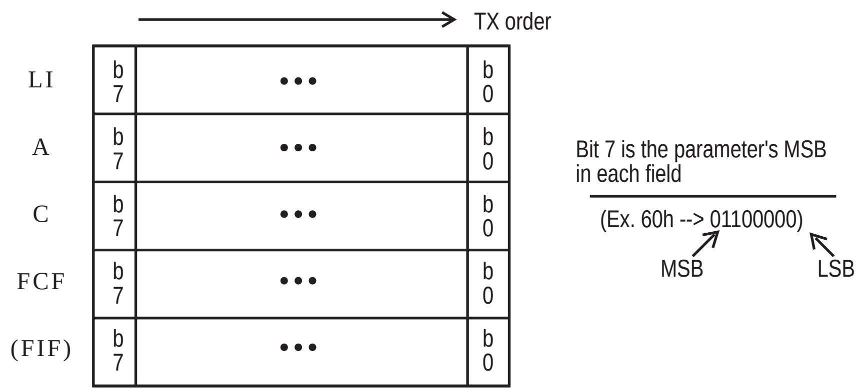


Fig. 3.6.1.2.2.2 : Procedure signal bit transmission order

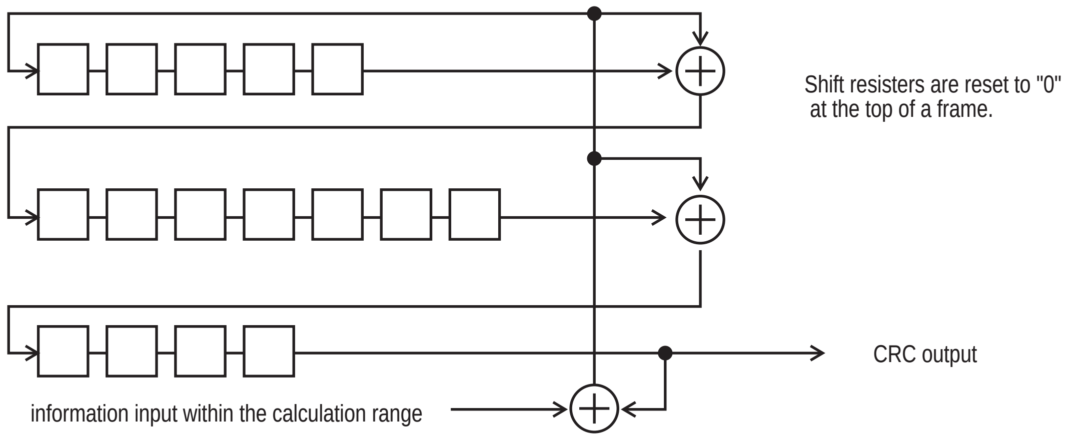


Fig. 3.6.1.2.3 : CRC coding method

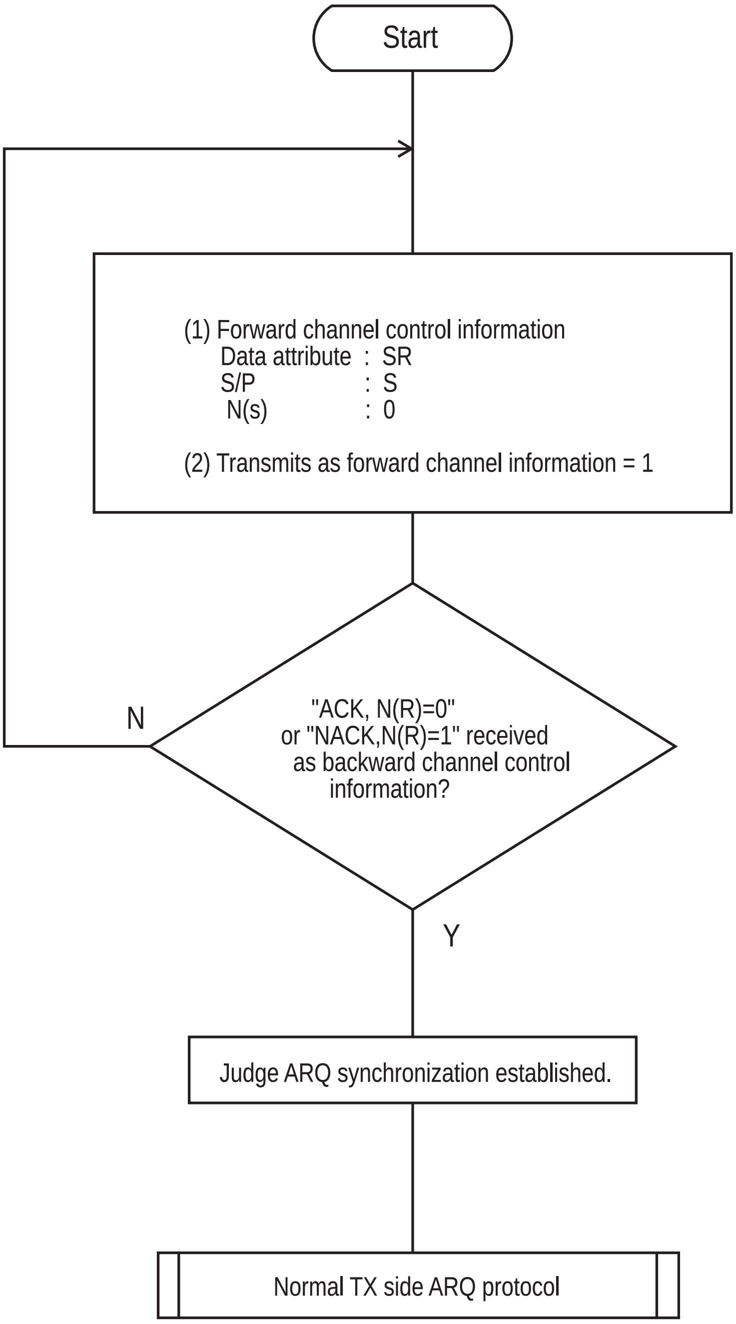


Fig. 3.6.2.1.1 : Transmission side synchronization establishment control flow

Reception side ARQ protocol

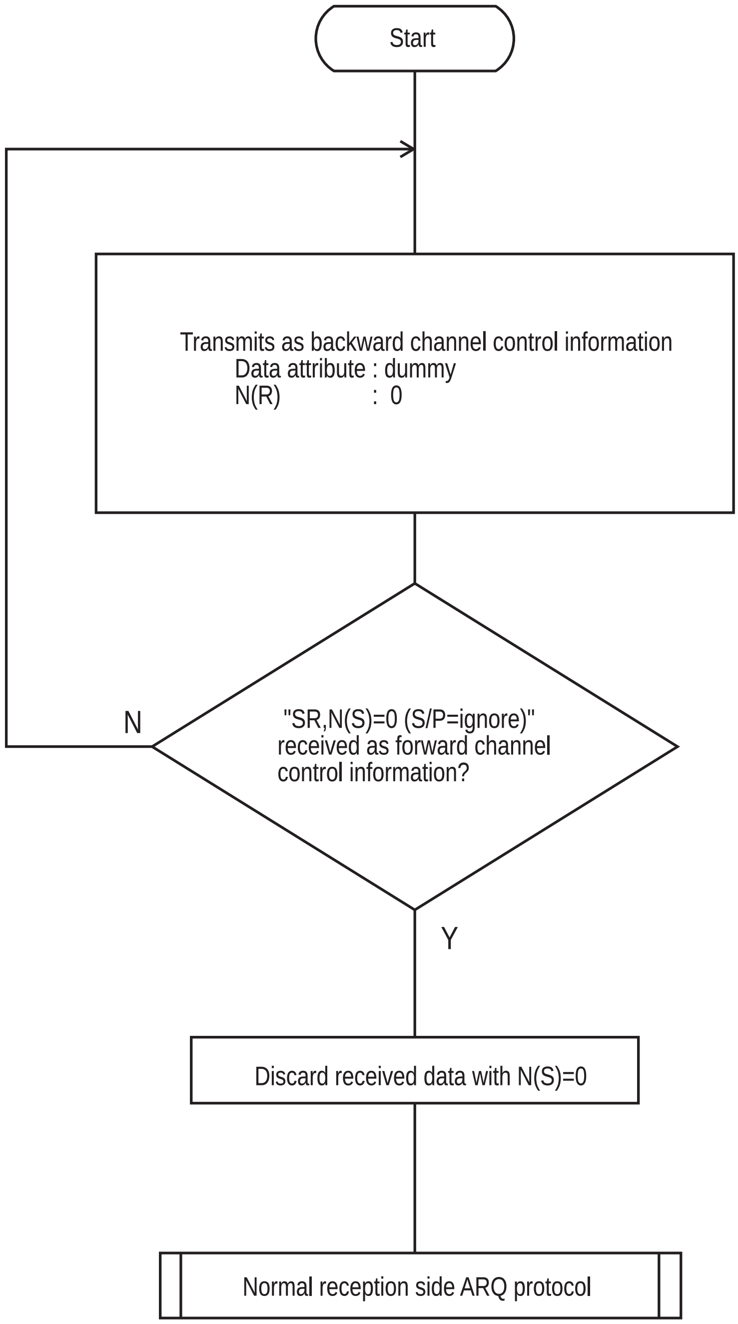
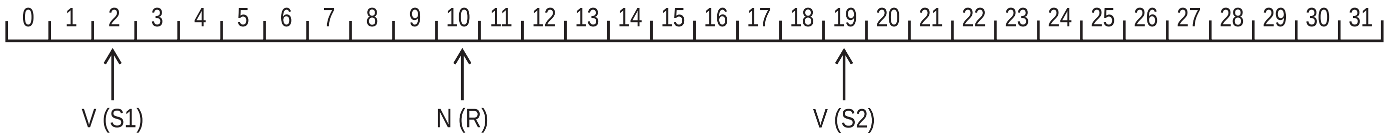


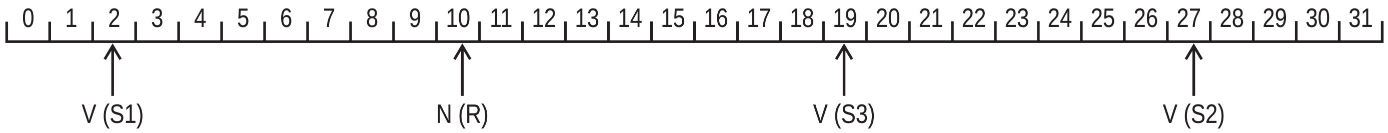
Fig. 3.6.2.1.2 : Reception side synchronization establishment control flow

SR Mode



V(S1) : Oldest unacknowledged frame number
V(S2) : Latest unacknowledged frame number
N(S) : Frame number transmitted by forward channel
N(R) : Frame number received by backward channel

GBN Mode



V(S3) : Transmission frame number in GBN mode

Fig. 3.6.2.2.1 : Transmission side control parameter

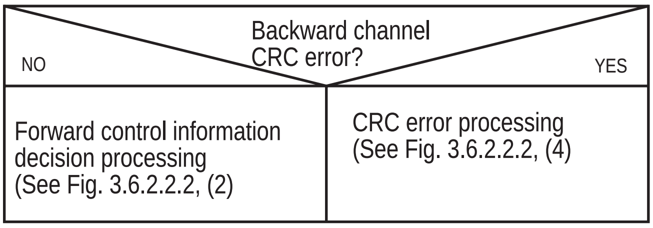
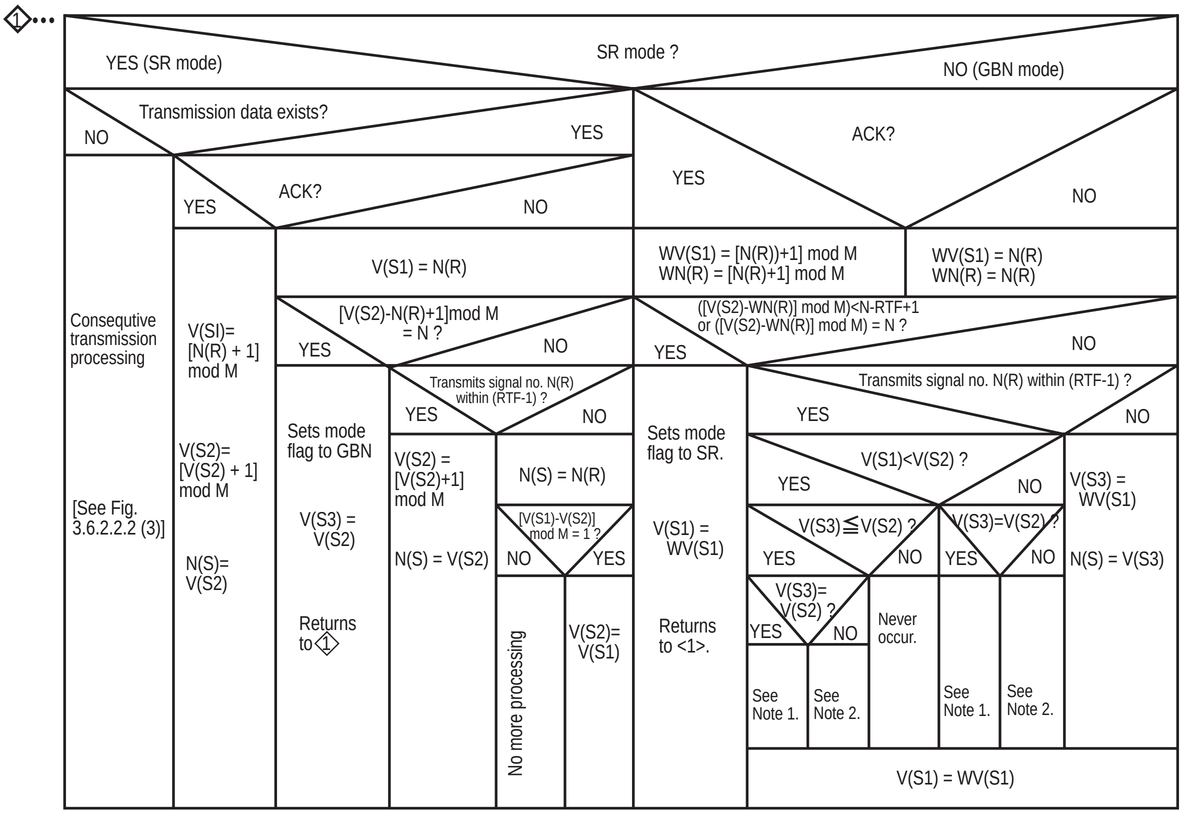


Fig. 3.6.2.2.2 (1) : Data transmission control sequence



Temporary save area of V(S1):WV(S1)
Temporary save area of N(R):WN(R)

Note 1 : When V(S3)=V(S2):
°V(S3)=WV(S1)
°N(S)=V(S3)
Note 2 : When V(S3)<V(S2):
°V(S3)=[V(S3)+1]modM
°N(S)=V(S3)
When 0≤V(S3)<V(S2), or V(S1)≤V(S3)≤N:
°V(S3)=[V(S3)+1]modM
°N(S)=V(S3)

Fig. 3.6.2.2.2 (2) : Data transmission control sequence (forward control information decision processing)

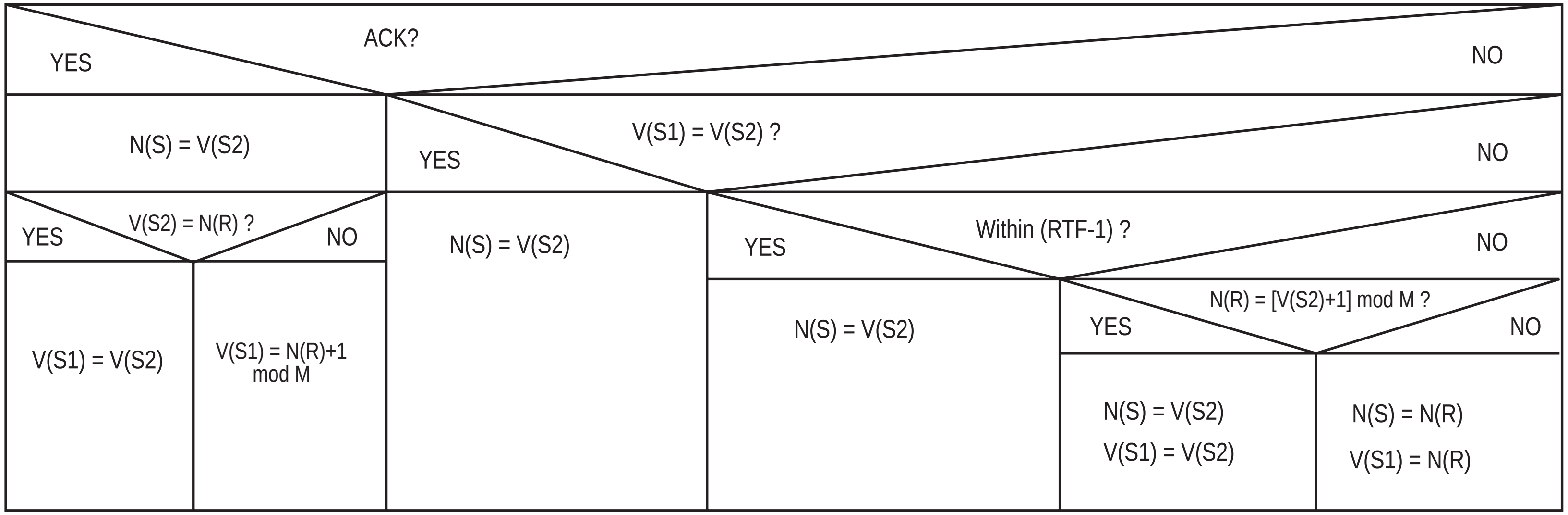


Fig. 3.6.2.2.2 (3) : Data transmission control sequence (consecutive transmission processing)

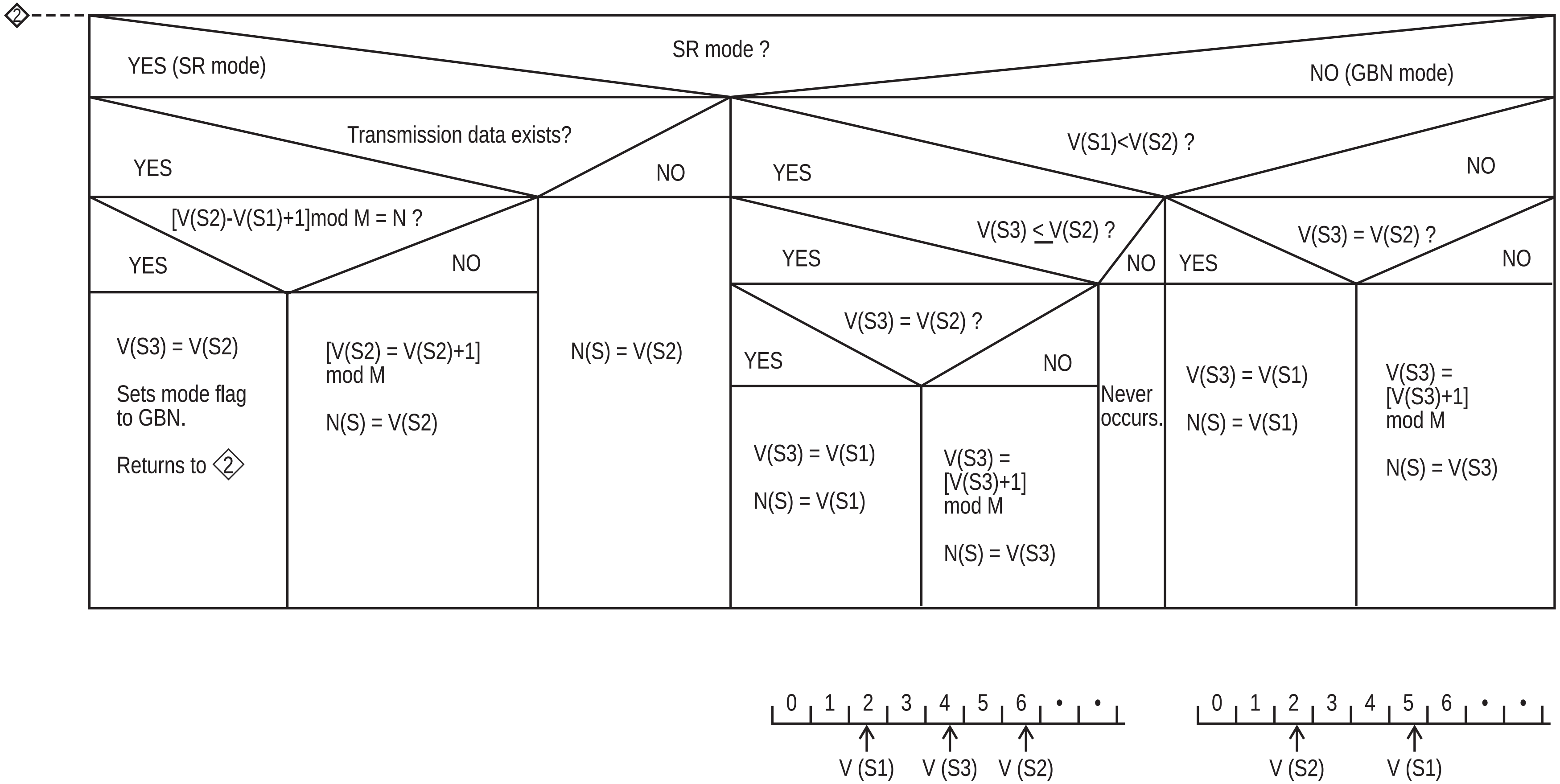
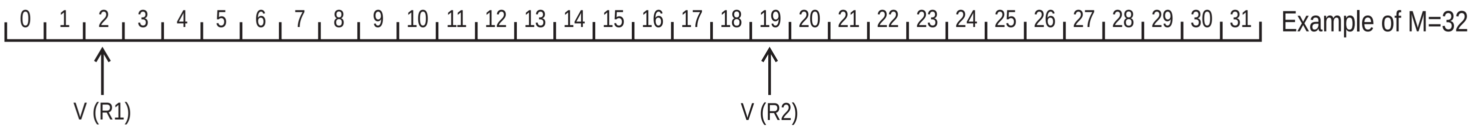


Fig. 3.6.2.2.2 (4) : Data transmission control sequence (CRC error processing)



Control parameters

V(R1) : Oldest non-reception frame number
V(R2) : Latest non-reception frame number
N(S) : Frame number received with forward channel
N(R) : Frame number to be transmitted by backward channel

Positional relationship between N(S), V(R1) and V(R2) can occur as the following four cases:

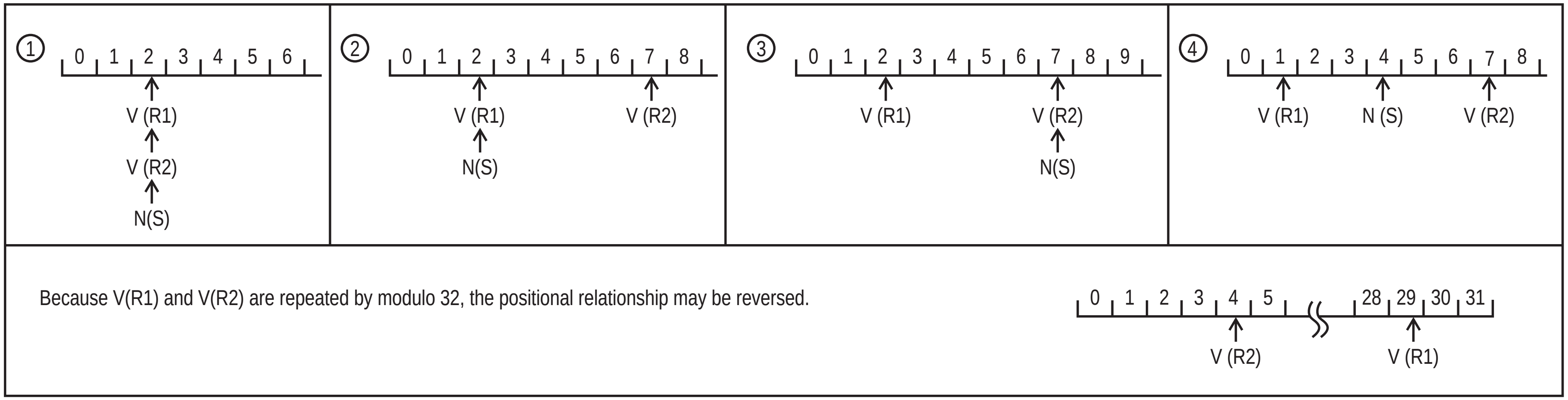


Fig. 3.6.2.3.1 : Reception side control parameters

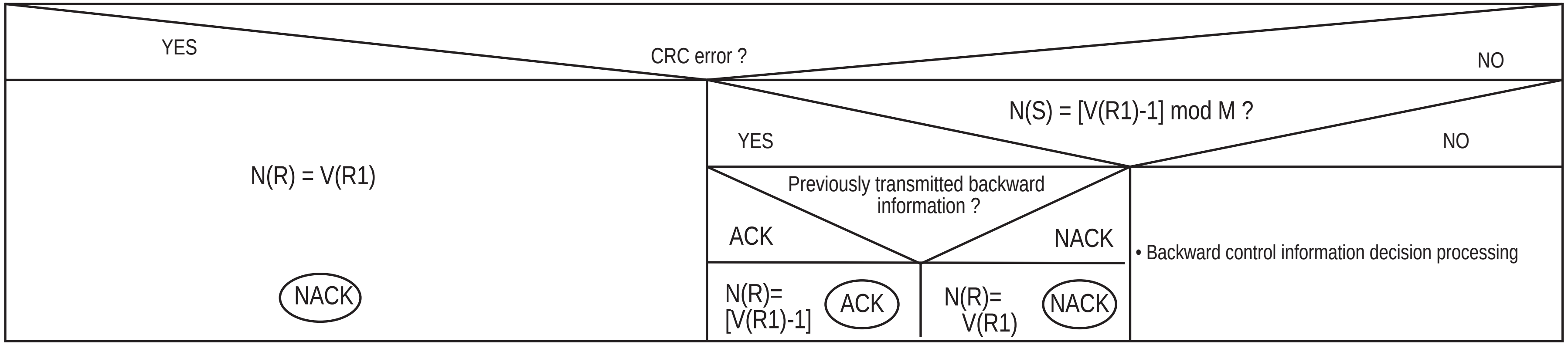
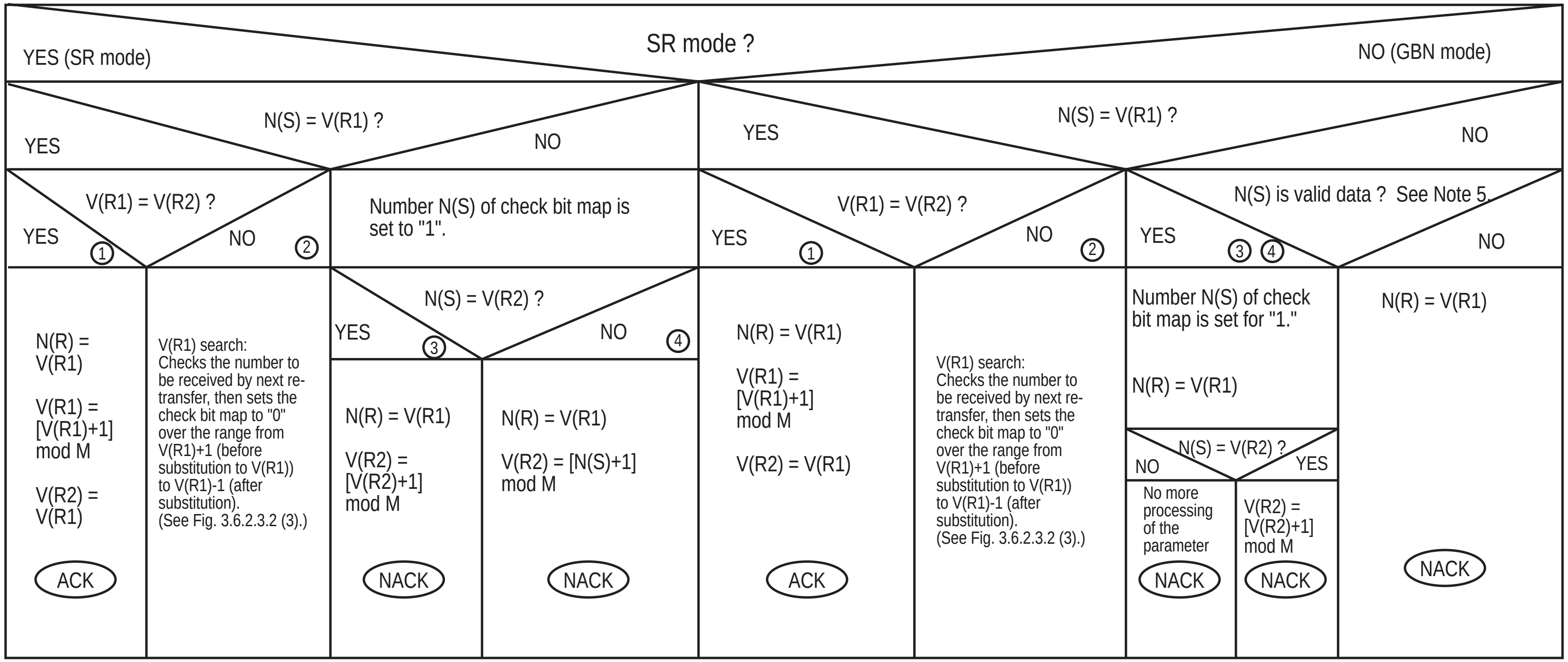


Fig. 3.6.2.3.2 (1) : Data reception control sequence

① to ④ correspond to the four positional relationships between N(S), V(R1) and V(R2).



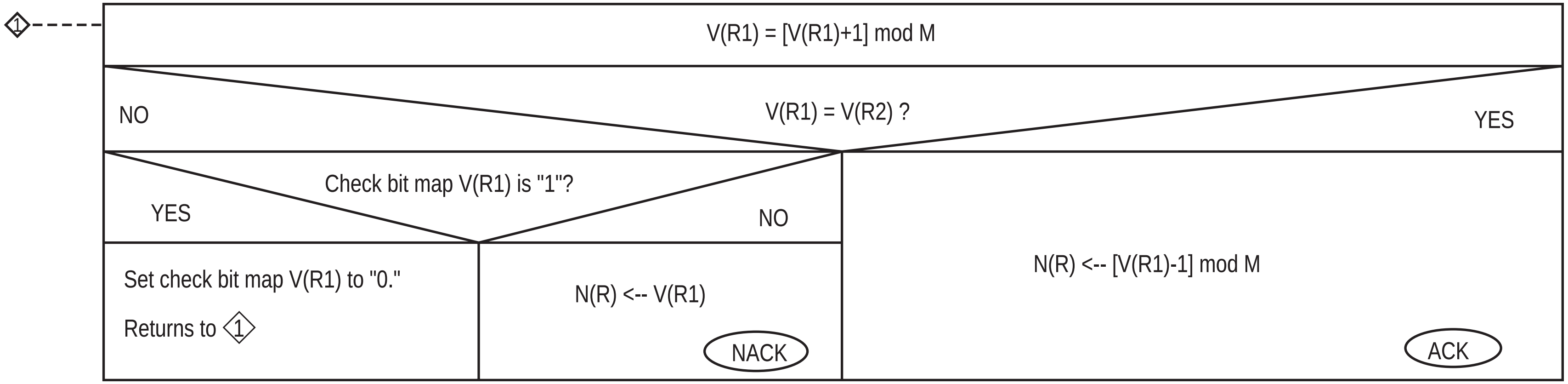
Note 5: Valid data is

(1) When V(R1) = V(R2), no valid data exists.

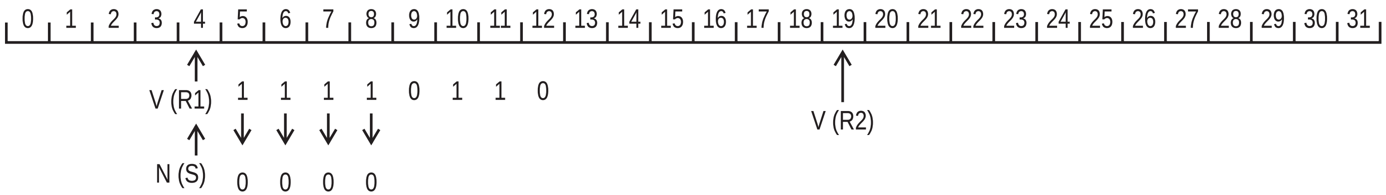
(2) When V(R1) < V(R2), V(R1)<N(S)≦V(R2).

(3) When V(R2) < V(R1), 0≦N(S)≦V(R2) or V(R1)<N(S)≦31

Fig. 3.6.2.3.2 (2) : Data reception control sequence (backward control information decision processing)



Reception check bit map



Reception check bit map

Content of bits ------- "0" : Unacknowledged
"1" : Acknowledged

Valid range of the content of bits: Between V(R1) and V(R2).

Fig. 3.6.2.3.2 (3) : Data reception control sequence (V(R1) search processing)

4. V.42 Annex modem communication procedures

4.1 Communication procedures

The modem communication procedures are shown in Fig. 4.1.

The activation and deactivation procedures are the same as for G3 facsimile communications and are shown in Chapter 2. Communication procedures, ranging from physical connection procedures to disconnection procedures are in accordance with the ITU-T V.22 bis, V.25 and V.42 Annex.

Details of each procedure are described in the following sections.

4.2 Physical connection procedures

4.2.1 Normal sequence

The physical connection procedure for modem units is shown in Fig. 4.2.1

Normal connections are not ensured as totally reliable for the modes wherein both modems1 and 2 function as responders, or where both modems 1 and 2 function as initiators.

4.2.2 Semi-normal sequence

The procedures for semi-normal sequence (FEC operation not established) are shown in Figs. 4.2.2.1 and 4.2.2.2.

4.3 Protocol establishment procedures

4.3.1 Normal sequence

The protocol establishment procedures for V.42 Annex modem units is shown in Fig. 4.3.1.1.

- Fig. 4.3.1.2 shows the flow for parameter negotiation.

  LR parameters for initiator units are listed in Table 4.3.1.

- Fig. 4.3.1.3 shows the synchronous/asynchronous switching flow for V.22bis modem for initiator units.

- Fig. 4.3.1.4 shows the synchronous/asynchronous switching flow for V.22bis modem for responder units.

- Fig. 4.3.1.5 shows the 48s timer start-up and stop algorithm for initiator units.

- Fig. 4.3.1.6 shows the 48s timer start-up and stop algorithm for responder units.

- Fig. 4.3.1.7 shows the LRC non-detection timer start-up and stop algorithm.

4.3.2 Semi-normal sequence

The semi-normal sequence procedures are shown in Figs. 4.3.2.1 to 4.3.2.19.

4.4 Disconnection procedure

4.4.1 Normal sequence

The disconnection sequence for V.42 Annex modems is shown in Fig. 4.4.1.

4.4.2 Semi-normal sequence

The semi-normal sequence procedures are shown in Figs. 4.4.2.1 to 4.4.2.4.

4.5 Error control

4.5.1 Frame structure

The frame used for V.42 Annex modem communications consists of 1120 bits and is independent from the frame structure used on the TCH in the the air interface.

The frame structure is shown in Fig. 4.5.1.

4.5.2 Synchronization control

The frame synchronization pull-in condition shall be to detect a frame sync pattern one time without guard. The out-of-sync condition set at guard 8 levels.

The transmission side stuff synchronization control flow is shown in Fig. 4.5.2.1.

The reception side stuff synchronization control flow is shown in Fig. 4.5.2.2.

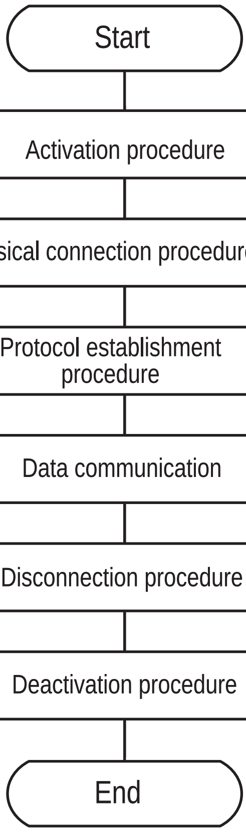


Fig. 4.1: V.42 Annex modem communication procedure

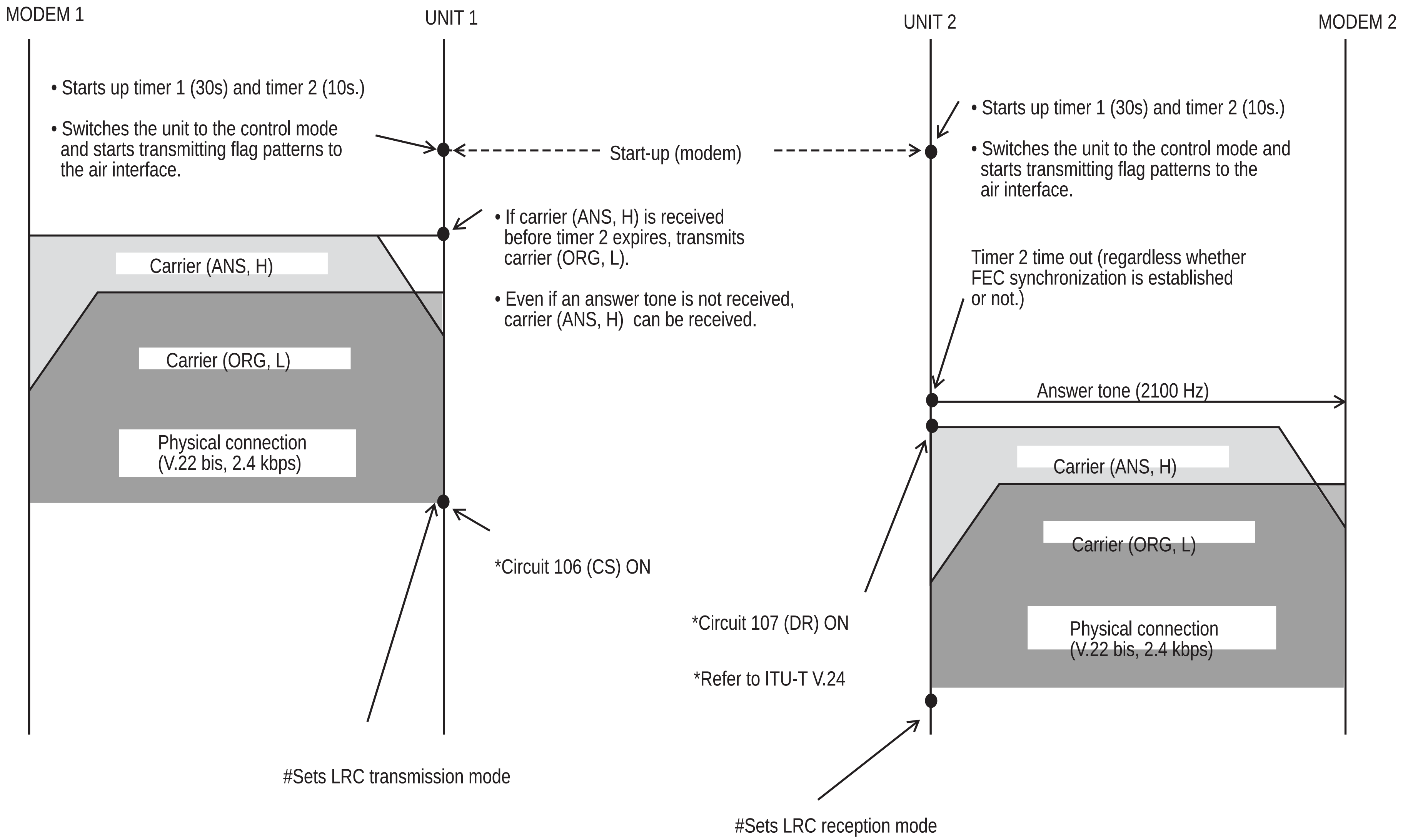


Fig. 4.2.1 : Physical connection procedure
• MODEM 1 responder operation
• MODEM 2 initiator operation

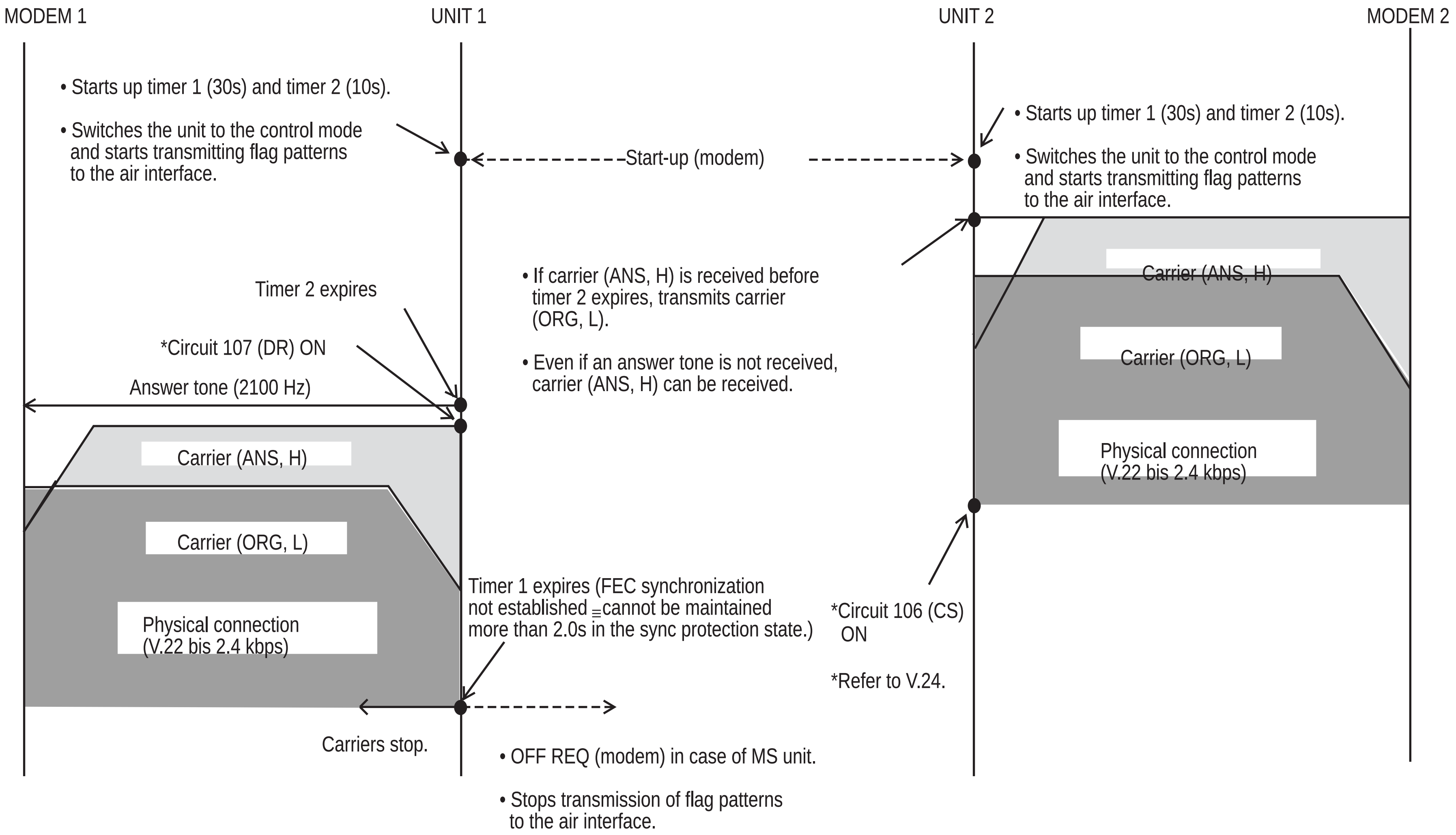


Fig. 4.2.2.1 : Physical connection procedure (FEC operation not established [1])
• MODEM 1 initiator operation
• MODEM 2 responder operation

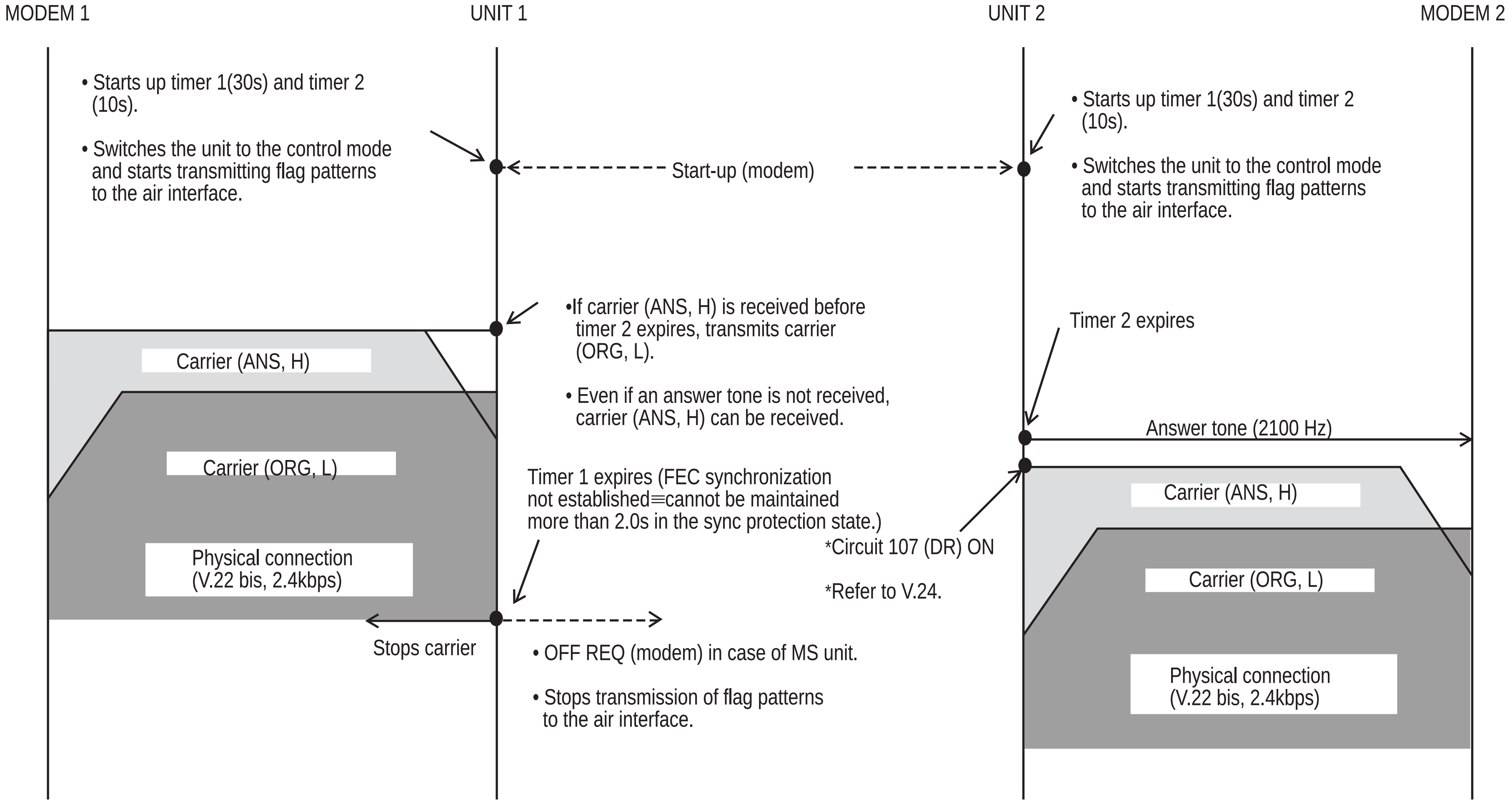
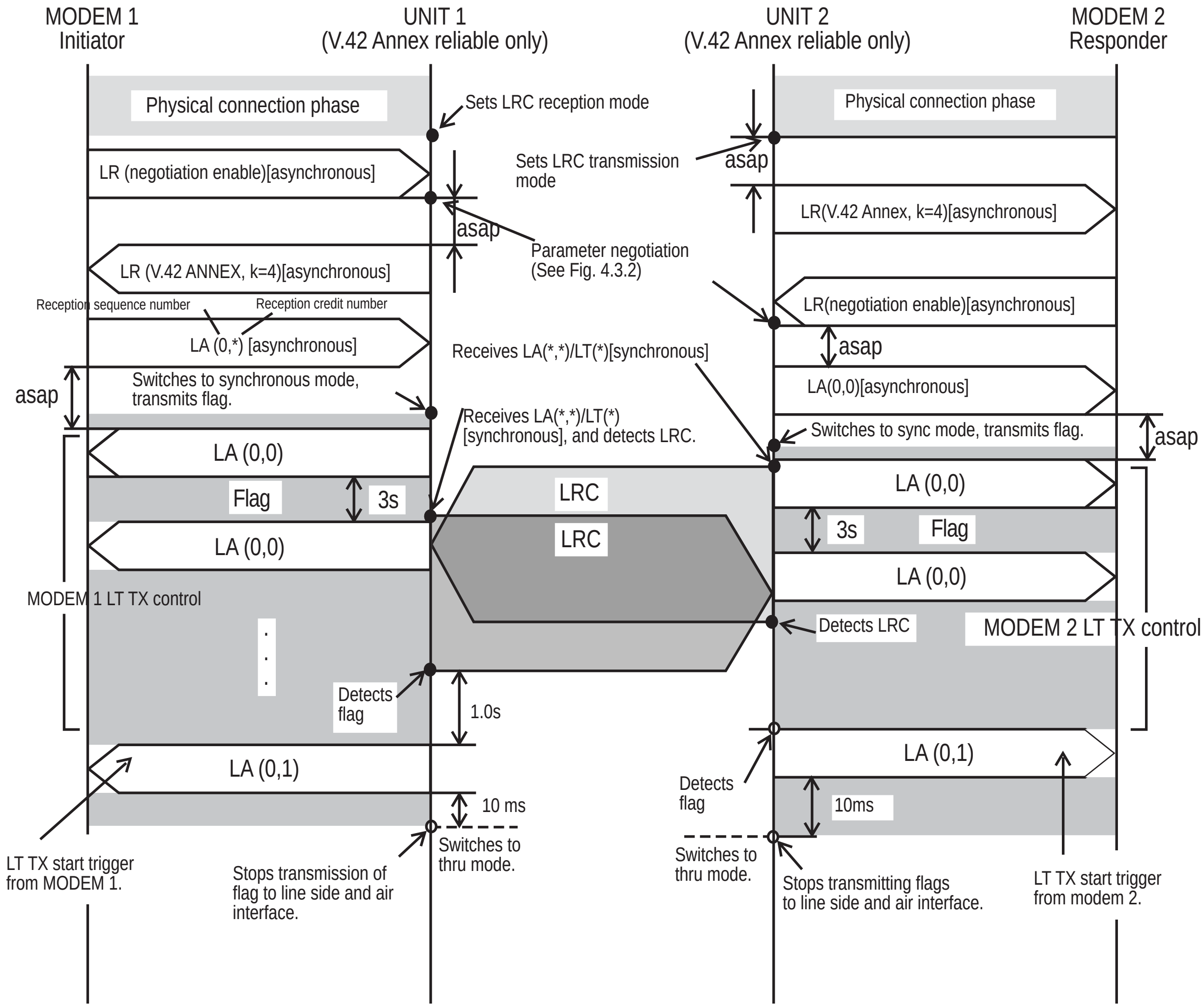


Fig. 4.2.2.2 : Physical connection procedures (FEC operation not established [2])
MODEM 1 responder operation
MODEM 2 initiator operation



LR parameter : See Table 4.3.1
LRC bit map : AAh AAh
Definition of detection of flag : Detecting a flag (7Eh)
in consecutive 6 bytes.

LRC signalling format
(in accordance with HDLC) :

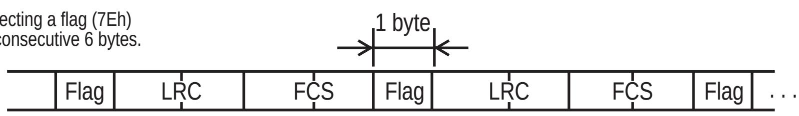


Fig. 4.3.1.1 : Protocol establishment procedure
• MODEM 1 initiator operation
• MODEM 2 responder operation

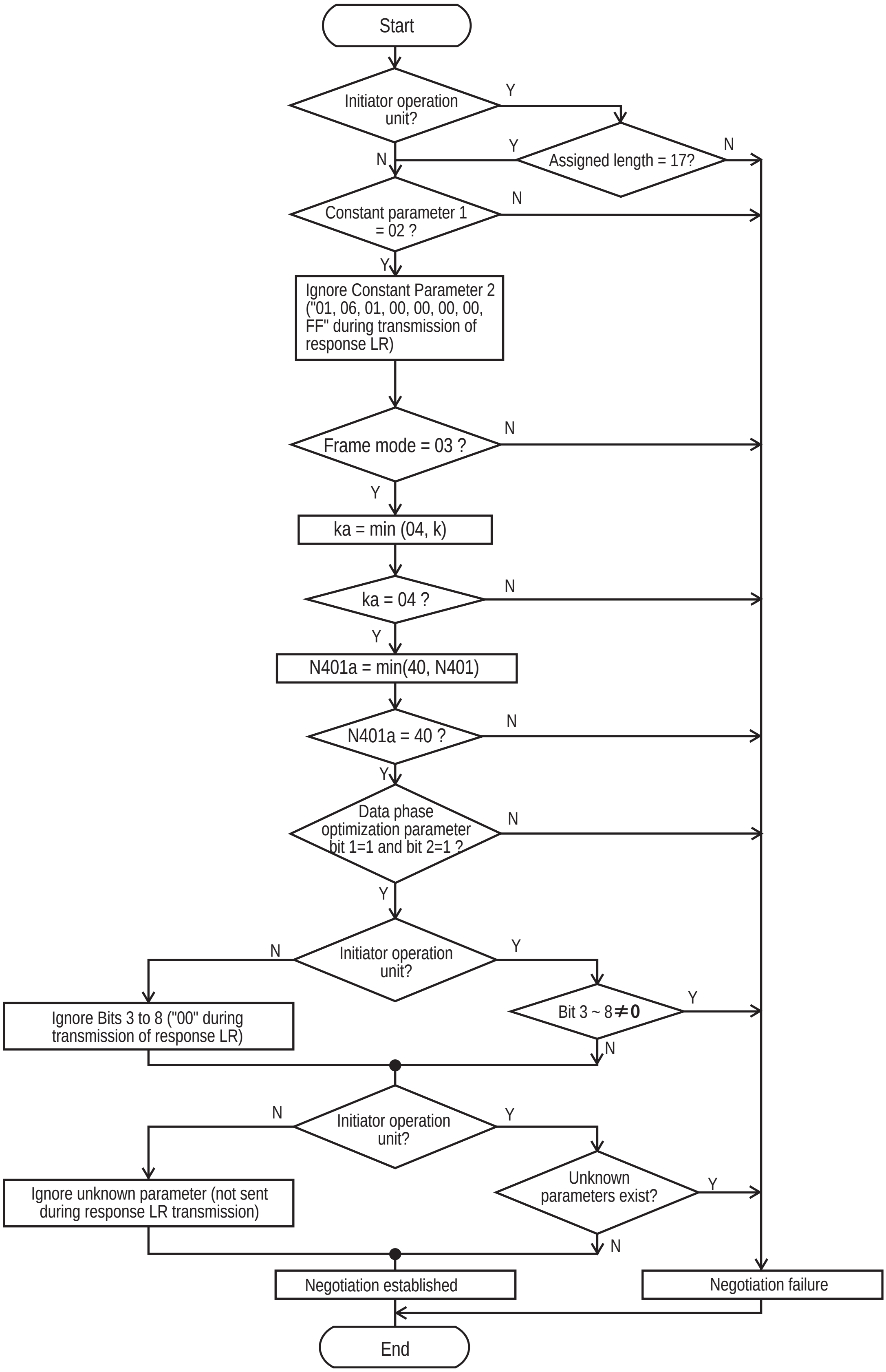
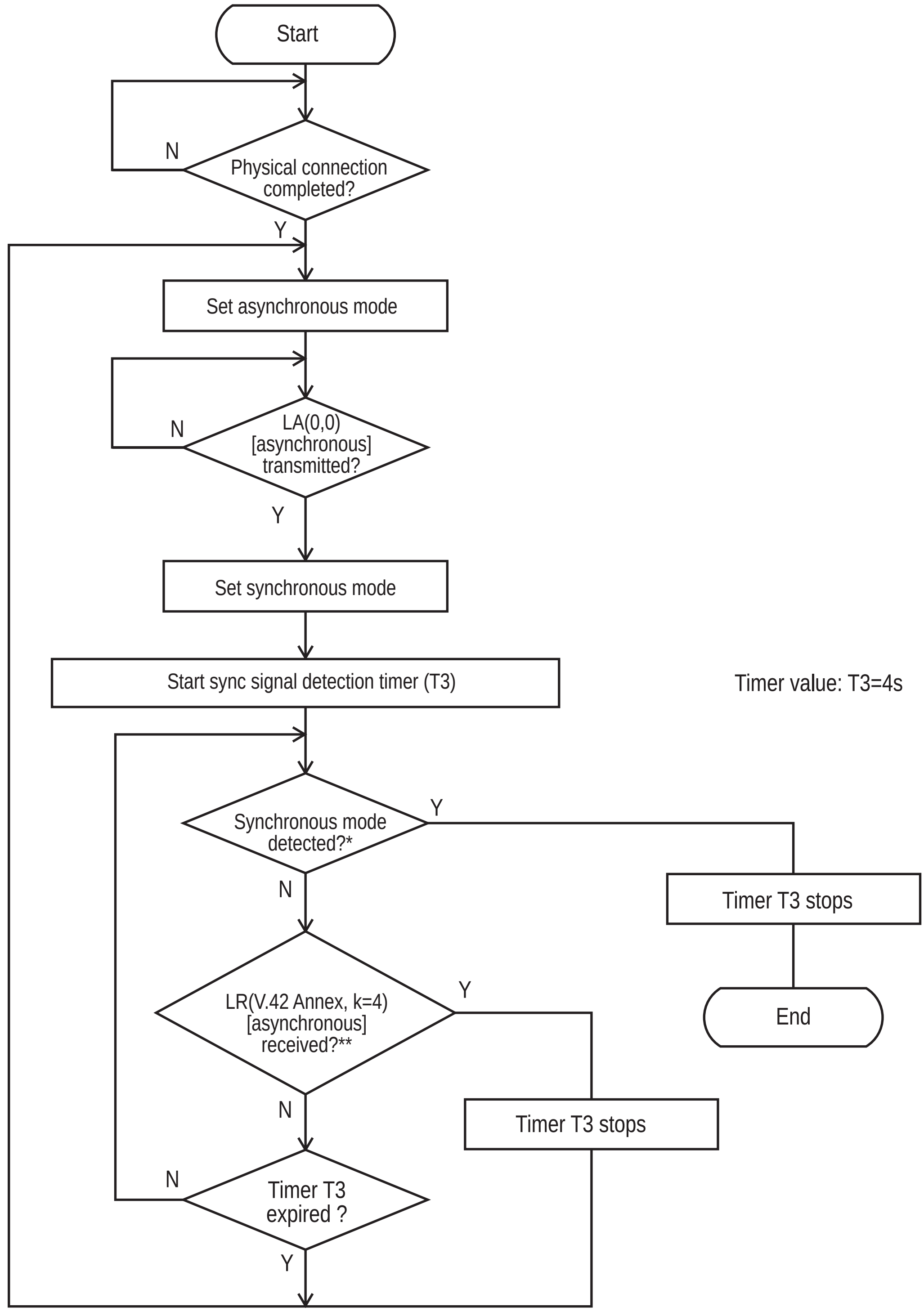


Fig. 4.3.1.2 : Parameter negotiation flow

Table 4.3.1 : LR parameters for initiator unit

Parameter name	Definition	Value (Hex)
Length assignment	-	17
Type assignment	LR	01
Constant parameter 1	-	02
Constant parameter 2	Type Length - - - - - -	01 06 01 00 00 00 00 FF
Frame mode	Type Length Mode	02 01 03
Maximum outstanding LT frames, k	Type Length k	03 01 04
Maximum information field length N401	Type Length Maximum length -	04 02 40 00
Data phase optimization	Type Length Facility	08 01 03



* Detect 4 HDLC sync flags consecutively.
** Frames from which stop bit is not deleted can be received.

Fig. 4.3.1.3 : V.22 bis modem synchronous/asynchronous switching flow for initiator unit

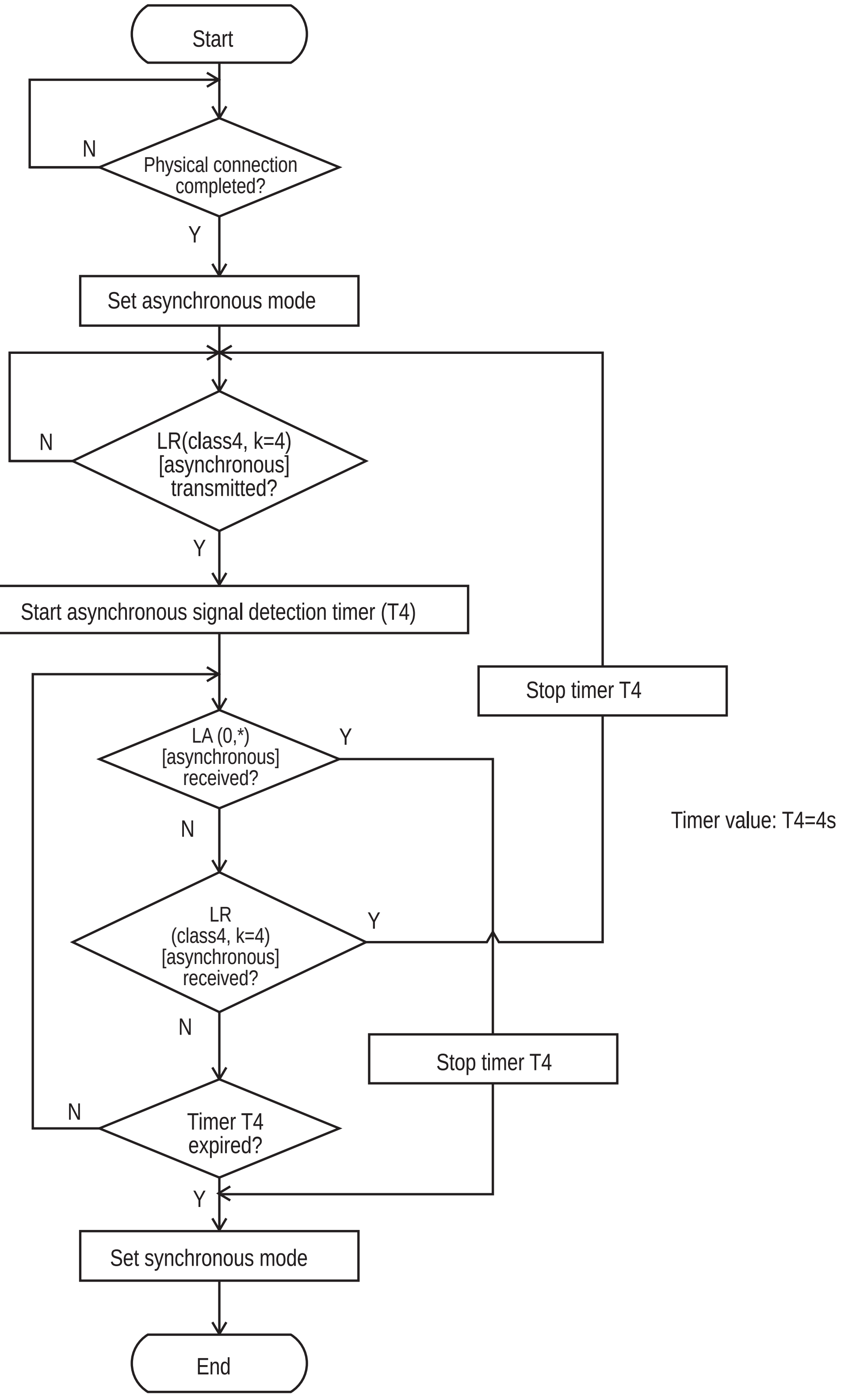


Fig. 4.3.1.4 : V.22bis modem synchronous/asynchronous switching flow for responder unit

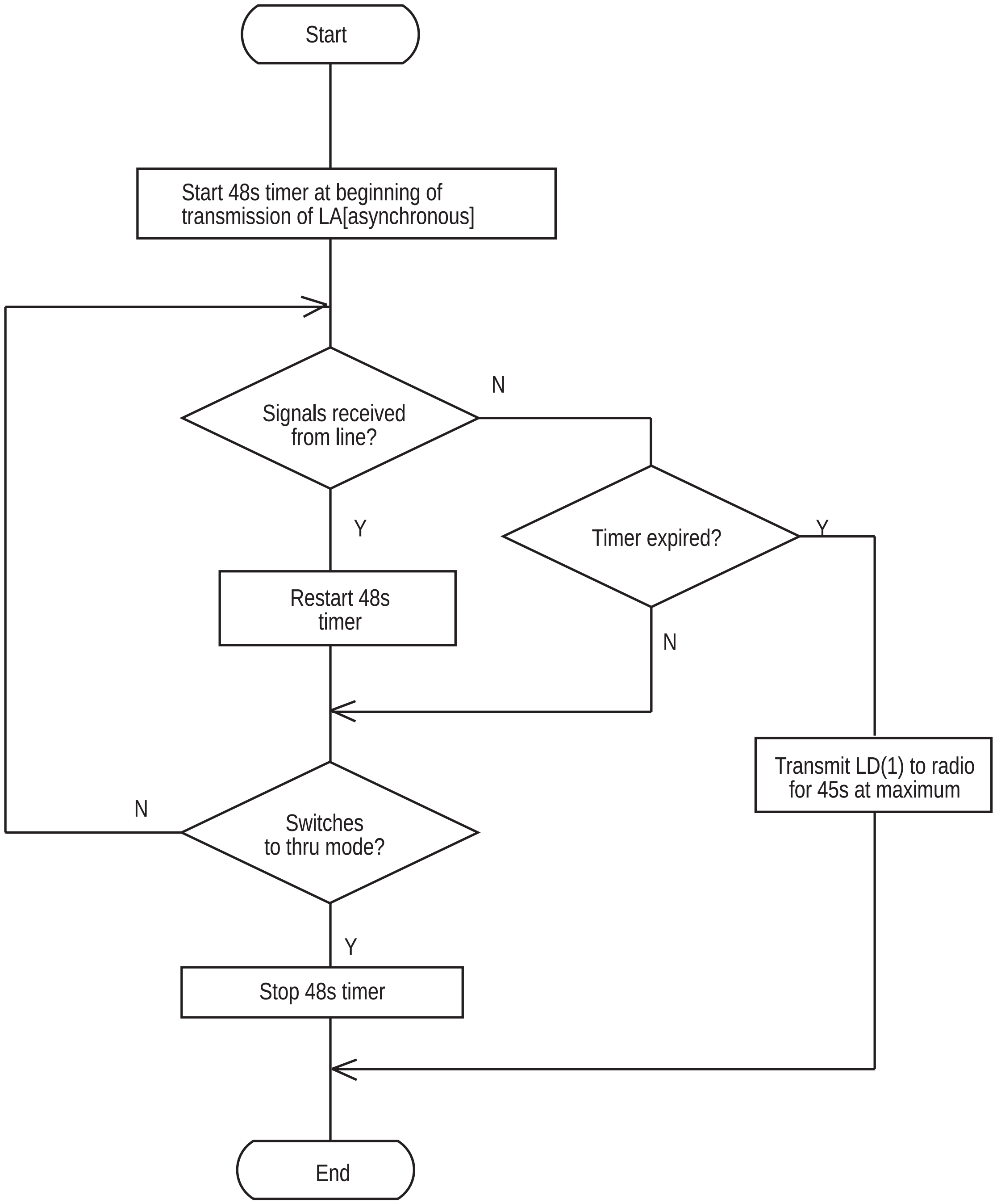


Fig. 4.3.1.5 : Start-up and stop algorithm for 48s timer for initiator unit

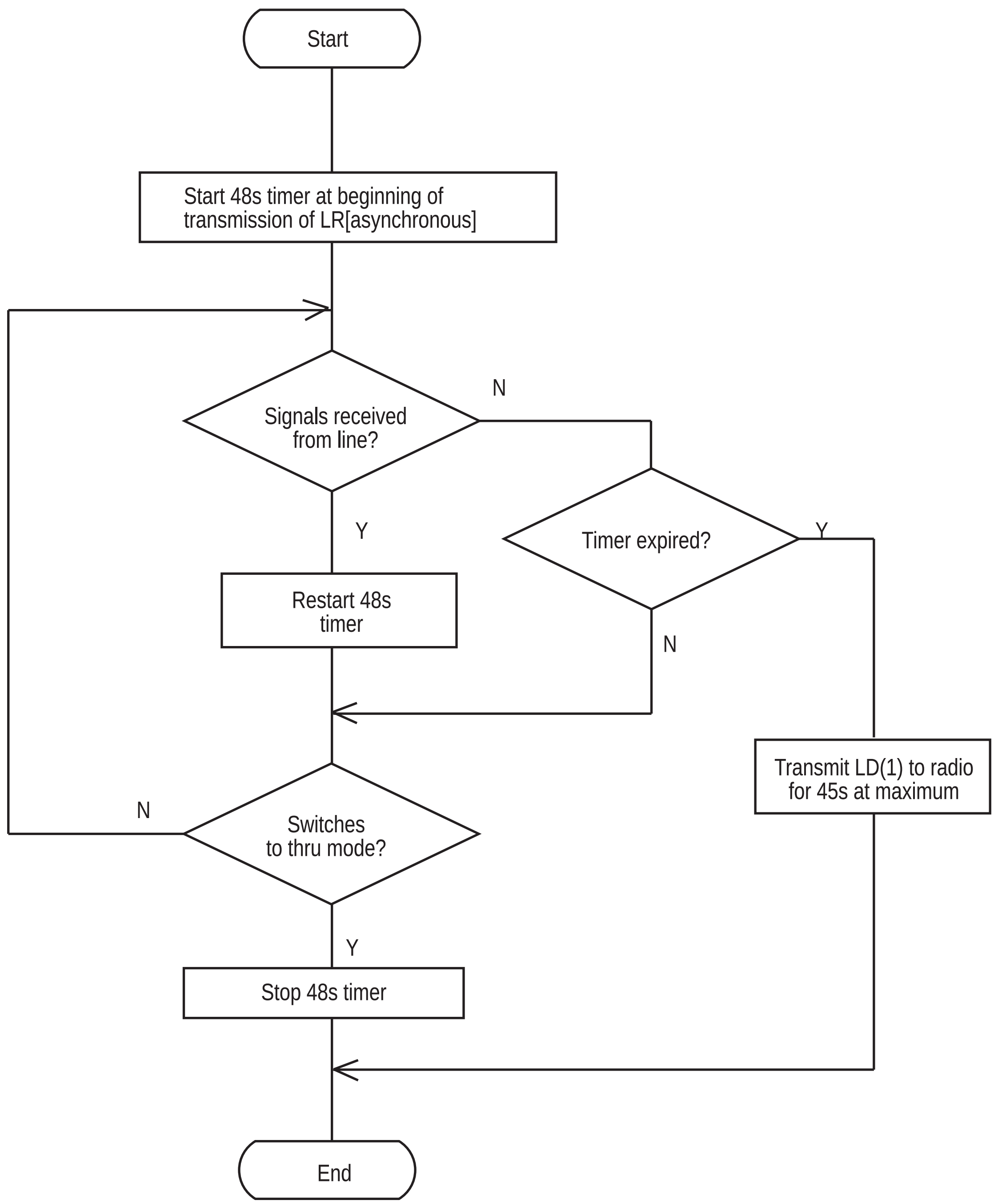


Fig. 4.3.1.6 : Start-up and stop algorithm for 48s timer for responder unit

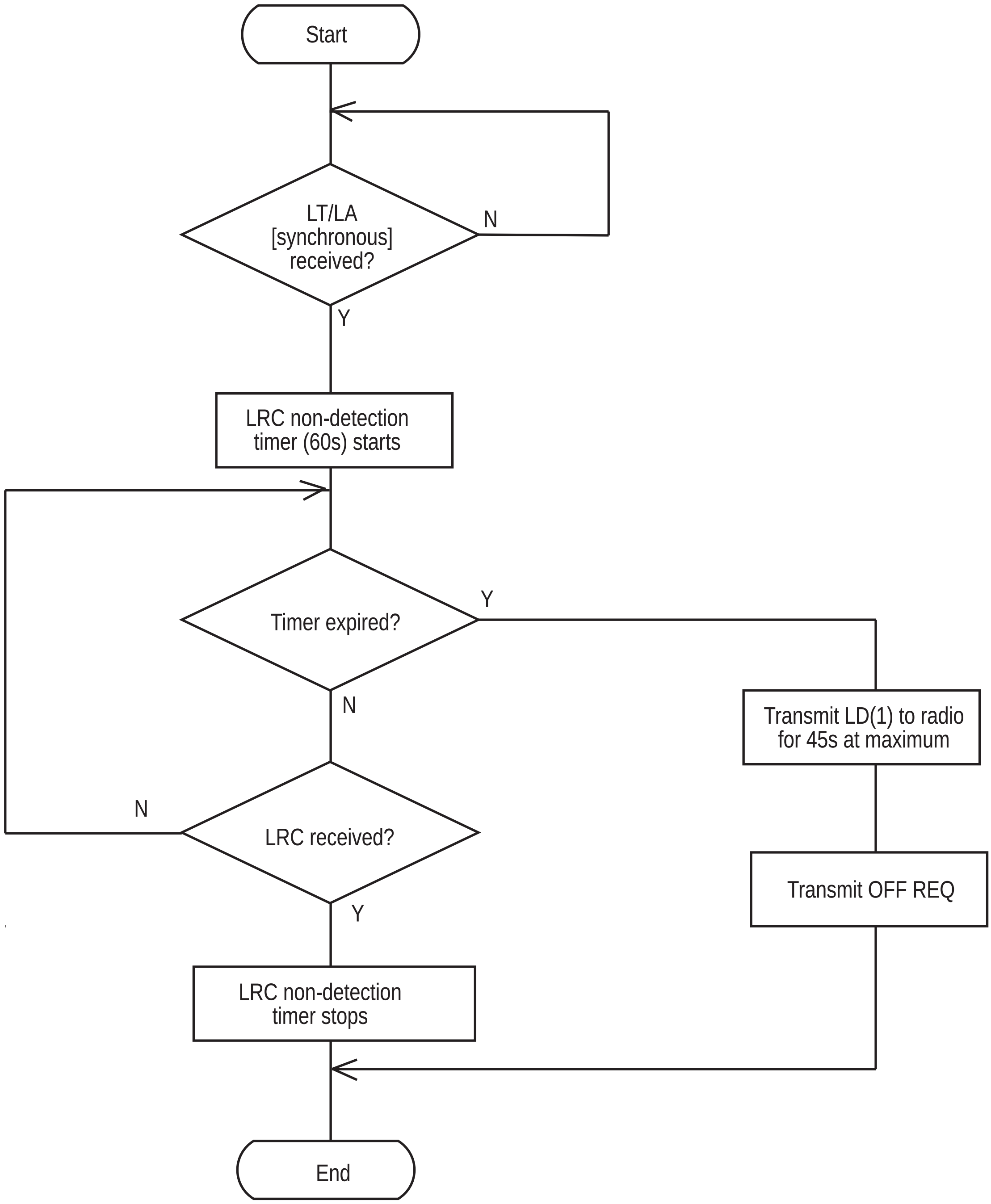


Fig. 4.3.1.7 : Start-up and stop algorithm for LRC non-detection timer

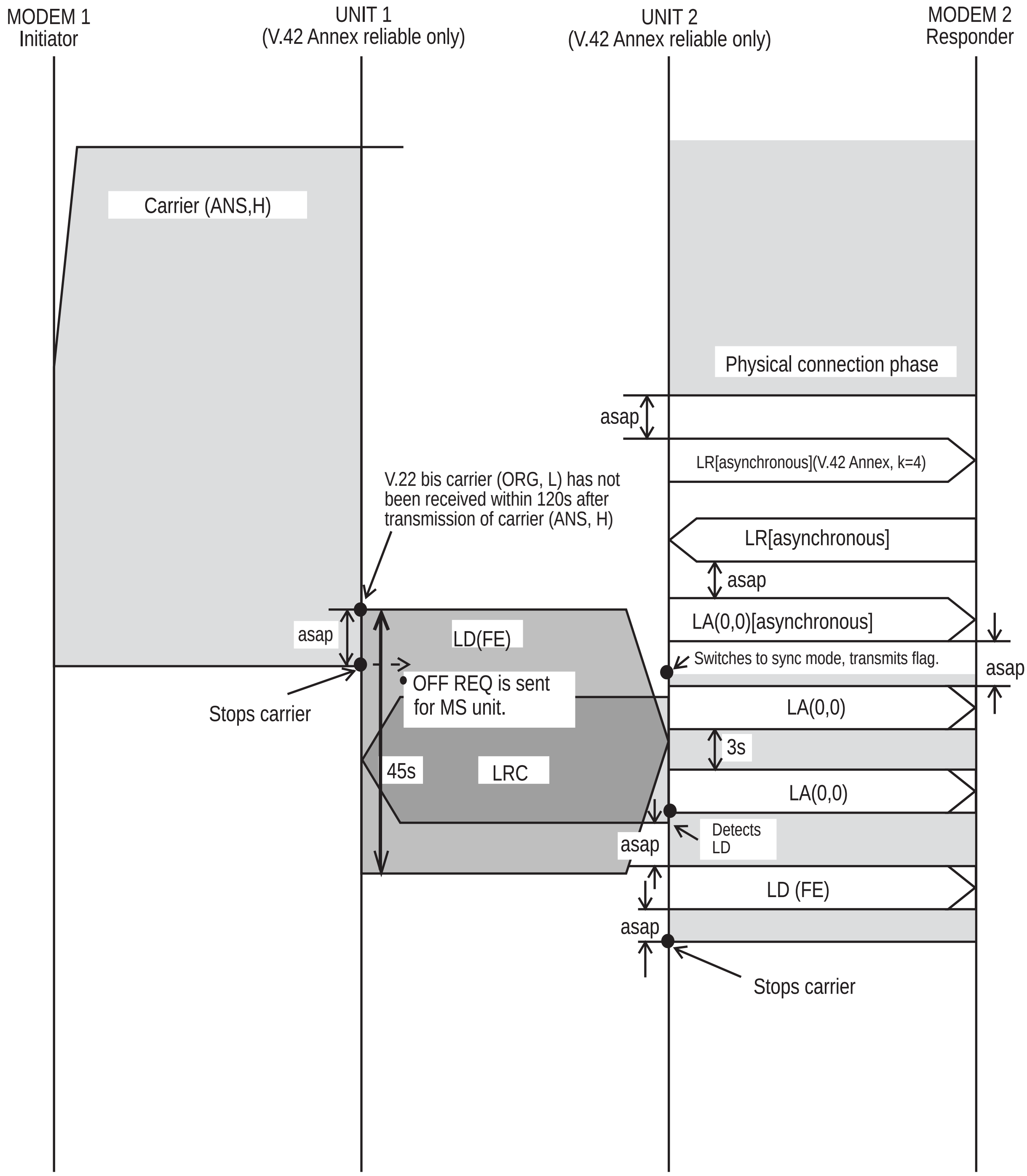


Fig. 4.3.2.1 : Protocol establishment procedure (physical connection not established [1])
-- Carrier (ORG, L) have not been received from V.22 bis --
• MODEM 1 initiator operation
• MODEM 2 responder operation

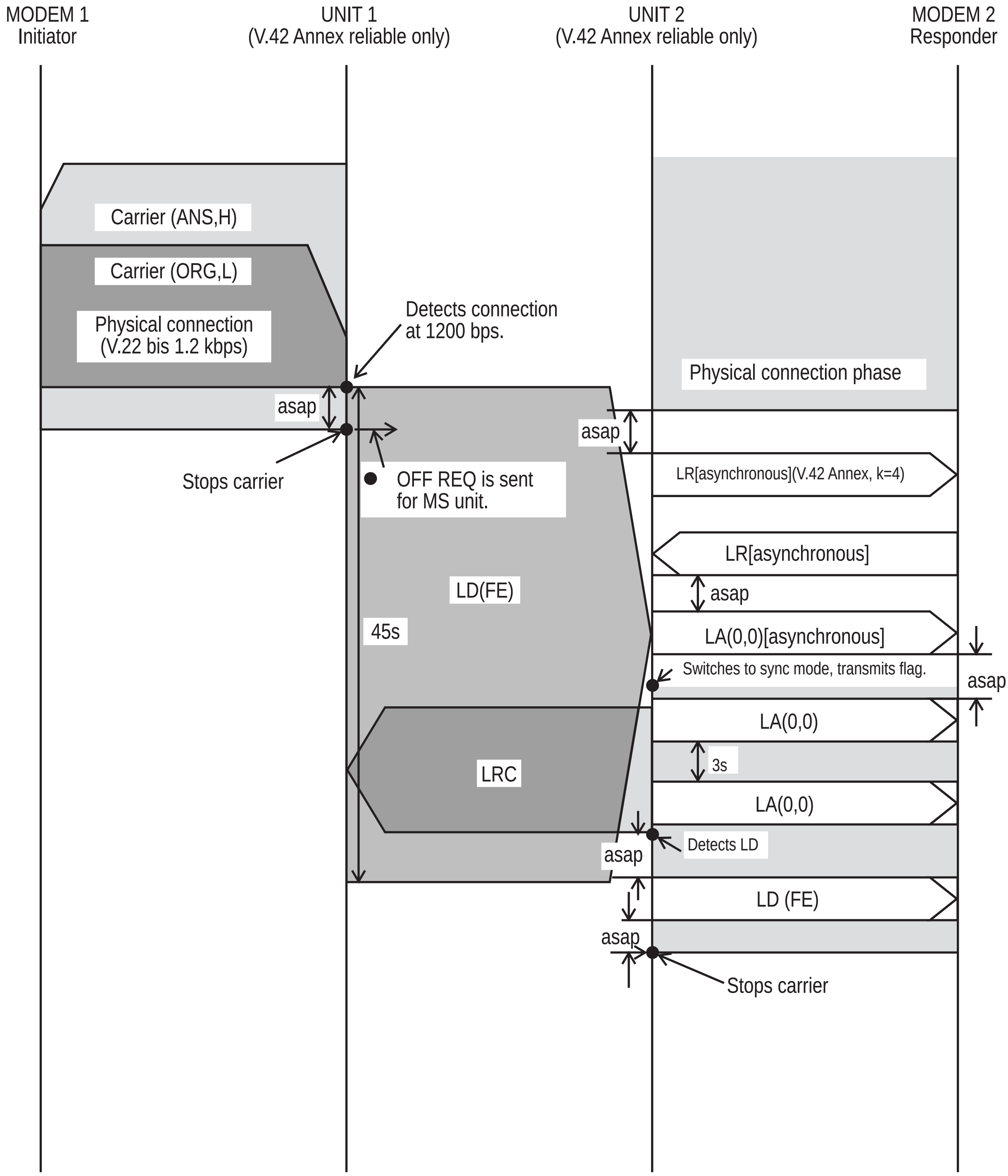


Fig. 4.3.2.2 : Protocol establishment procedure (physical connection not established [2])
-- Connection at V.22 bis (1200 bps) --
• MODEM 1 initiator operation
• MODEM 2 responder operation

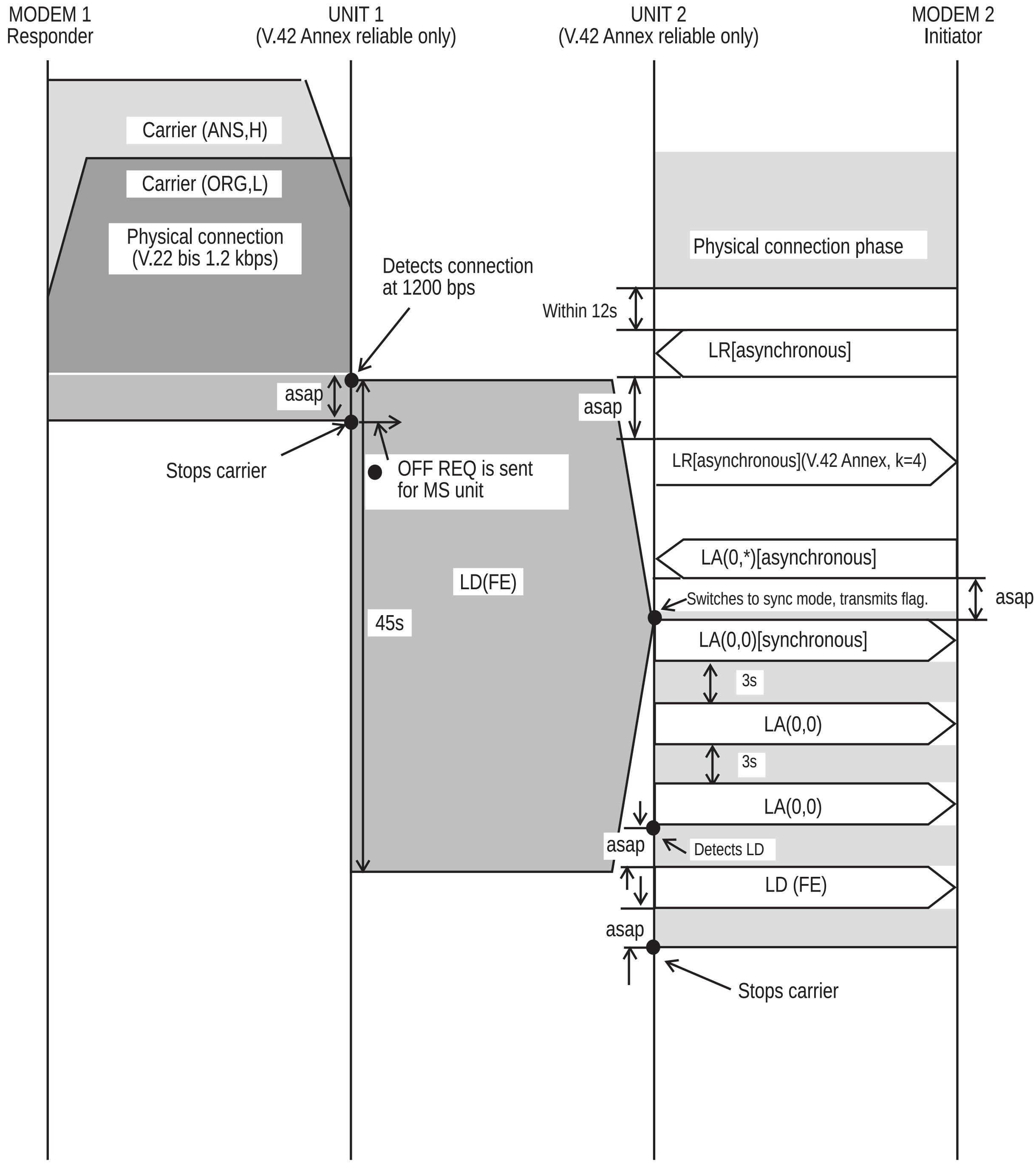


Fig. 4.3.2.3 : Protocol establishment procedure (physical connection not established [3])
-- Connection at V.22 bis (1200 bps) --
- MODEM 1 responder operation
- MODEM 2 initiator operation

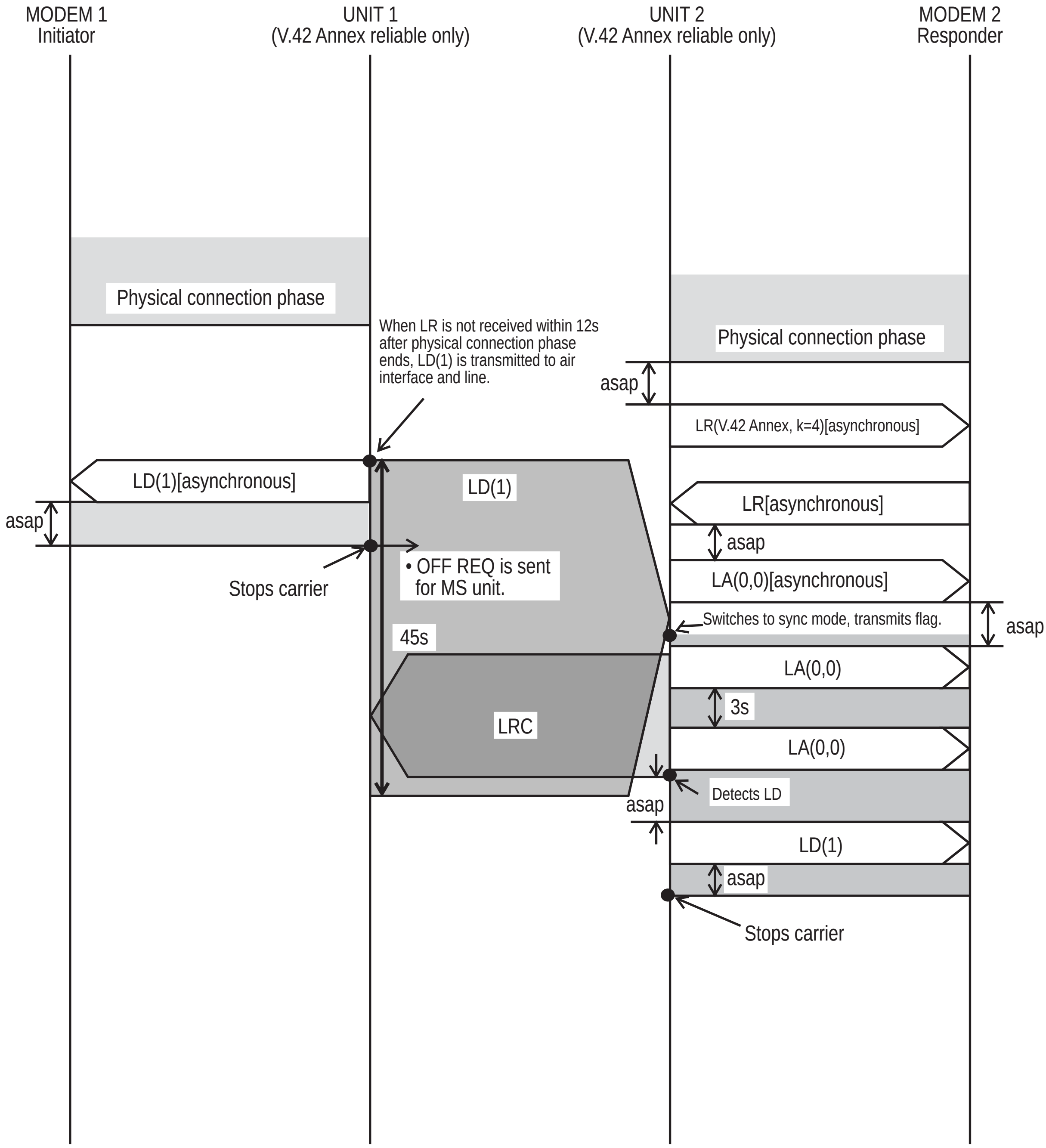


Fig. 4.3.2.4 : Protocol establishment procedure (negotiation failed [1])
-- Call initiating LR not received --
• MODEM 1 initiator operation
• MODEM 2 responder operation

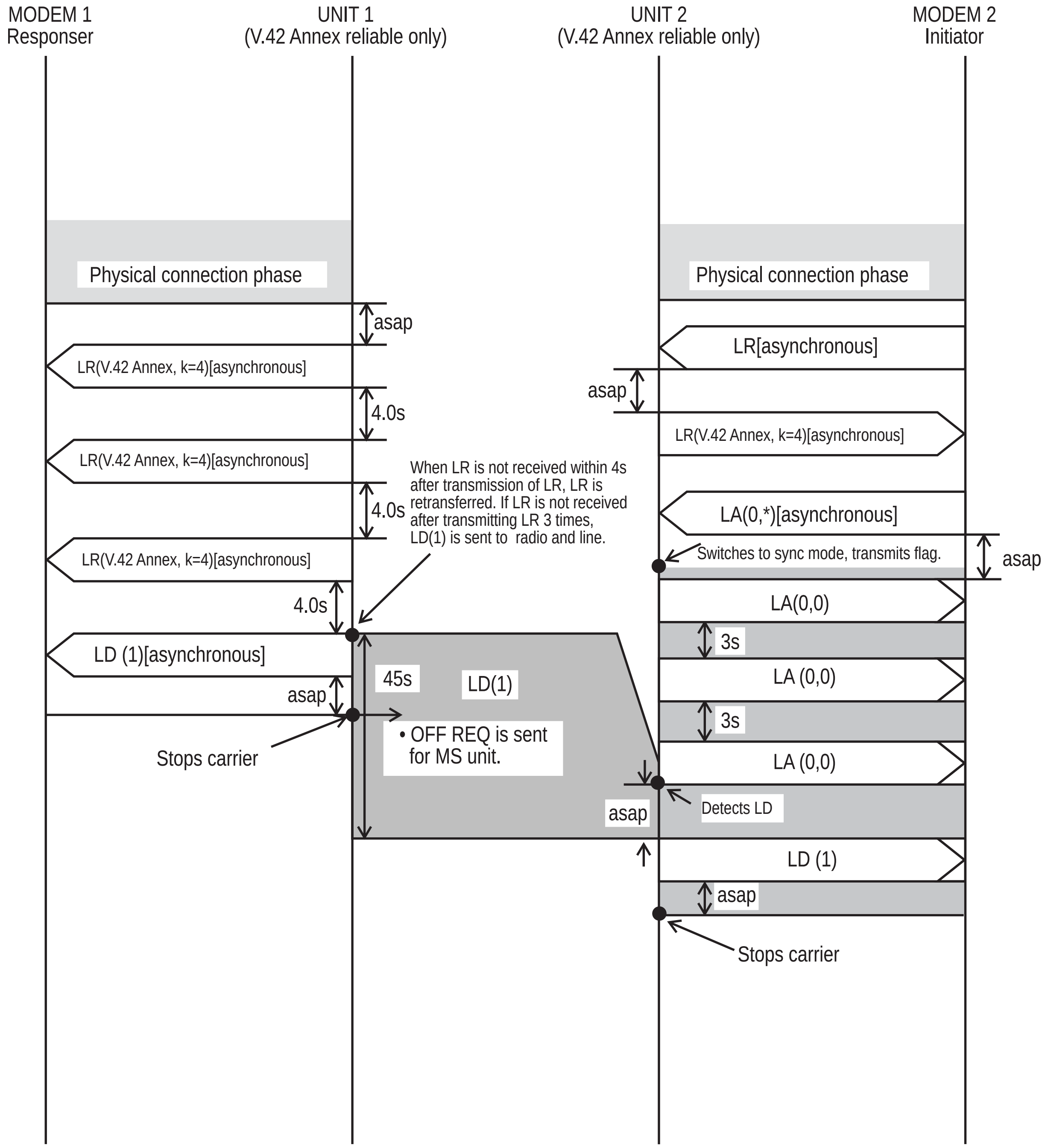


Fig. 4.3.2.5 : Protocol establishment procedure (negotiation failed [2])
-- Response LR not received --
- MODEM 1 responder operation
- MODEM 2 initiator operation

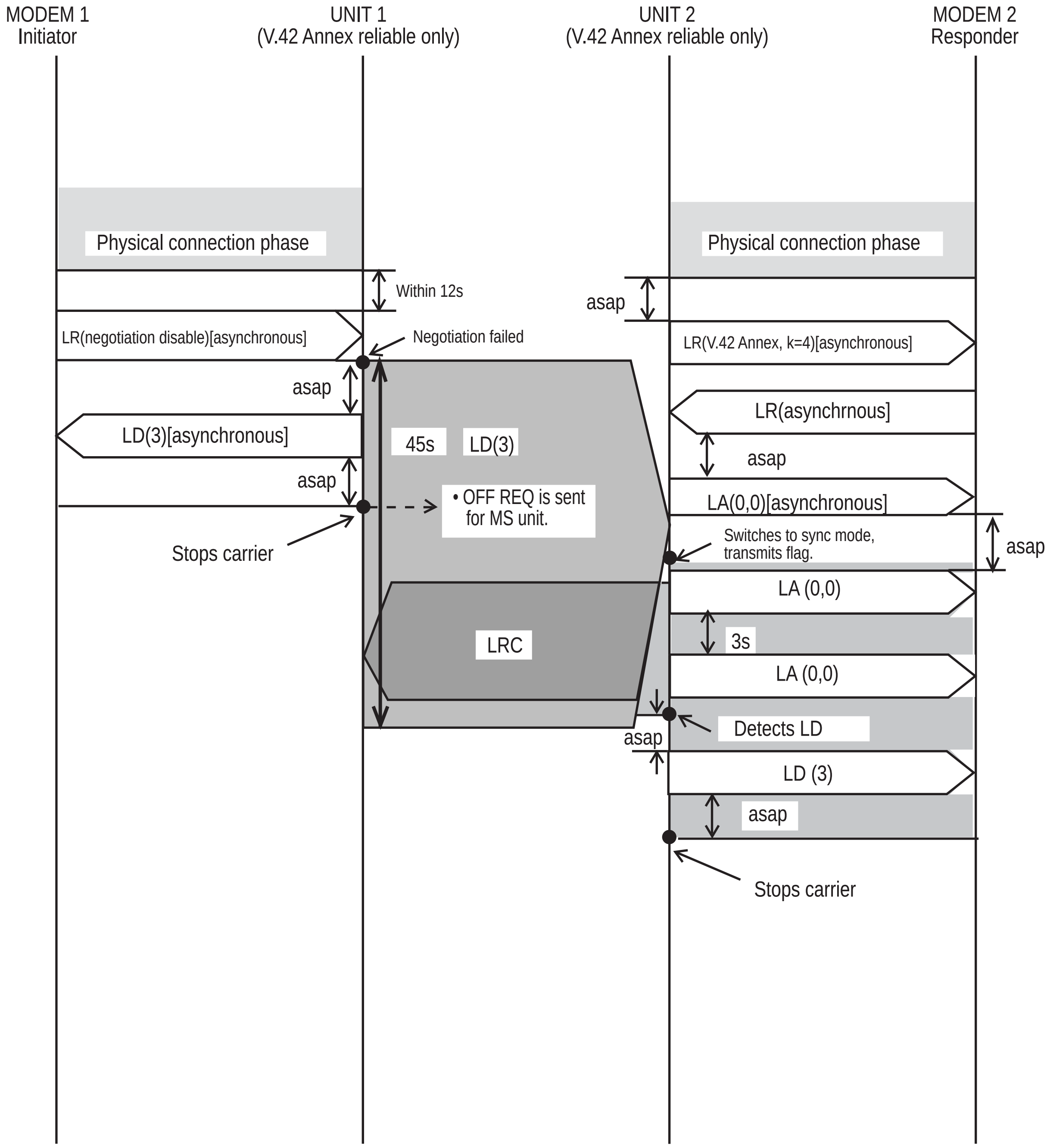


Fig. 4.3.2.6 : Protocol establishment procedure (negotiation failed [3])
• MODEM 1 initiator operation
• MODEM 2 responder operation

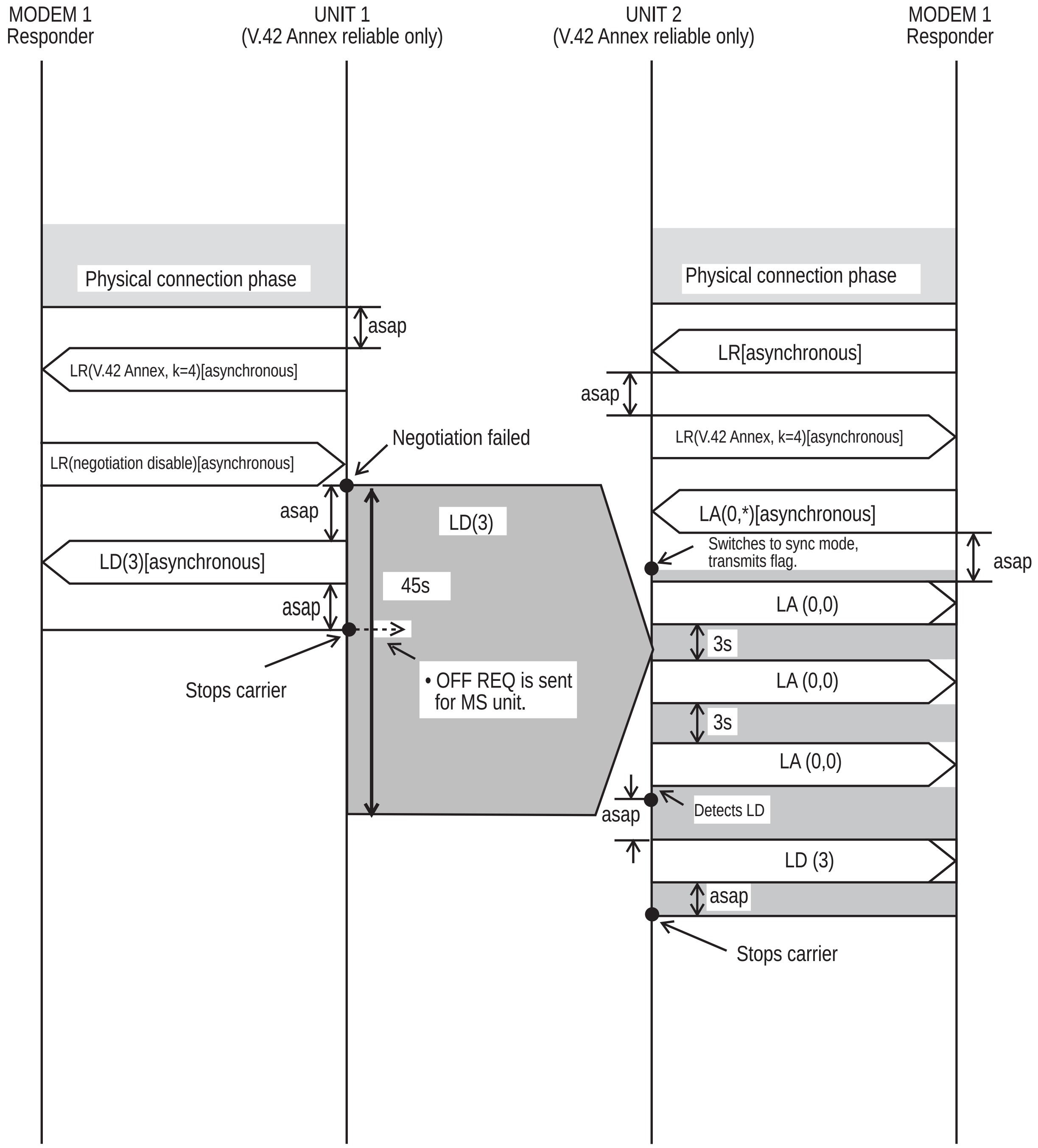


Fig. 4.3.2.7 : Protocol establishment procedure (negotiation failed [4])
• MODEM 1 responder operation
•MODEM 2 initiator operation

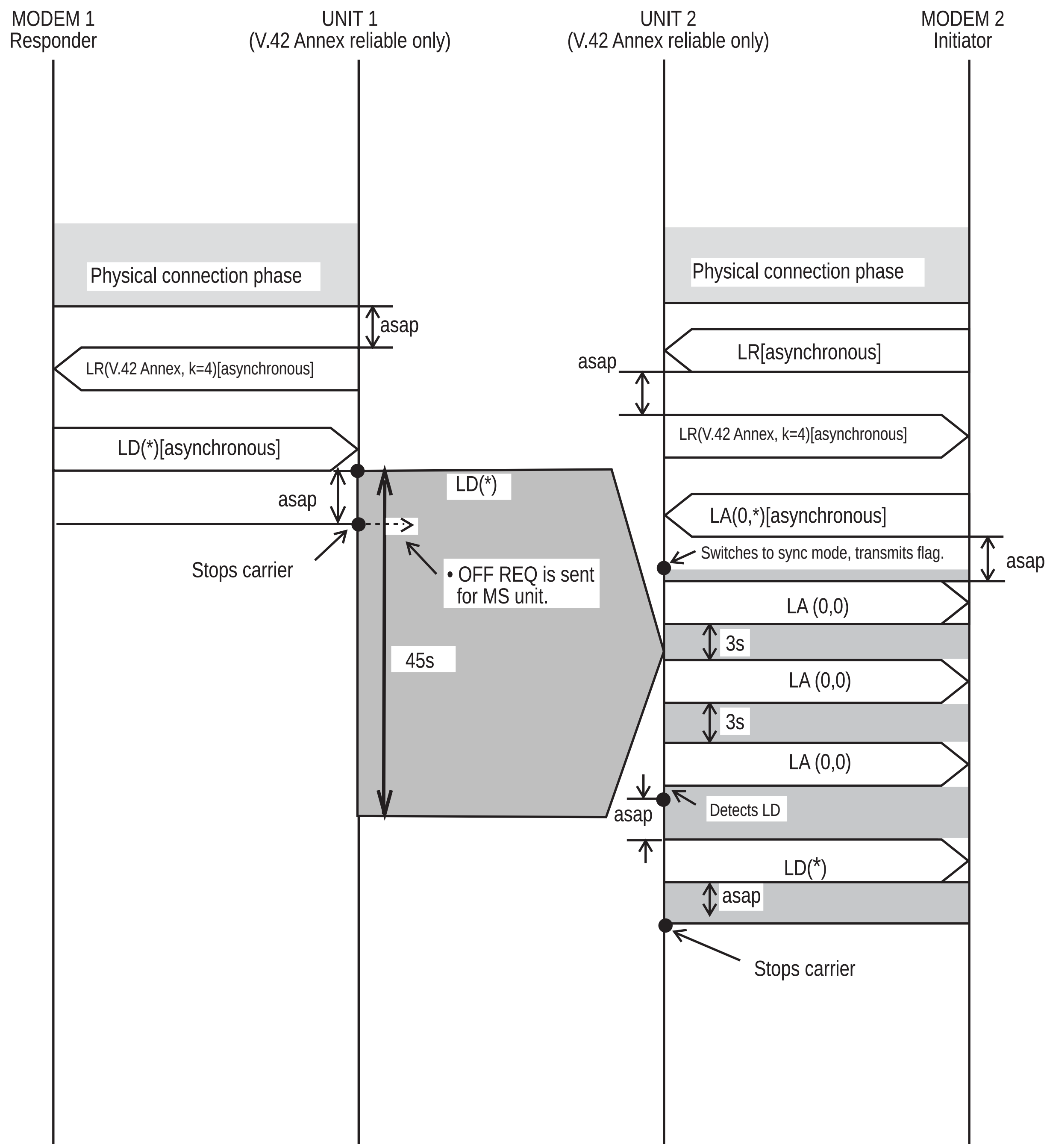


Fig. 4.3.2.8 : Protocol establishment procedure (negotiation failed [5])
-- LD reception --
• MODEM 1 responder operation
• MODEM 2 initiator operation

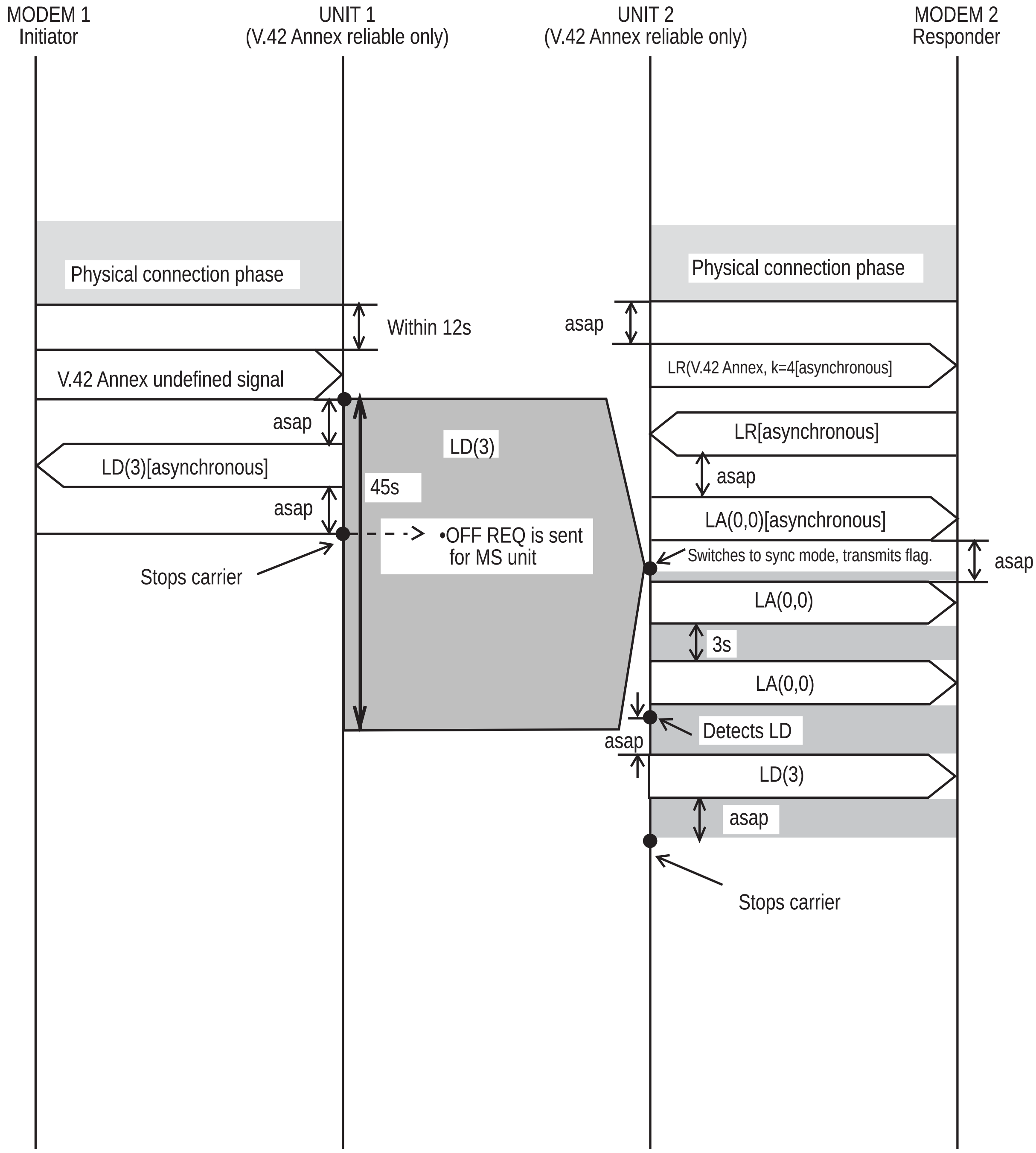


Fig. 4.3.2.9 : Protocol establishment procedure (negotiation failed [6])
-- V.42 Annex undefined signal reception --
MODEM 1 initiator operation
MODEM 2 responder operation

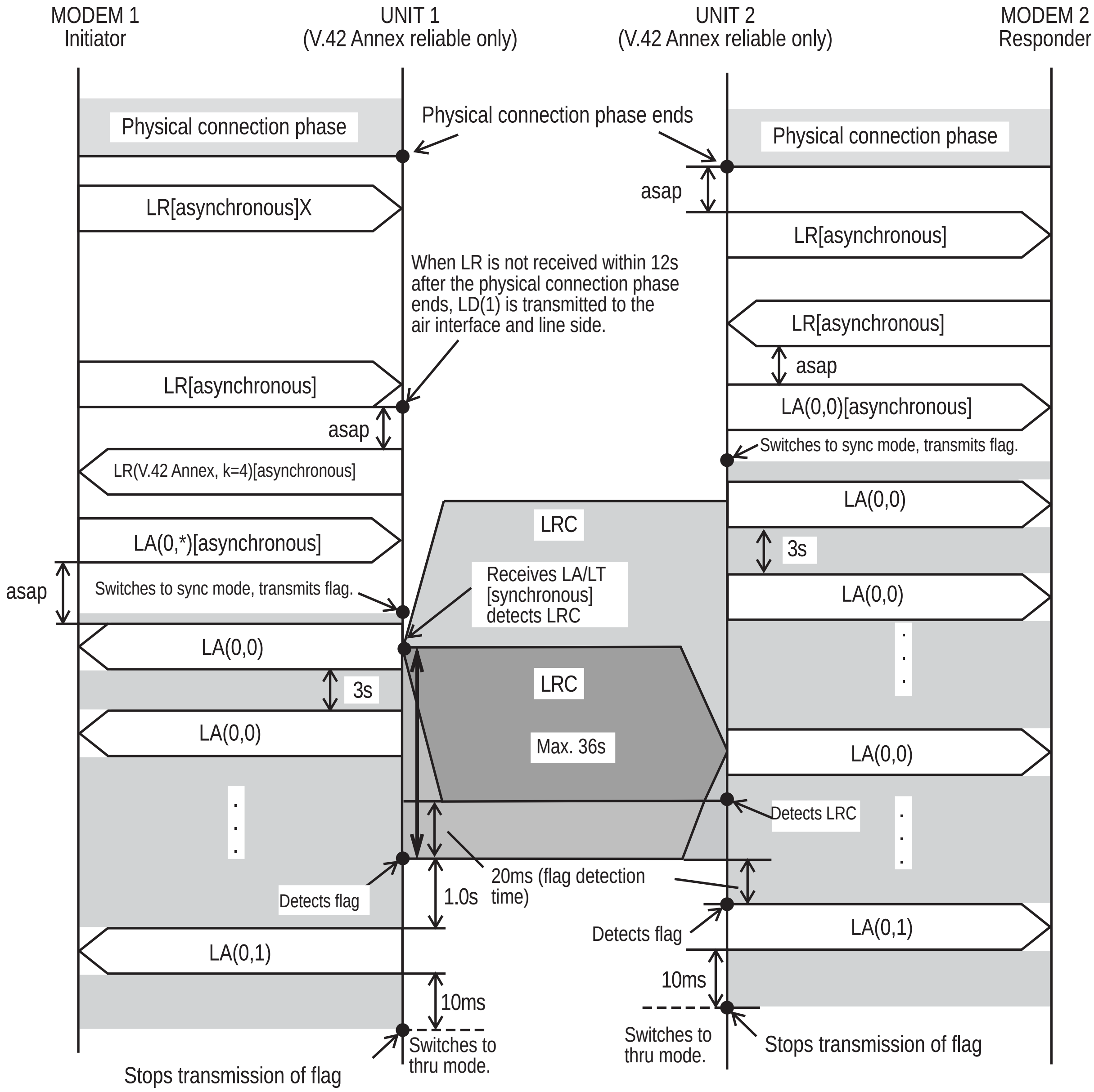


Fig. 4.3.2.10 : Protocol establishment procedure (LR errors [1])
• MODEM 1 initiator operation
• MODEM 2 responder operation

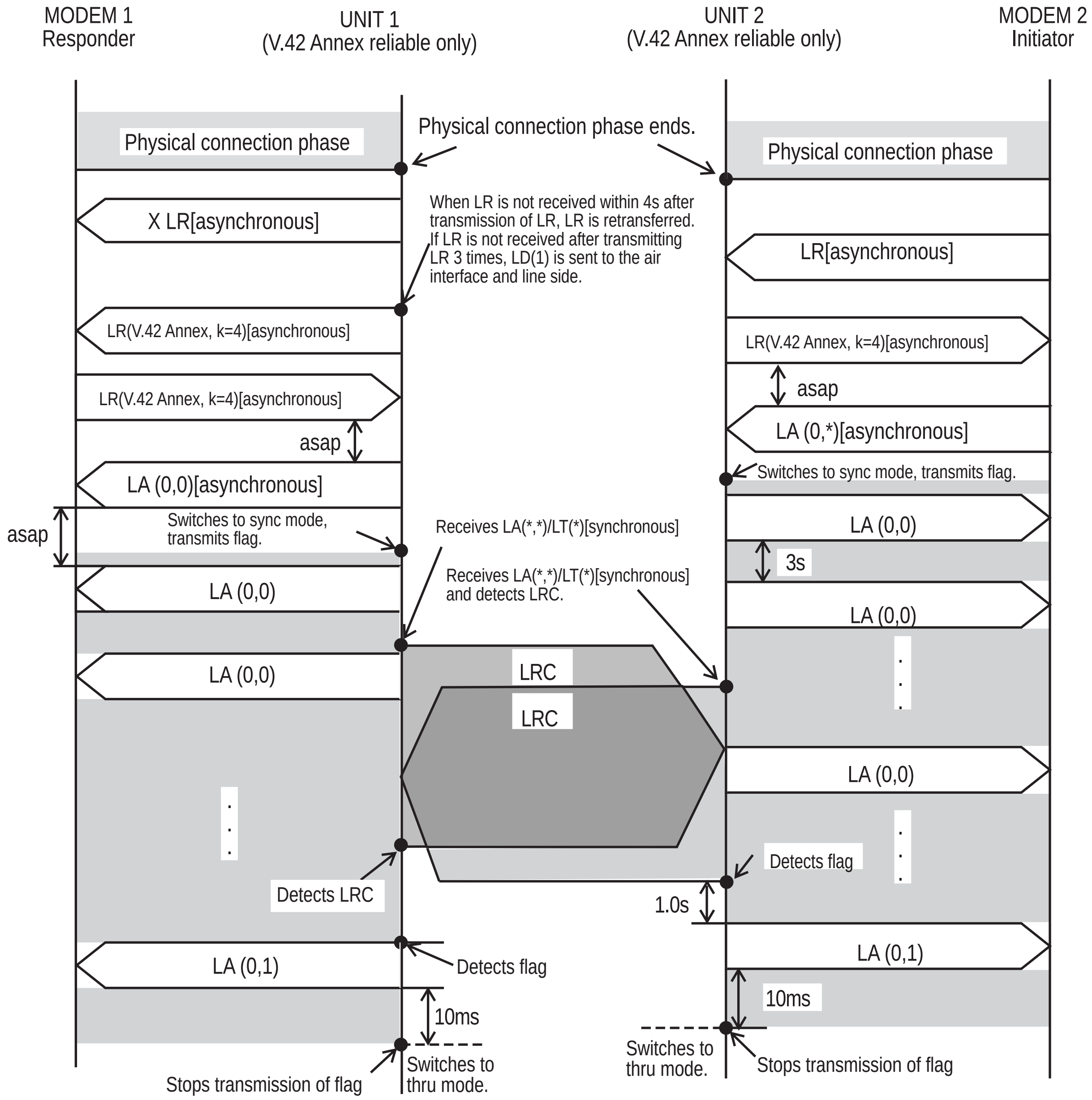


Fig. 4.3.2.11 : Protocol establishment procedure (LR errors [2])
MODEM 1 responder operation
MODEM 2 initiator operation

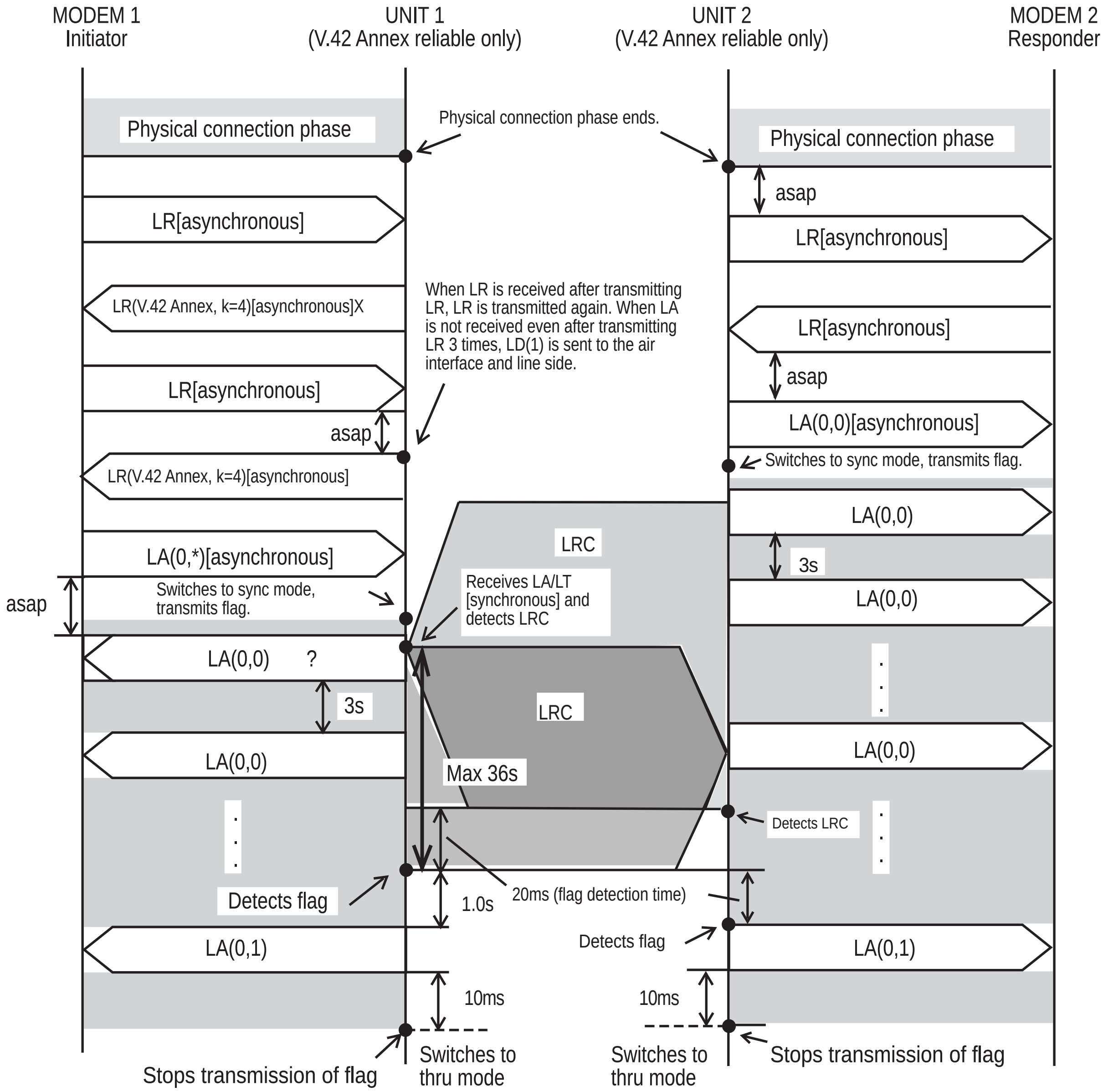


Fig. 4.3.2.12 : Protocol establishment procedure (LR errors [3])
• MODEM 1 initiator operation
• MODEM 2 responder operation

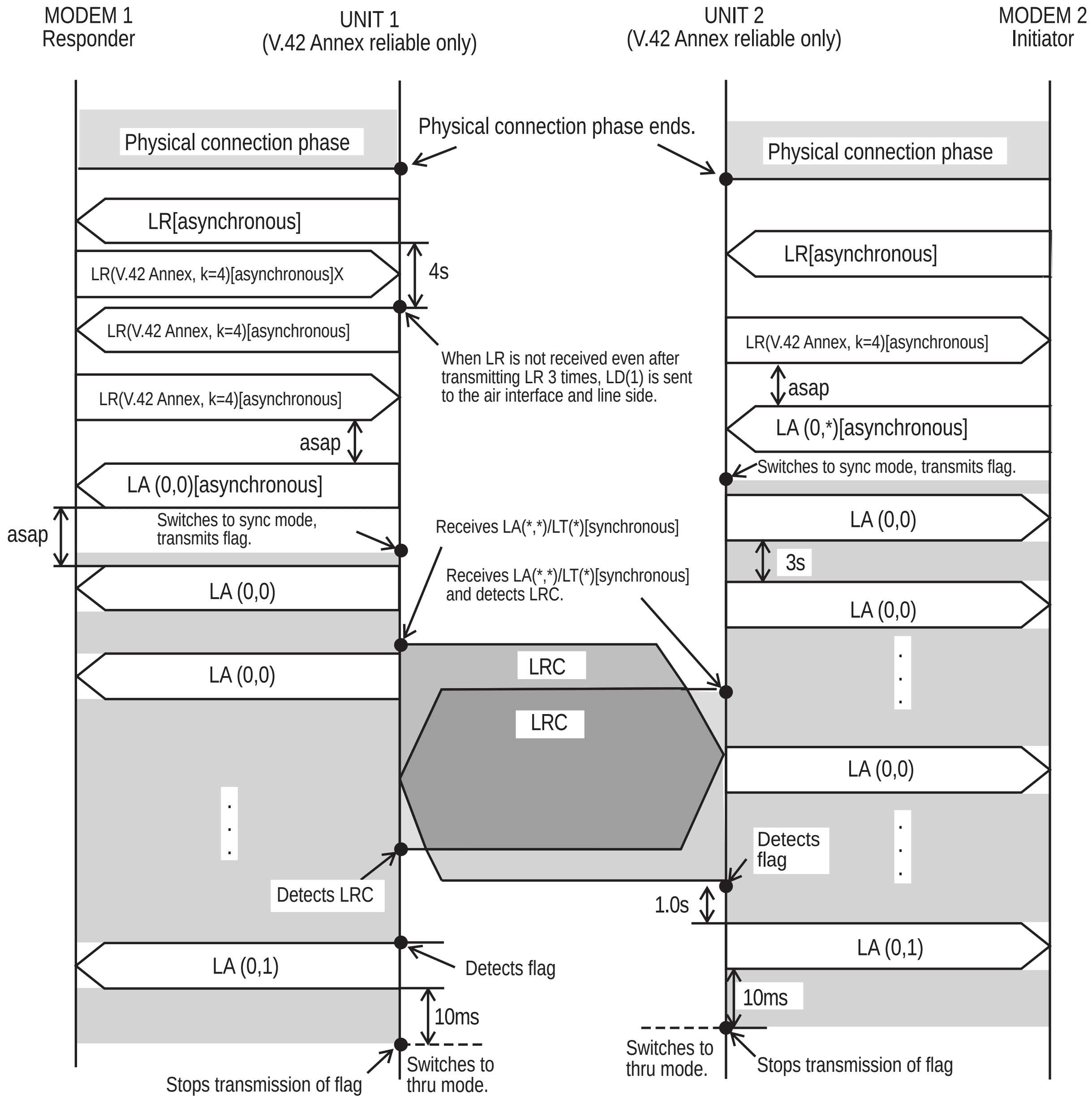


Fig. 4.3.2.13 : Protocol establishment procedure (LR errors [4])
• MODEM 1 responder operation
• MODEM 2 initiator operation

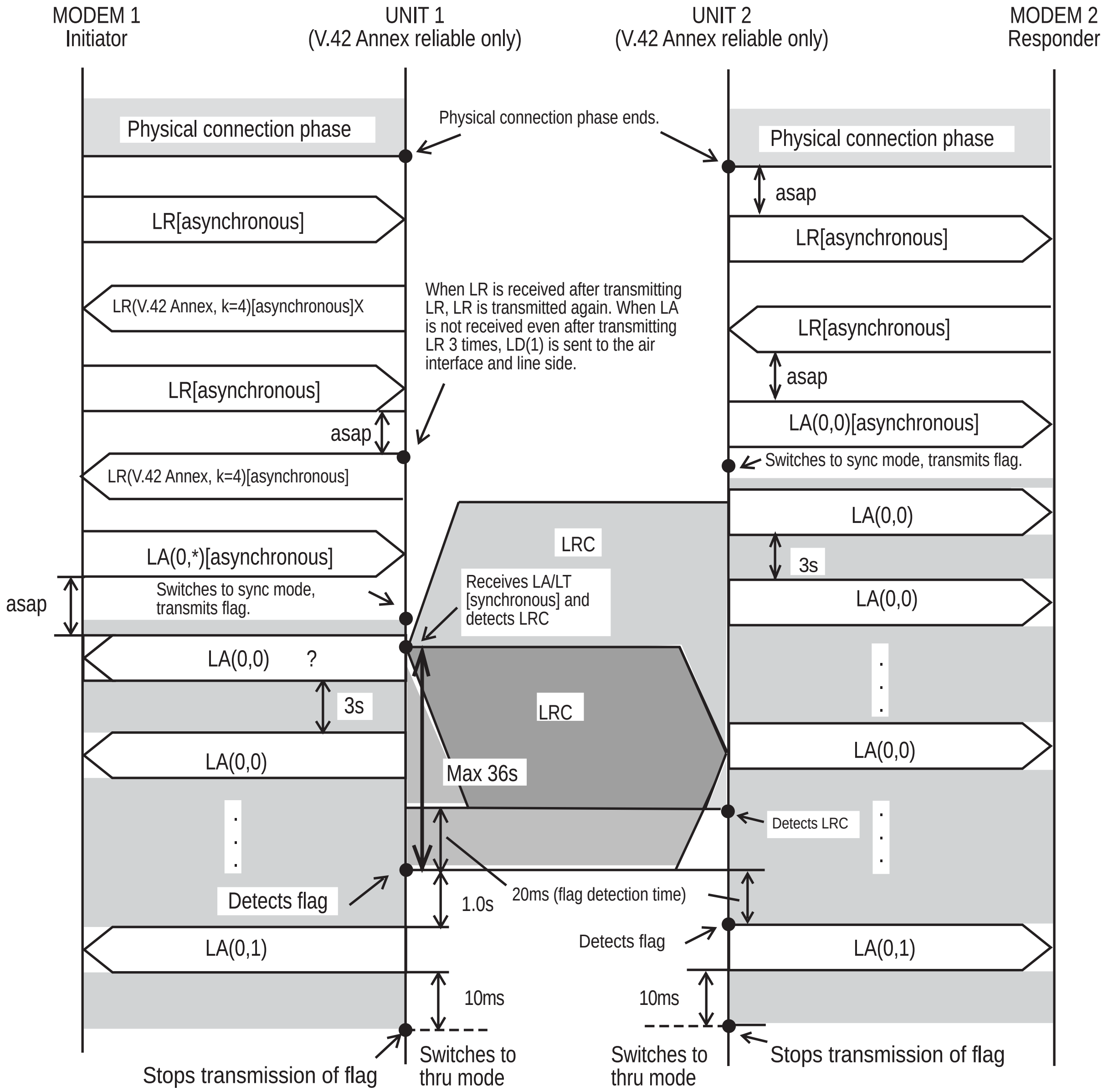


Fig. 4.3.2.12 : Protocol establishment procedure (LR errors [3])
• MODEM 1 initiator operation
• MODEM 2 responder operation

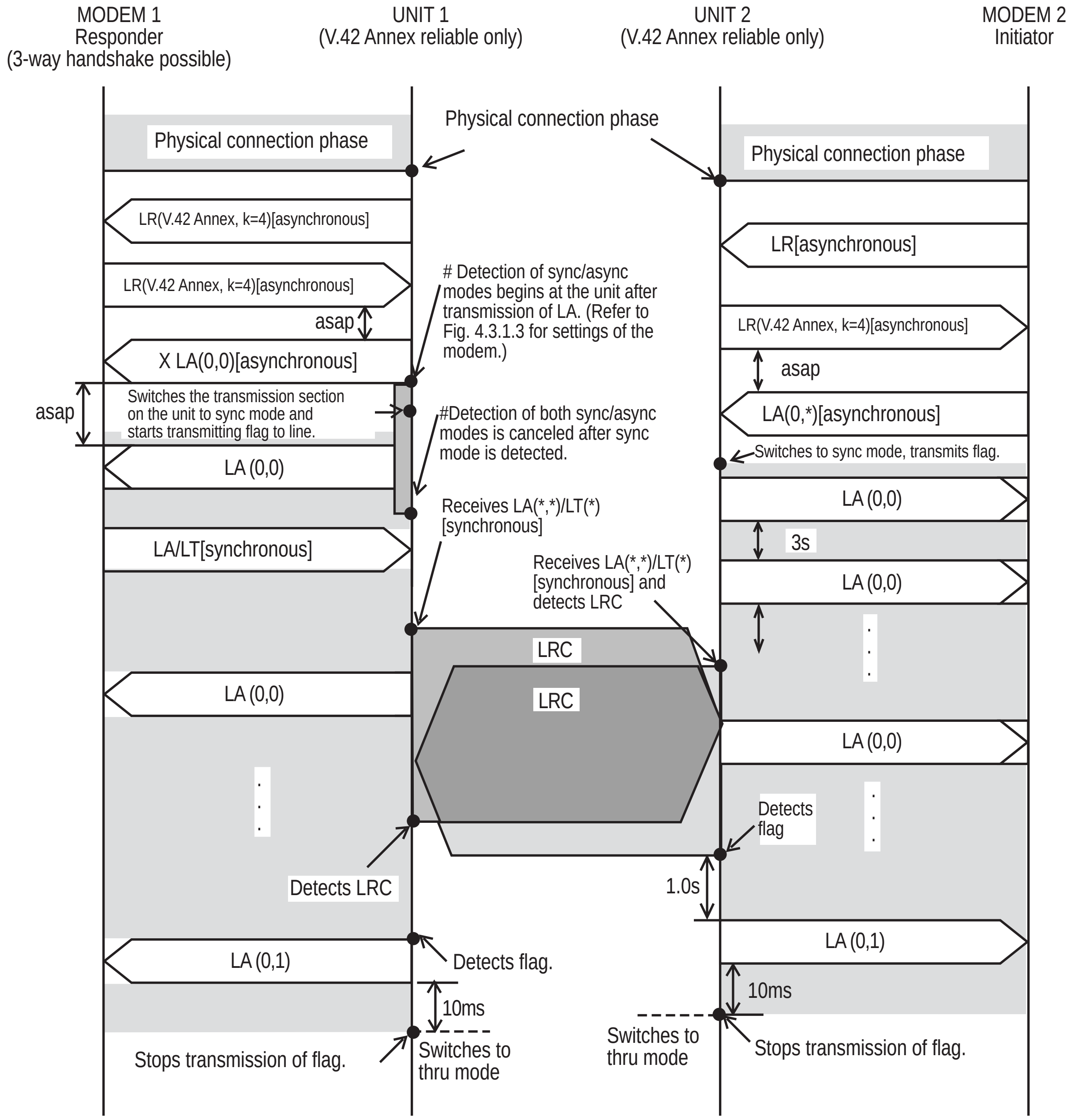


Fig. 4.3.2.15 : Protocol establishment procedure (LA errors [2])
MODEM 1 responder operation
MODEM 2 initiator operation

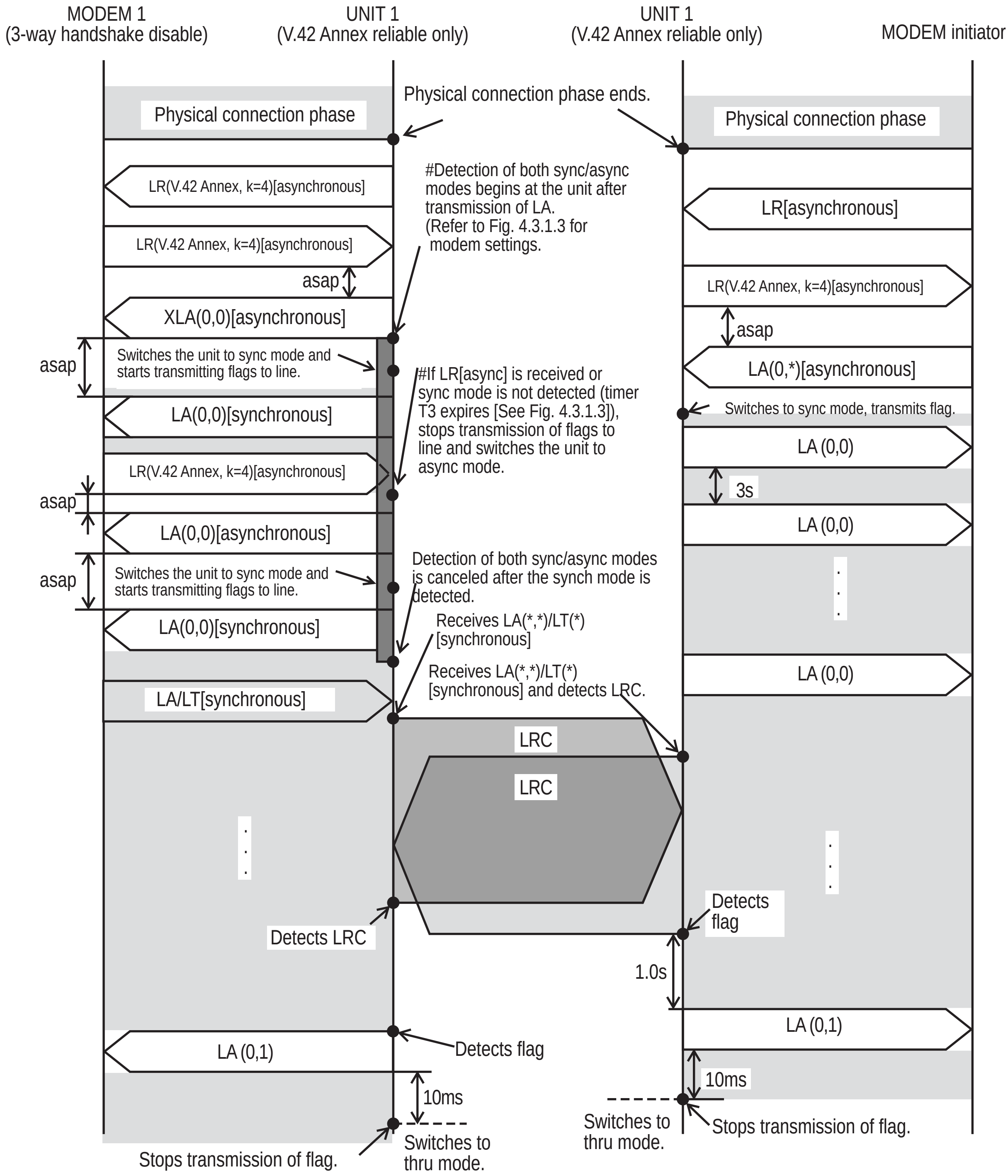


Fig. 4.3.2.16 : Protocol establishment procedure (LA errors [3])
MODEM 1 responder operation
MODEM 2 initiator operation

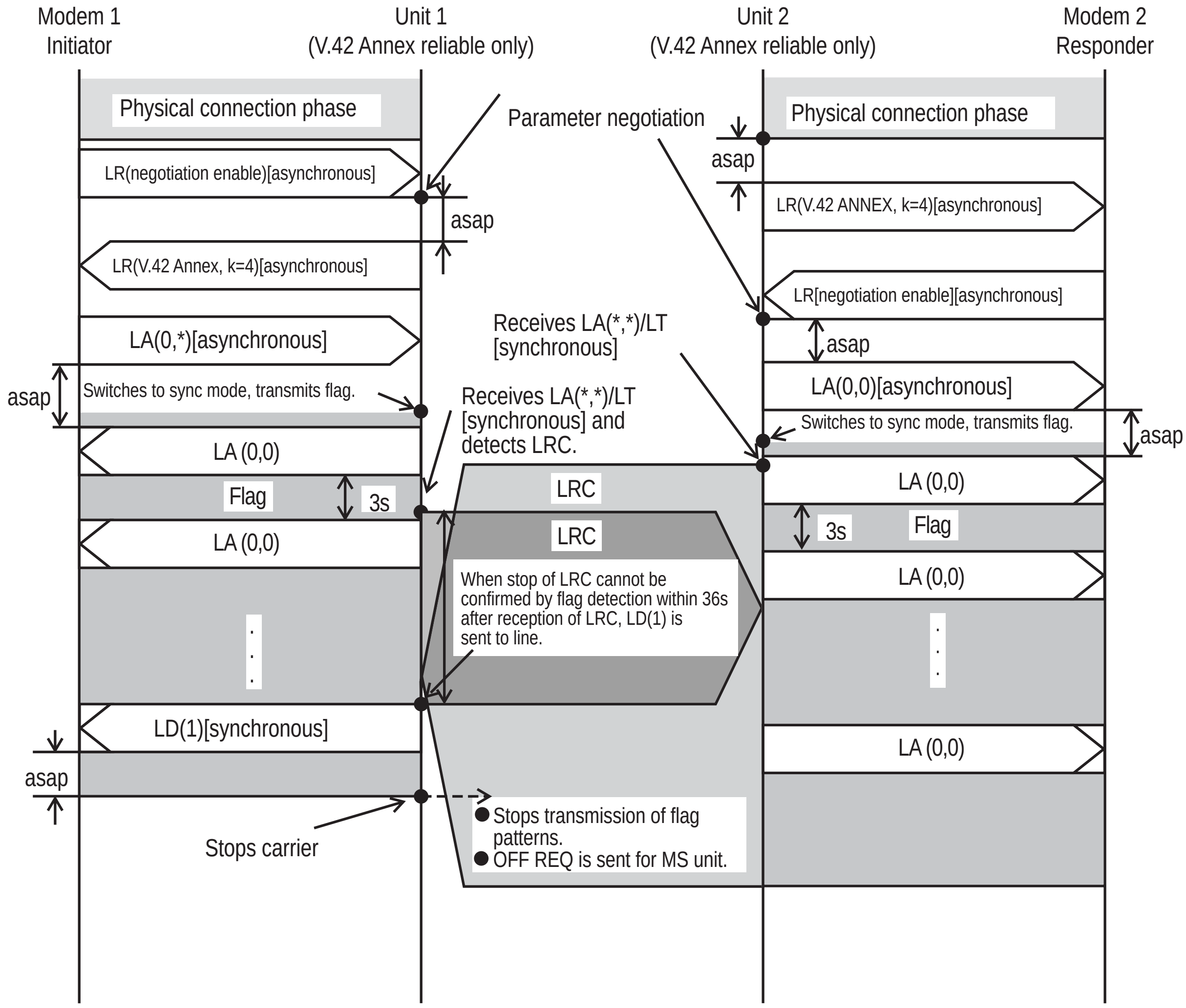


Fig. 4.3.2.17 : Protocol establishment procedure (LRC stop unacknowledged [1])
MODEM 1 initiator operation
MODEM 2 responder operation

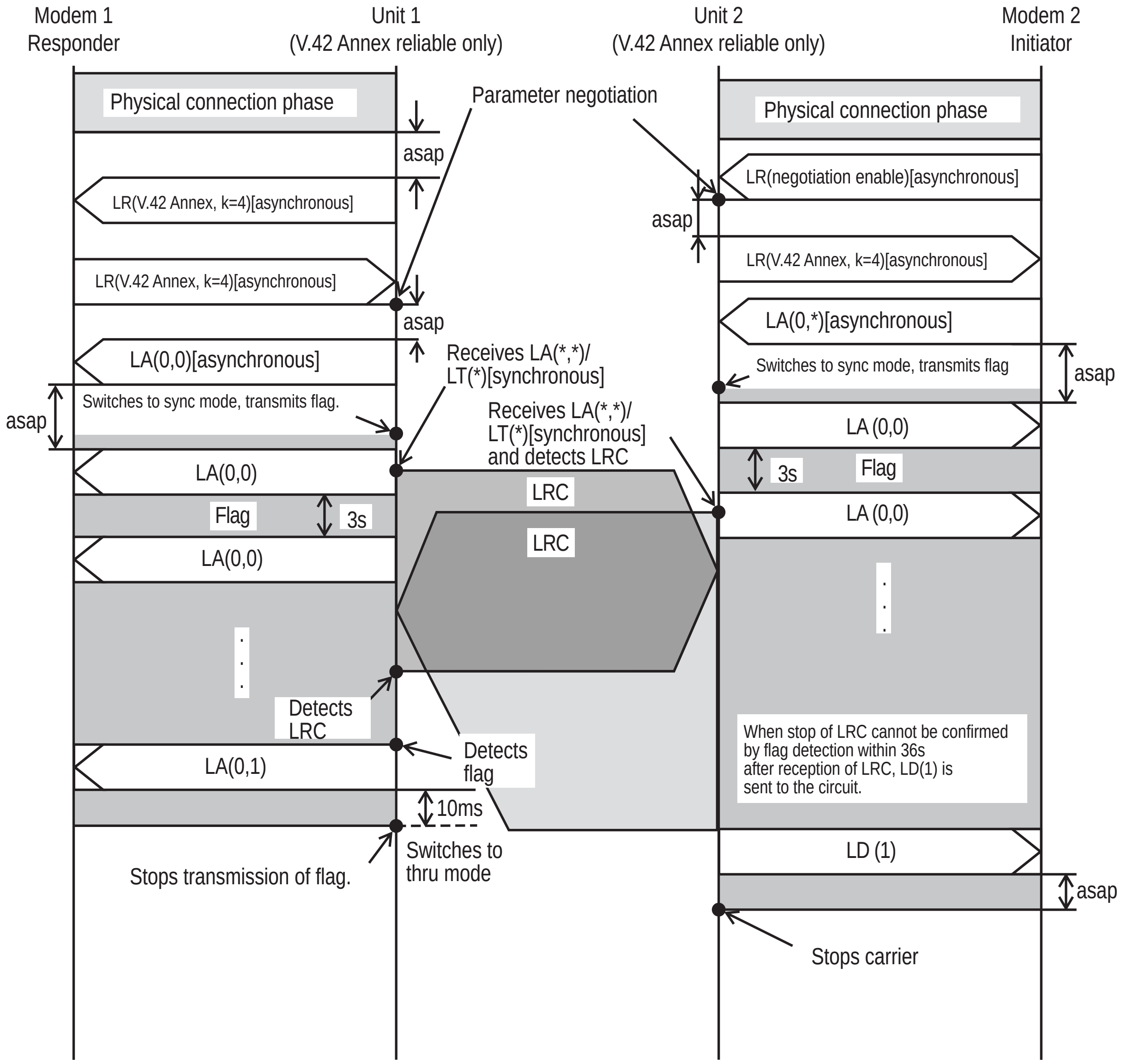


Fig. 4.3.2.18 : Protocol establishment procedure (LRC stop unacknowledged [2])
• MODEM 1 responder operation
• MODEM 2 initiator operation

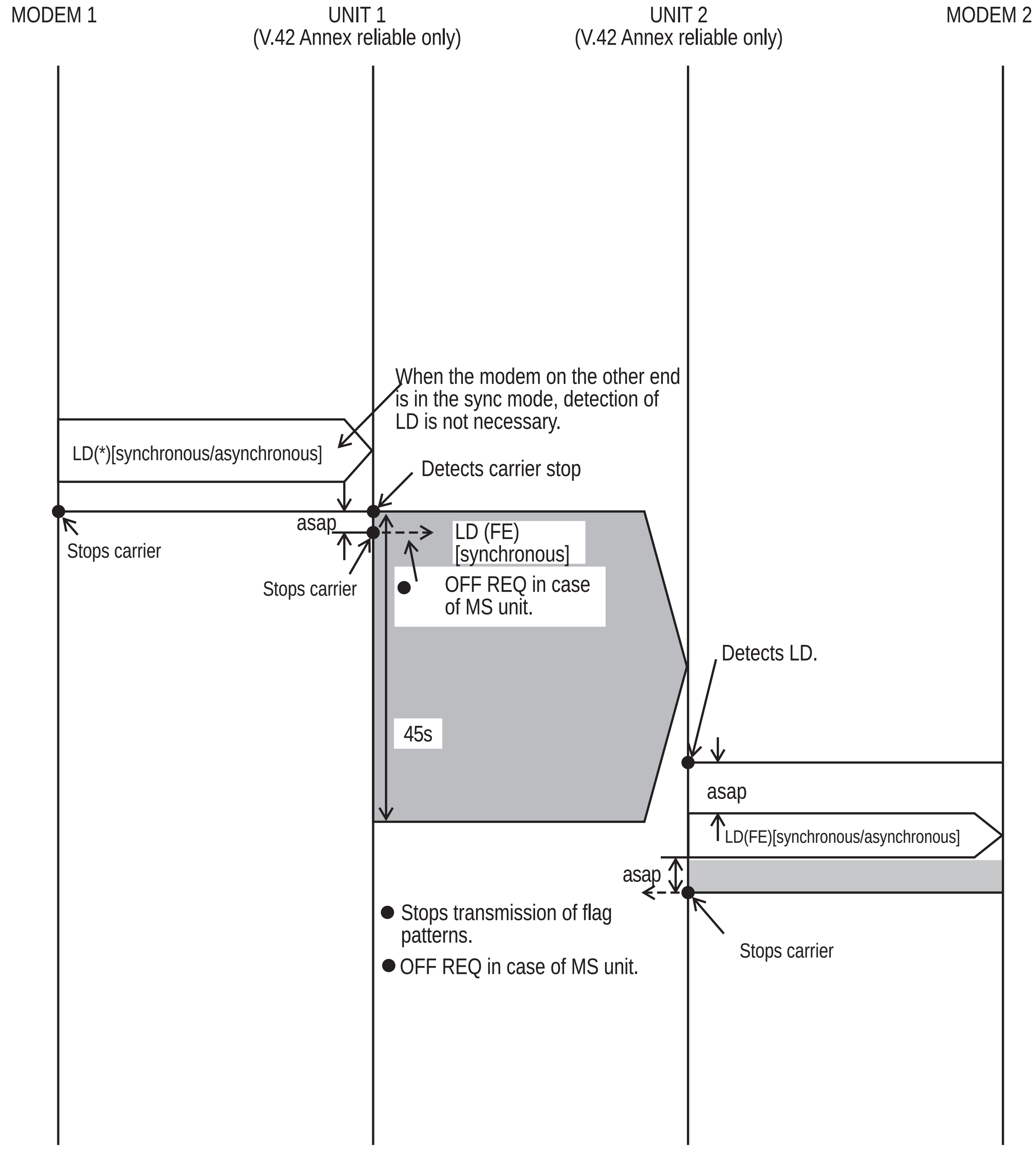
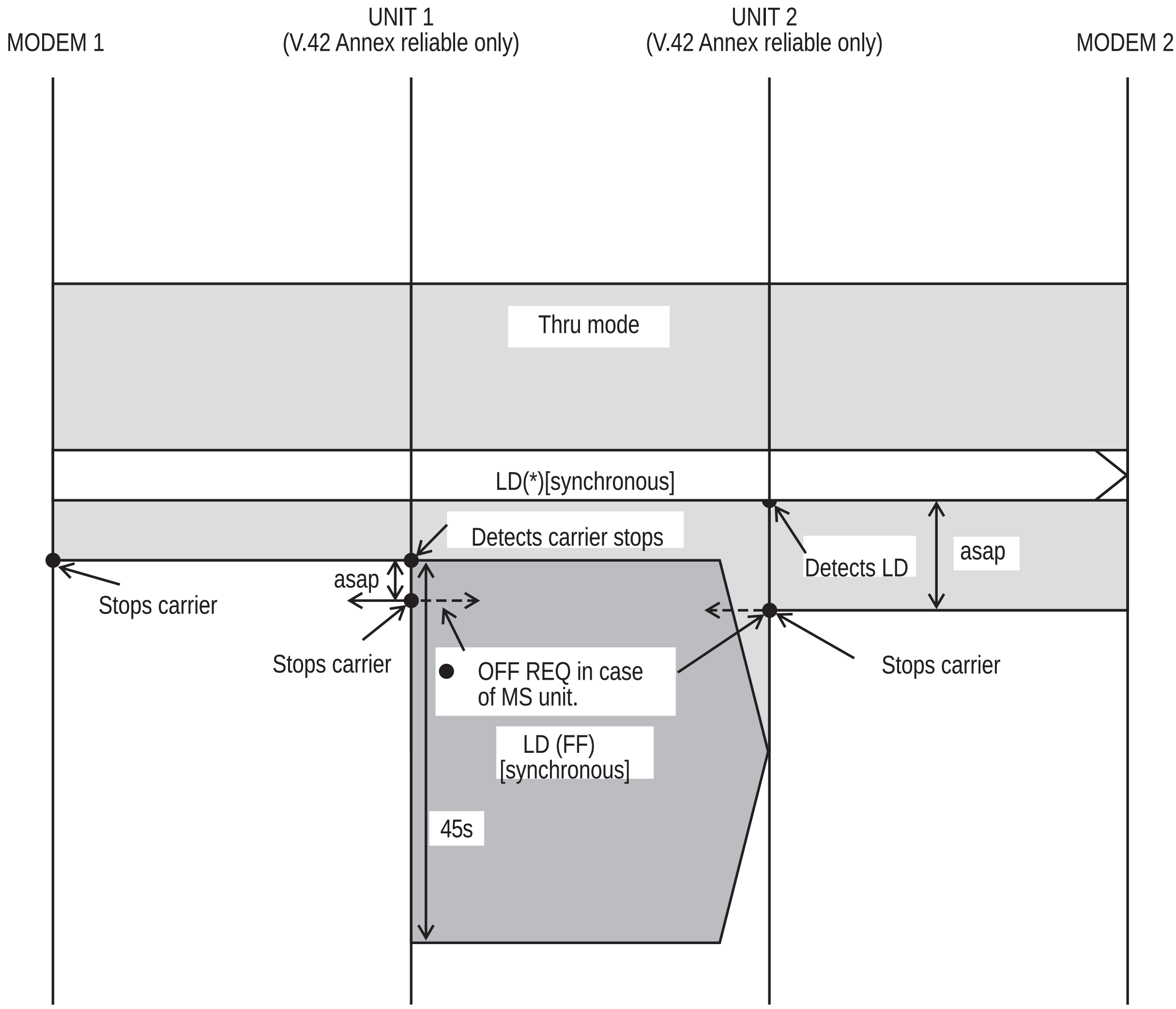


Fig. 4.3.2.19 : Protocol establishment procedure (LD reception)
-- Control mode --



Note : If instantaneous cut-off continues more than 700ms,
it is assumed as carrier cut-off.

Fig. 4.4.1 : Disconnection procedure
-- Thru mode --

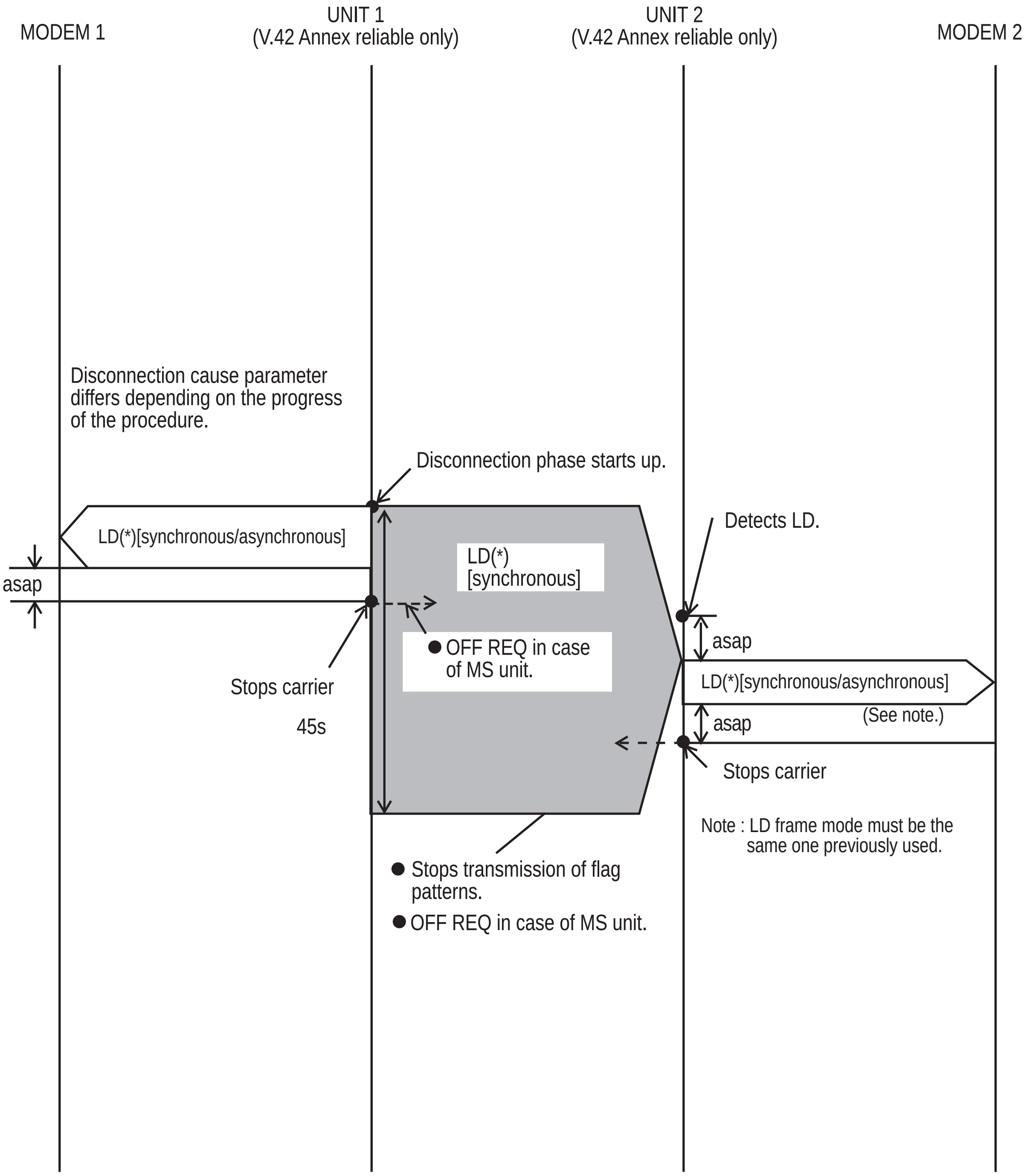


Fig. 4.4.2.1 : Disconnection procedure (disconnection phase start-up)
-- Control mode --

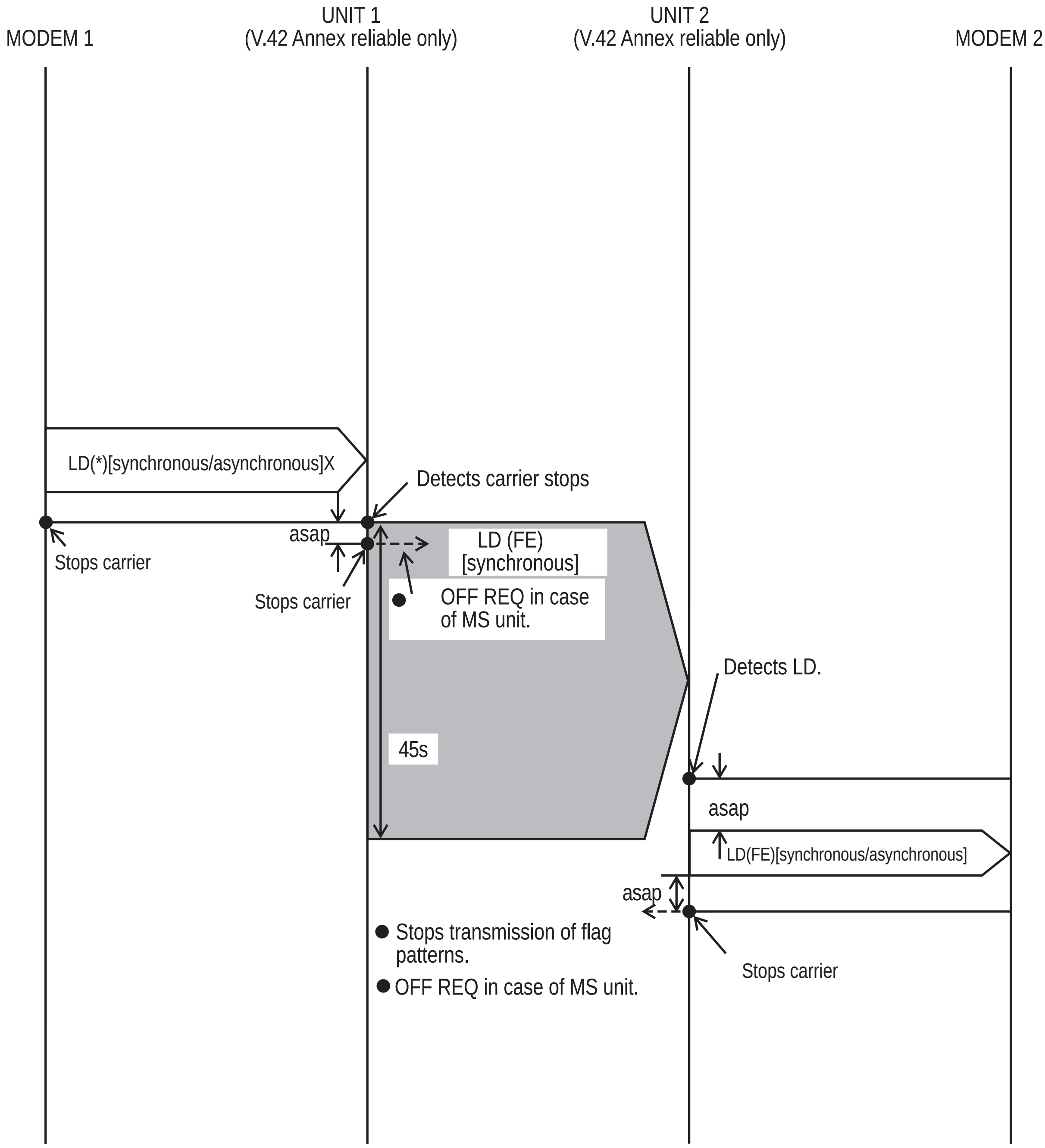


Fig. 4.4.2.2 : Disconnection procedure (LD errors [1])
-- Control mode --

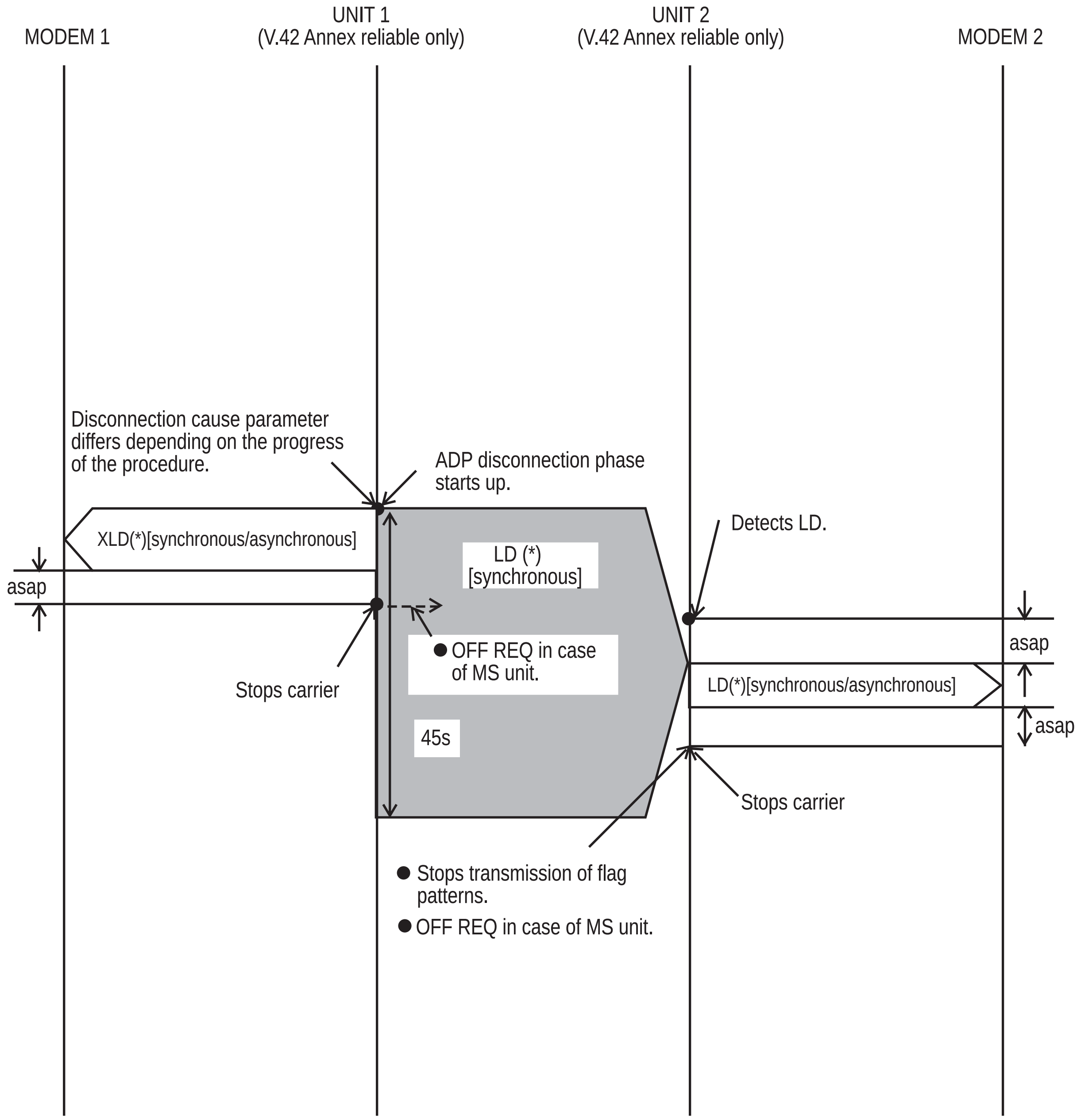


Fig. 4.4.2.3 : Disconnection procedure (LD errors [2]))
-- Control mode --

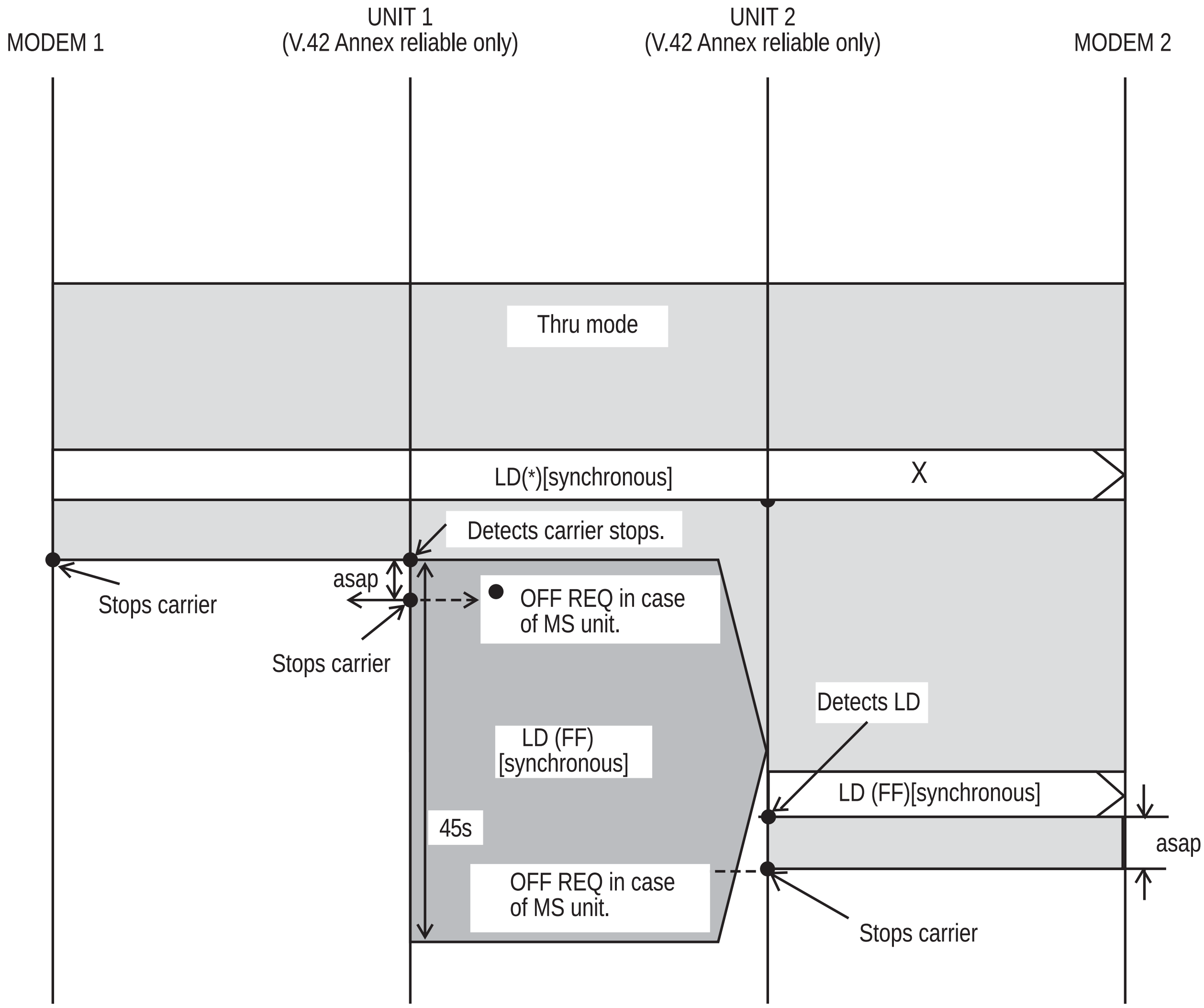


Fig. 4.4.2.4 : Disconnection procedure (LD errors [3])
--Thru mode --

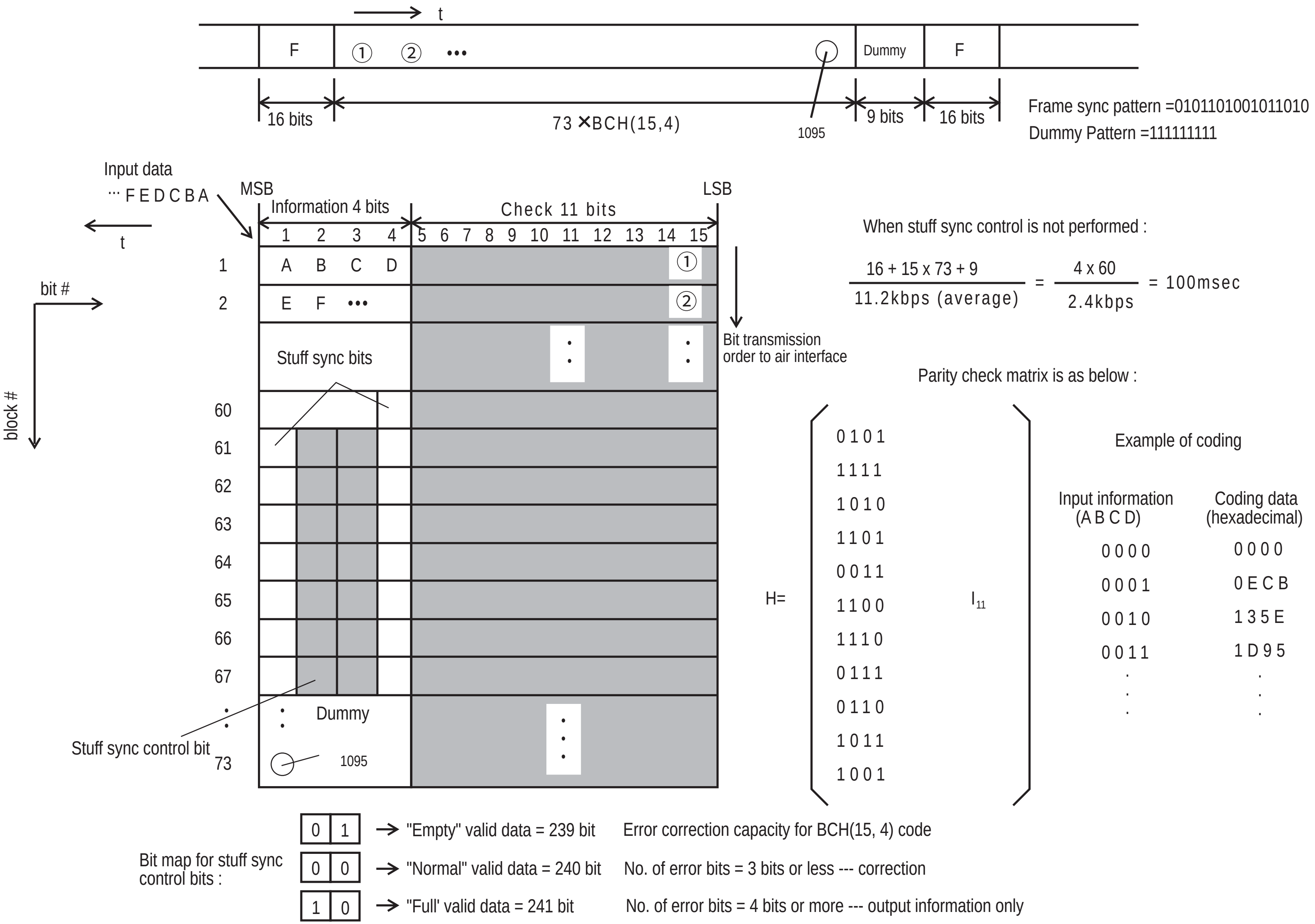


Fig. 4.5.1 : Frame structure

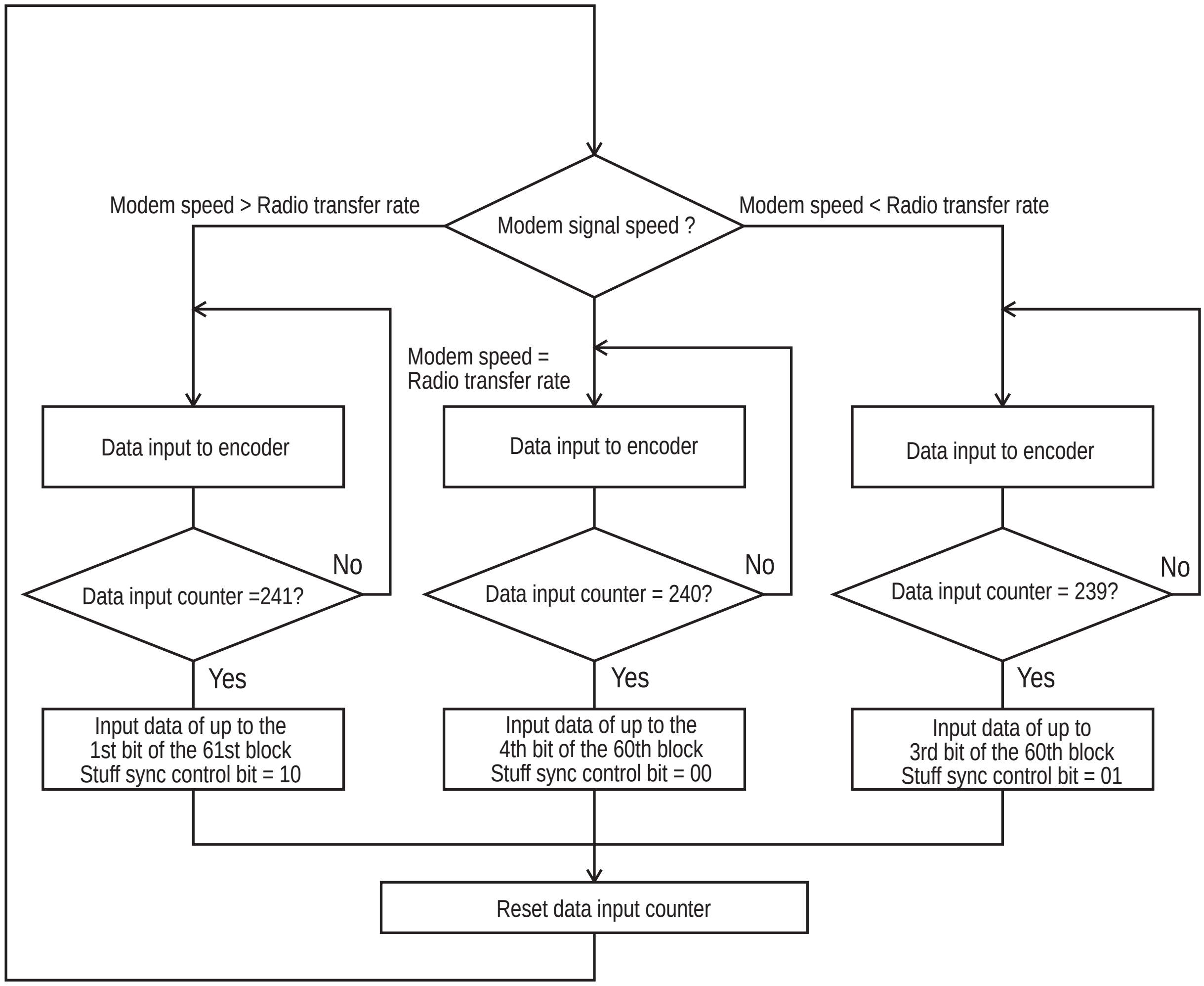


Fig. 4.5.2.1 : Stuff sync control flow (transmission side)

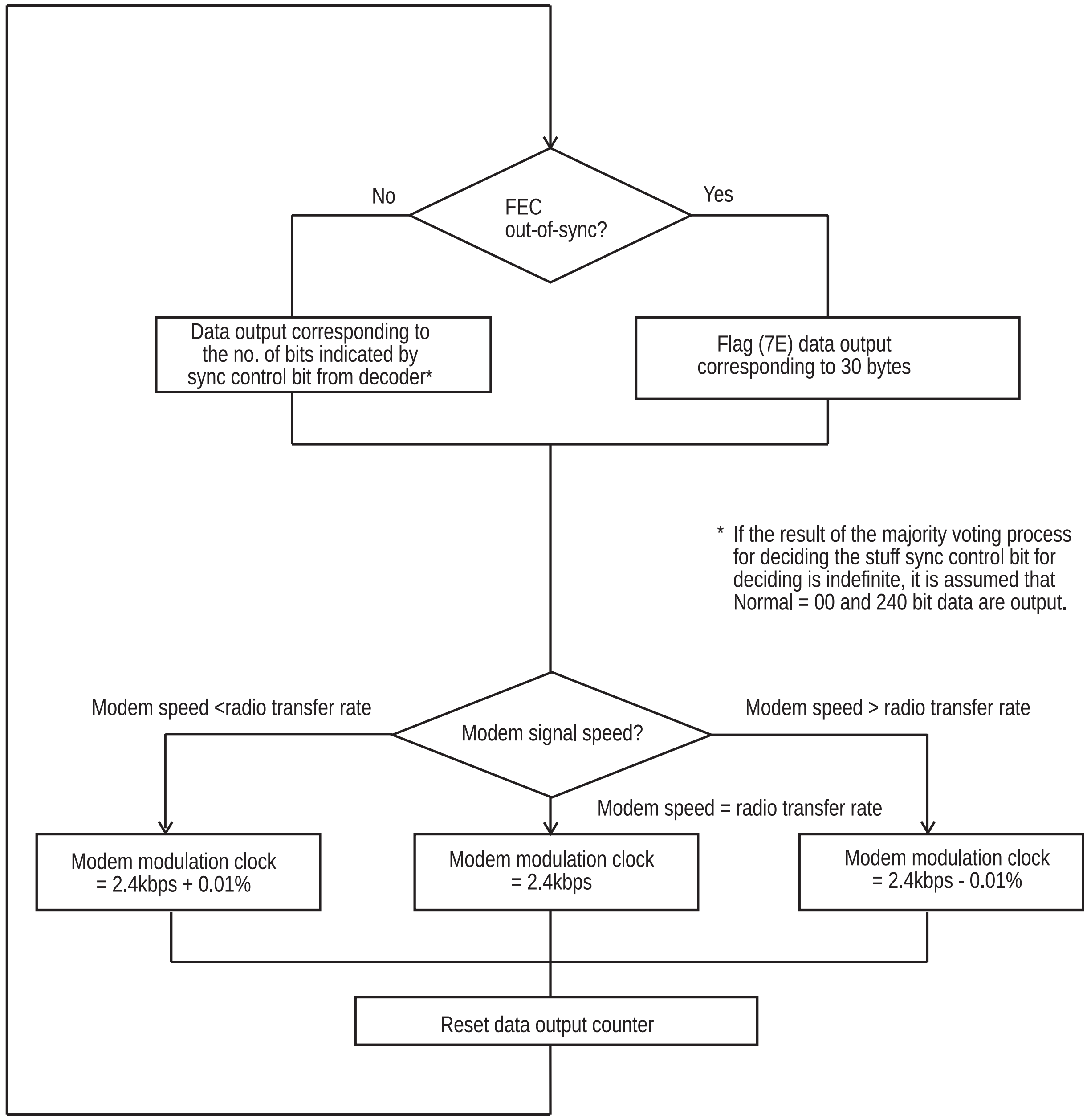


Fig. 4.5.2.2 : Stuff sync control flow (reception side)

5. G3 Facsimile ECM communication procedure

5.1 Overview of communication procedure

The ECM communication procedures are based on section 3 (Fig. 3.1.1) "G3 facsimile communication procedures." Therefore, all or parts of section 3.2 "Pre-message procedure," Section 3.5 " List of thresholds" and section 3.6 "Error control" shall also apply to this procedure.

Phases B, C and D shall comply with ITU-T T.30 and T.30 Annex A and T.4 Annex A .

Refer to Section 2 for activation and deactivation procedures in the same manner as for non-ECM procedures.

Details of each phase are described in the following sections.

5.2 Pre-message procedure (Phase B)

The procedure for the transmission side unit is shown in Fig. 5.2.T.B.1 and the procedure for the reception side unit is shown in Fig. 5.2.R.B.1. Fig. 5.2.T.B.2 shows the method for waiting for both V.21 and V.27ter/V.29 on the transmission unit side.

5.2.1 Transmission procedure on the activating side

The pre-message procedure for transmission on the activating side is illustrated in Fig. 5.2.1.1 while the output conditions for "TCF error detection" signal is shown in Fig. 5.2.1.2. The selection algorithm for CFR//CRP/FTT is illustrated in Fig. 5.2.1.3; the output conditions for FTT and the specified speed decision algorithm for DCS is shown in Fig. 5.2.1.4.

5.2.2 Reception procedure on the activating side

The pre-message procedure for reception on the activating side is shown in Fig. 5.2.2.

5.3 Image signal transmission (Phase C)

The image signal transmission procedure for the transmitting unit during ECM communications is shown in Fig. 5.3.T.C.1 while the procedure for the receiving unit is shown in Fig. 5.3.R.C.1.

The format for the image signal transmitted in the air interface during ECM communications is shown in Fig. 5.3.T.C.2, while the flag insertion method is shown in Fig. 5.3.R.C.2 and the various control threshold values in the ECM sequence are listed in Table 5.3.R.C.3.

5.4 Post-message procedure (Phase D)

The basic control flow for the transmitting unit in phase D is shown in Figs. 5.4.T.D.1 and 5.4.T.D.2. In relation to the control on the transmitting side, the response selection flow is shown in Figs. 5.4.T.D.3 and 5.4.T.D.4 while the command reception subroutine is shown in Fig. 5.4.T.D.5.

The basic control flow on the receiving unit in phase D is shown in Figs. 5.4.R.D.1 and 5.4.R.D.2. Fig. 5.4.R.D.3 illustrates the wait control flow, Fig. 5.4.R.D.4 shows response reception control flow, while Fig. 5.4.R.D.5 shows the RR response reception control flow. Fig. 5.4.R.E.1 shows the release flow for the receiving unit.

Details of individual controls are given in the following sections :

5.4.1 Block end control

The block end control (PPS-NULL) flow is shown in Fig. 5.4.1.R.D.1.

5.4.2 Multi-page control

The multi-page control (PPS-MPS) flow is shown in Fig. 5.4.2.R.D.1.

5.4.3 Procedure end control

The procedure end control (PPS-EOP) flow is shown in Fig. 5.4.3.R.D.1.

5.4.4 Message end control

The message end control (PPS-EOM) flow is shown in Fig. 5.4.4.R.D.1.

5.4.5 Retransmission end procedure

The block end control (EOR-NULL) flow in the retransmission end procedure is shown in Fig. 5.4.5.R.D.1.

The multi-page control (EOR-MPS) flow in the retransmission end procedure is shown in Fig. 5.4.5.R.D.2.

The procedure end control (EOR-EOP) flow in the retransmission end procedure is shown in Fig. 5.4.5.R.D.3.

The message end control (EOR-EOM) flow in the retransmission end procedure is shown in Fig. 5.4.5.R.D.4.

Appendix I. Setting method for parameter RTF in the ARQ procedure

This appendix describes the setting method for parameter RTF in the ARQ procedure. In making decisions on the RTF value, network operators must understand concrete values for each of the following items :

i) Internal processing time for ADP and IWF related to ARQ operation (i.e., the time required for transmitting ACK/NAK in response to the reception frame).

ii) Maximum buffering time (during transmission and reception) for TCH frames inside the MS.

iii) Maximum delay in the radio transmission path (including the processing delay for TCH frames in the radio equipment in the BS)

iv) Maximum transmission delay between stations from the radio BS to IWF.

Values of i) through iv) above are summed up for the routes from ADP to IWF and from IWF to ADP respectively, and converted to the corresponding number of ARQ frames and these values are assumed as RTF values.

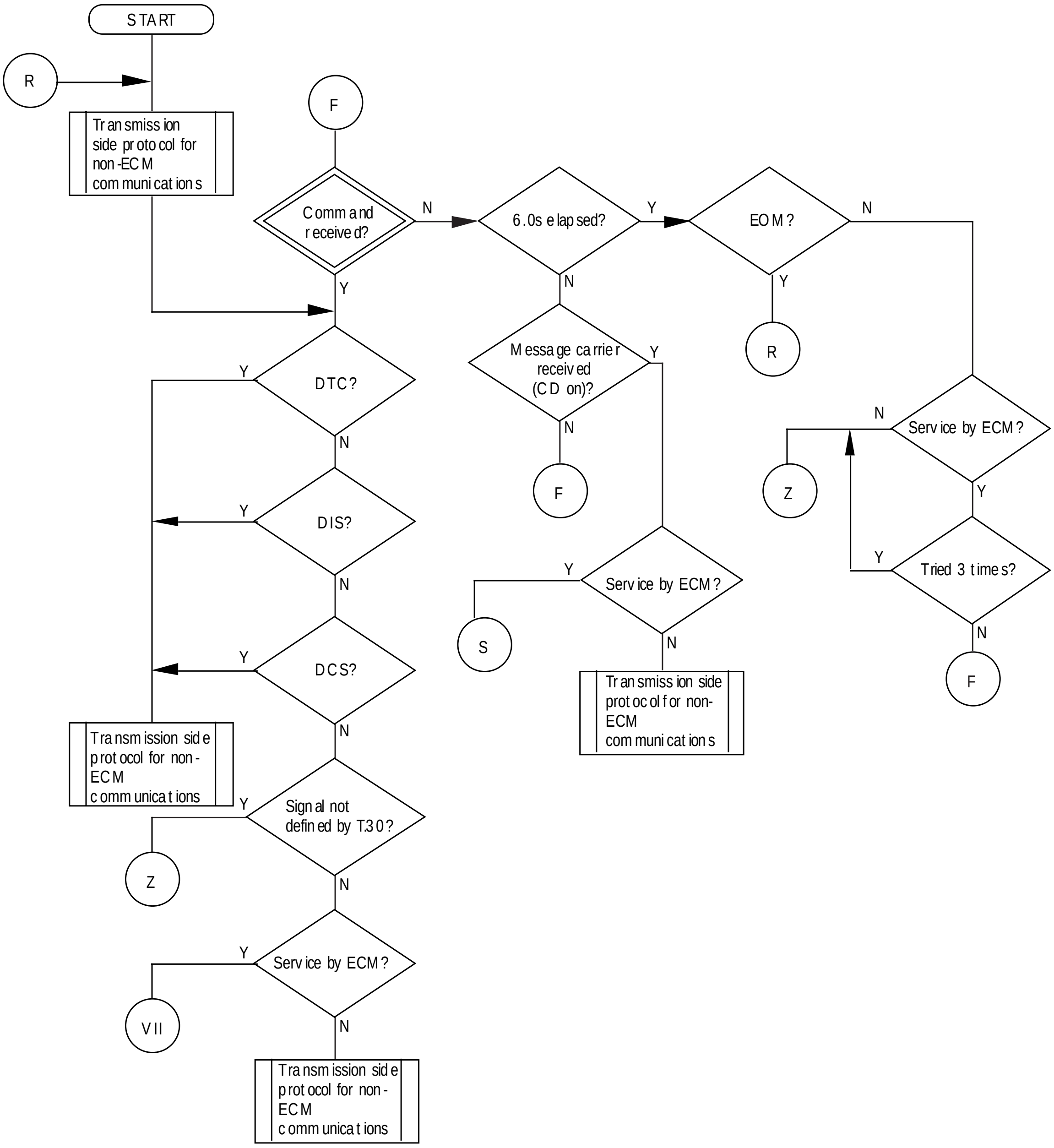


Fig. 5.2.T.B.1 : Transmission side unit, Phase B

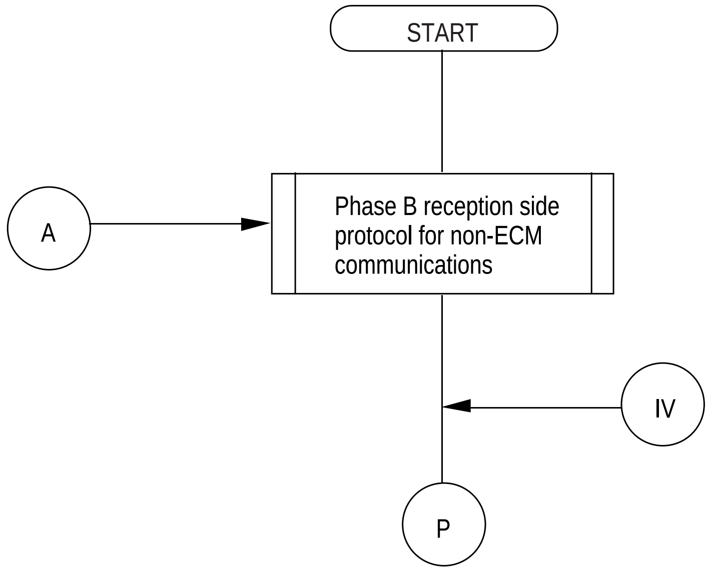


Fig. 5.2.R.B.1 : Reception side unit, Phase B

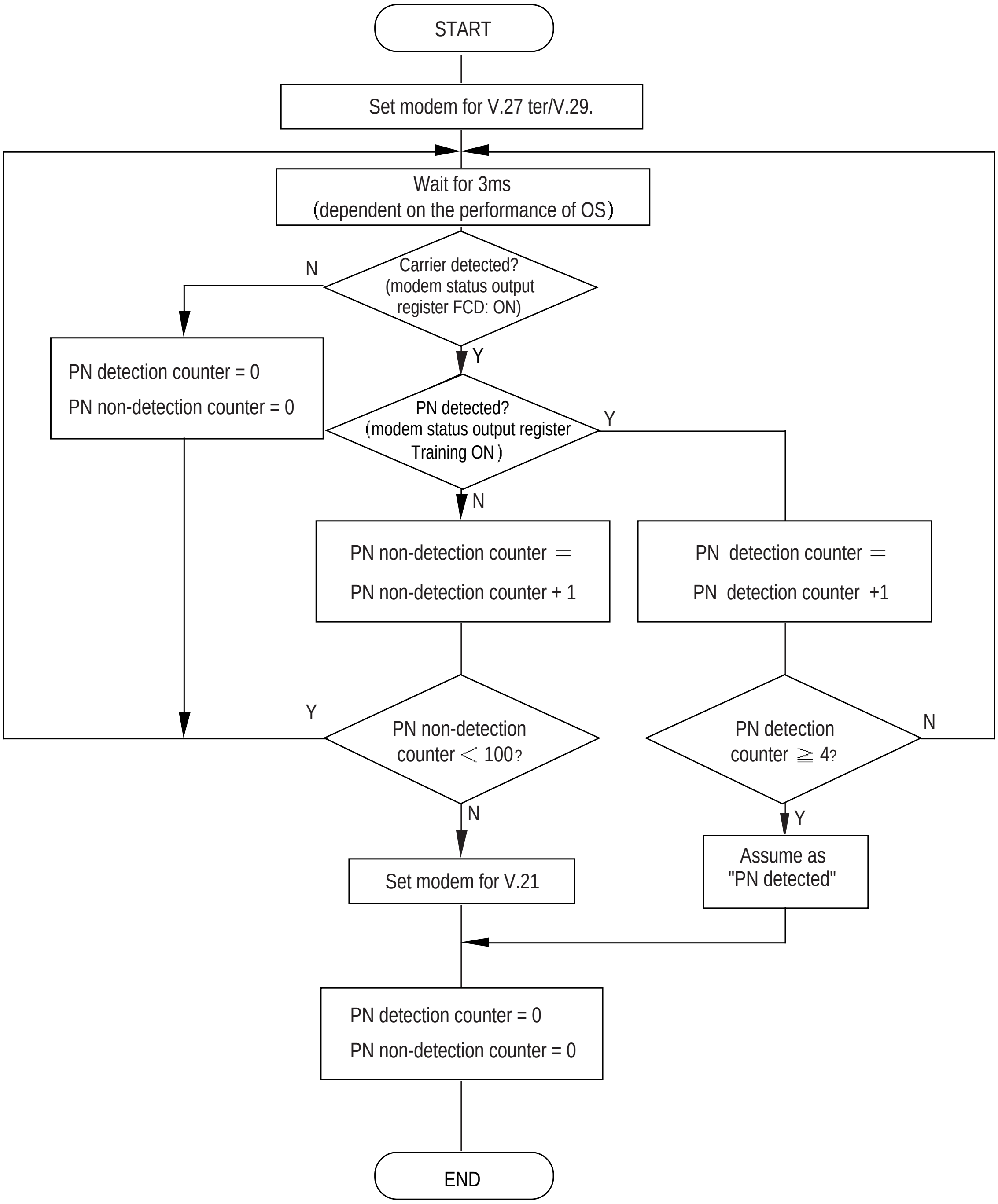


Fig. 5.2.T.B.2 : Standby methods for both V.21 and V.27ter/V.29

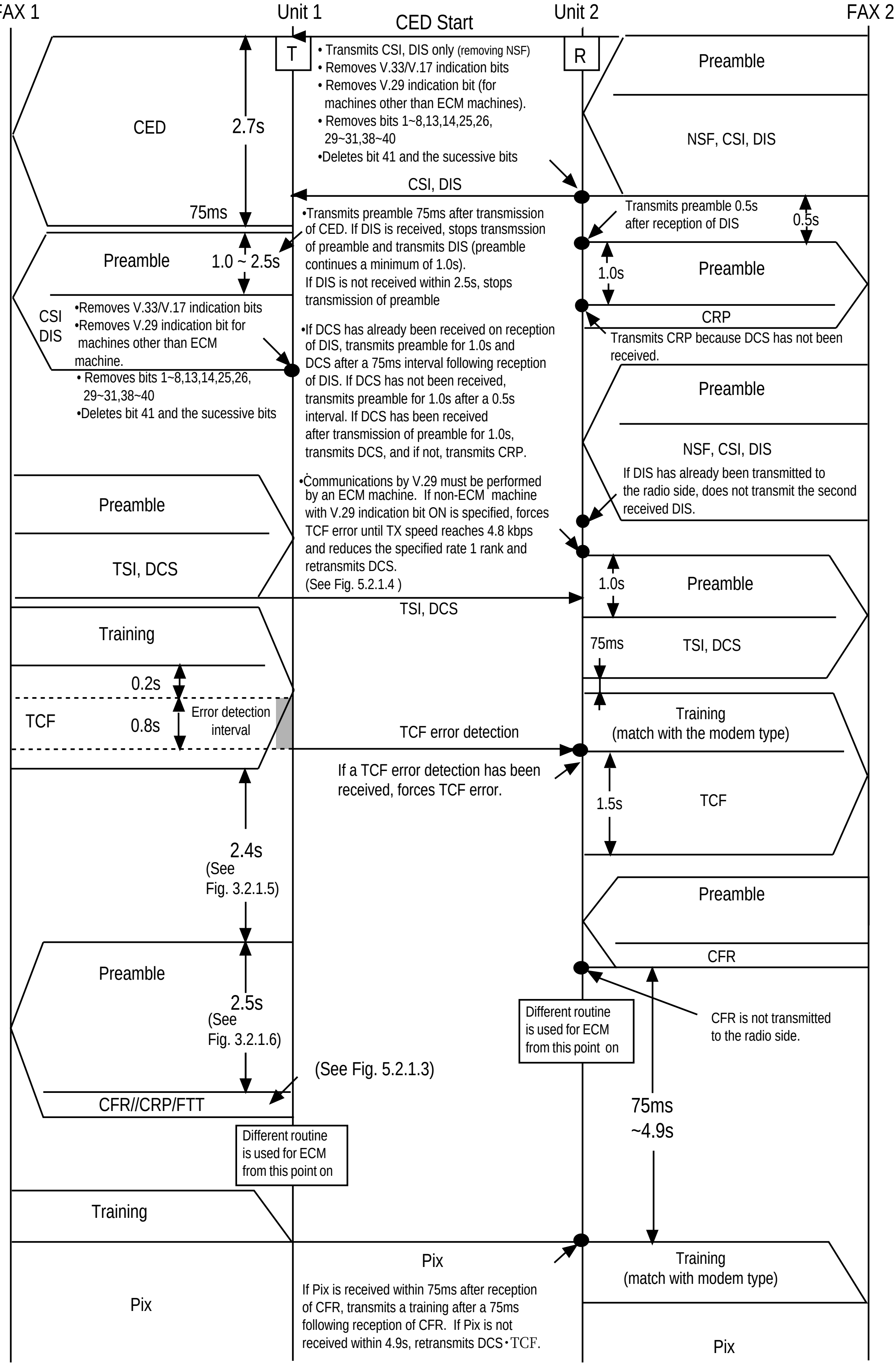


Fig. 5.2.1.1 : Pre-message procedure (Transmission on the activating side)

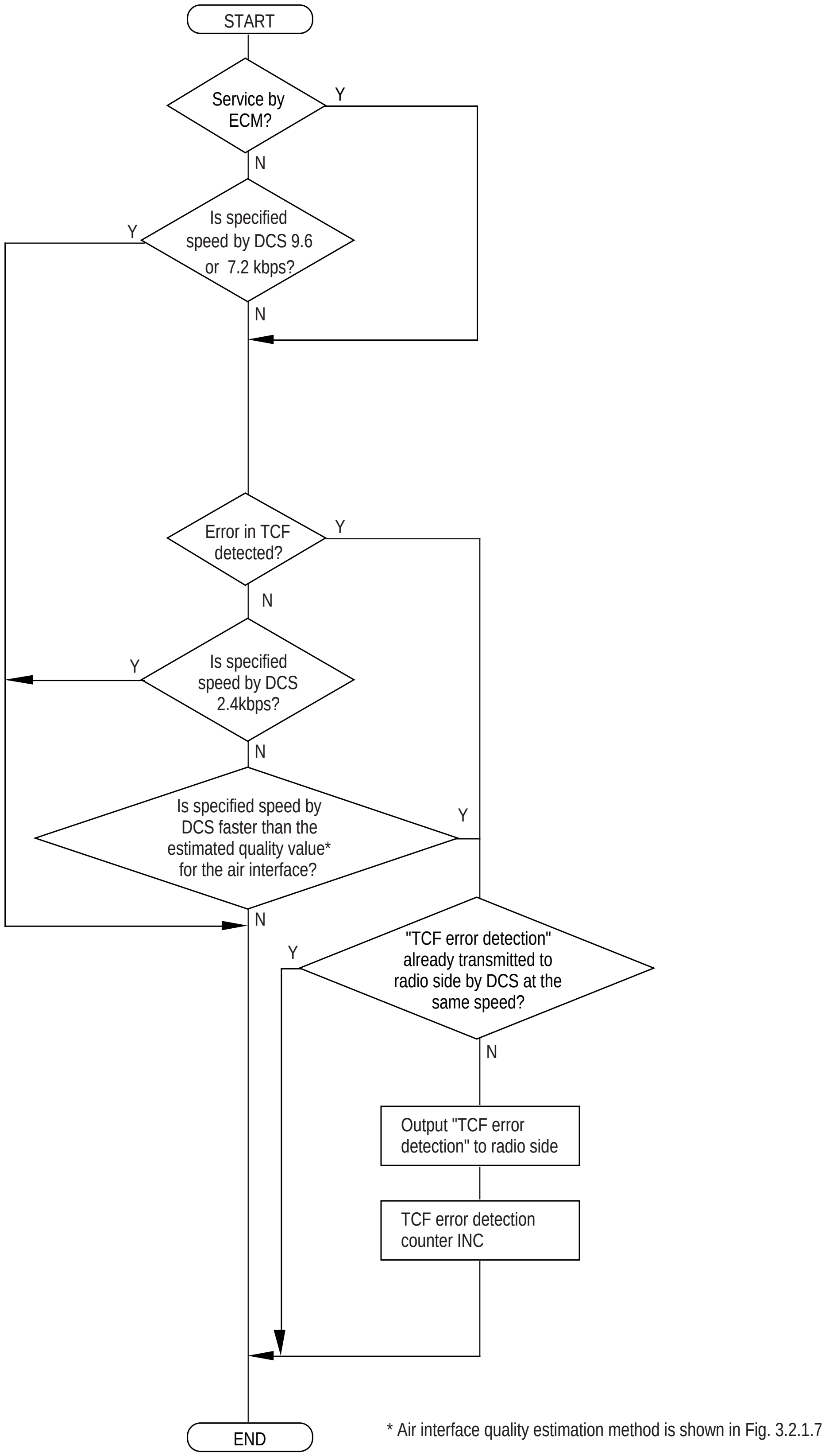


Fig. 5.2.1.2 : Output conditions for "TCF error detection"

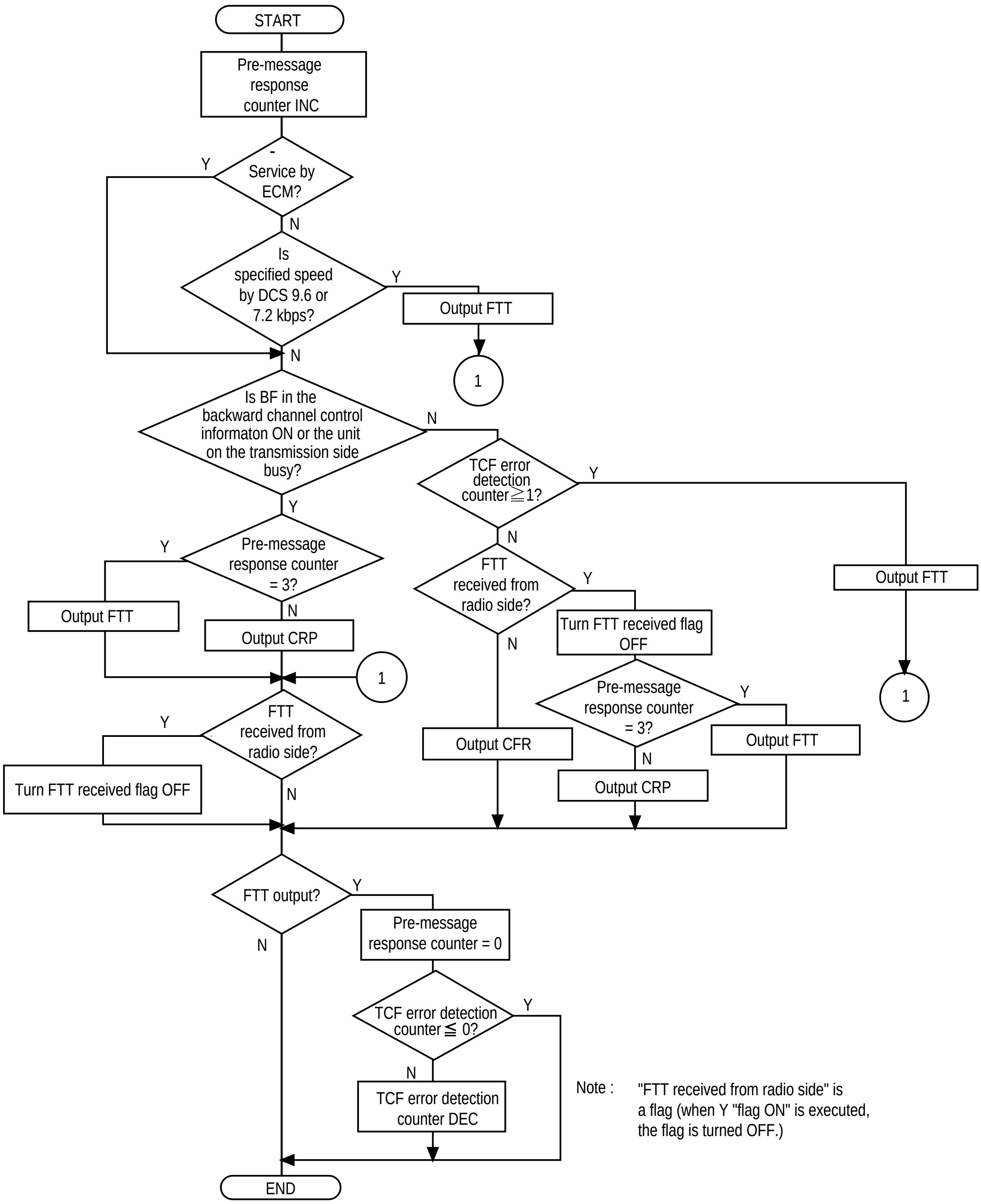


Fig. 5.2.1.3 : CFR//CRP/FTT Selection Algorithm

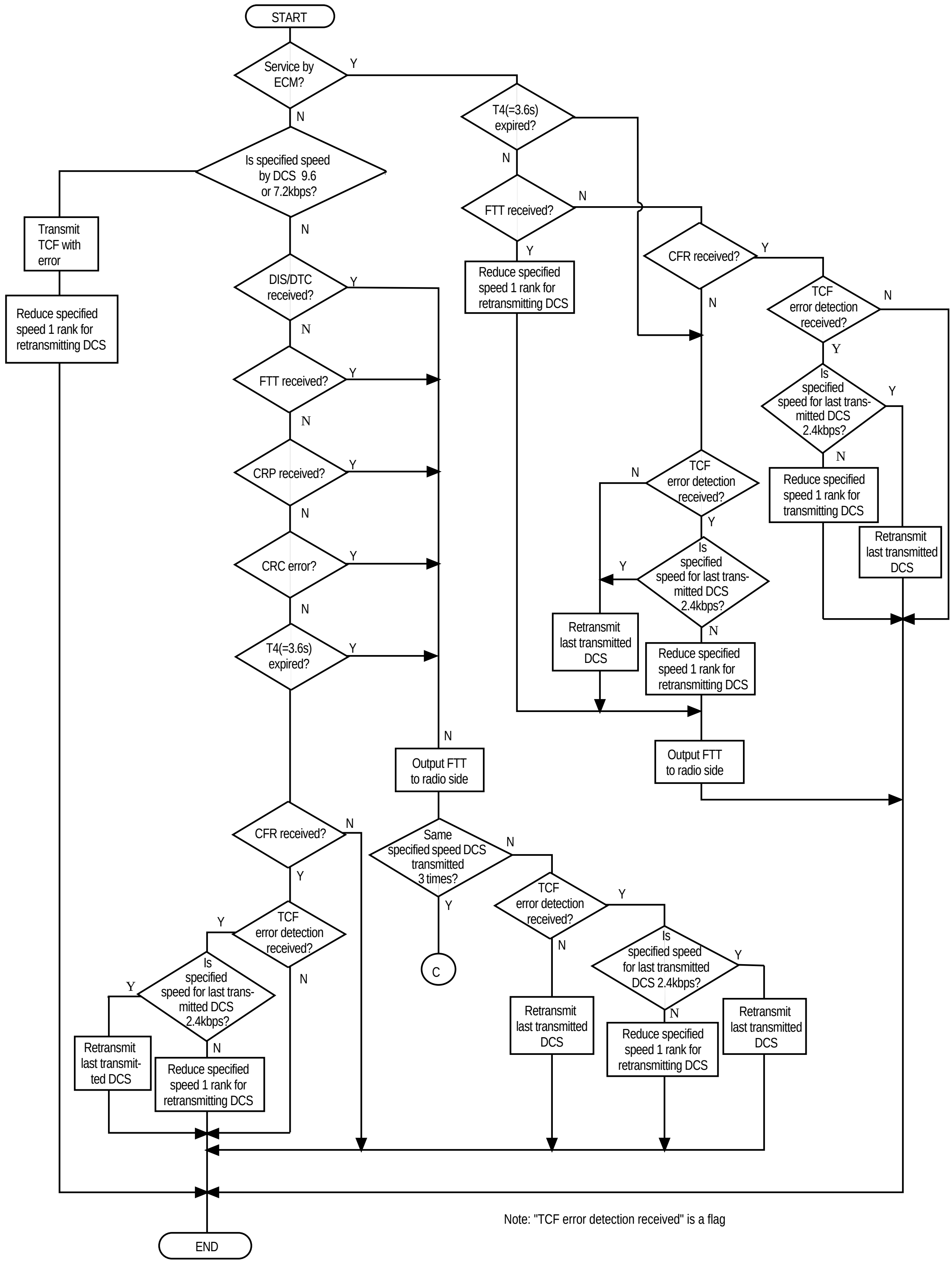


Fig. 5.2.1.4 : FTT Output conditions and DCS specified speed decision algorithm

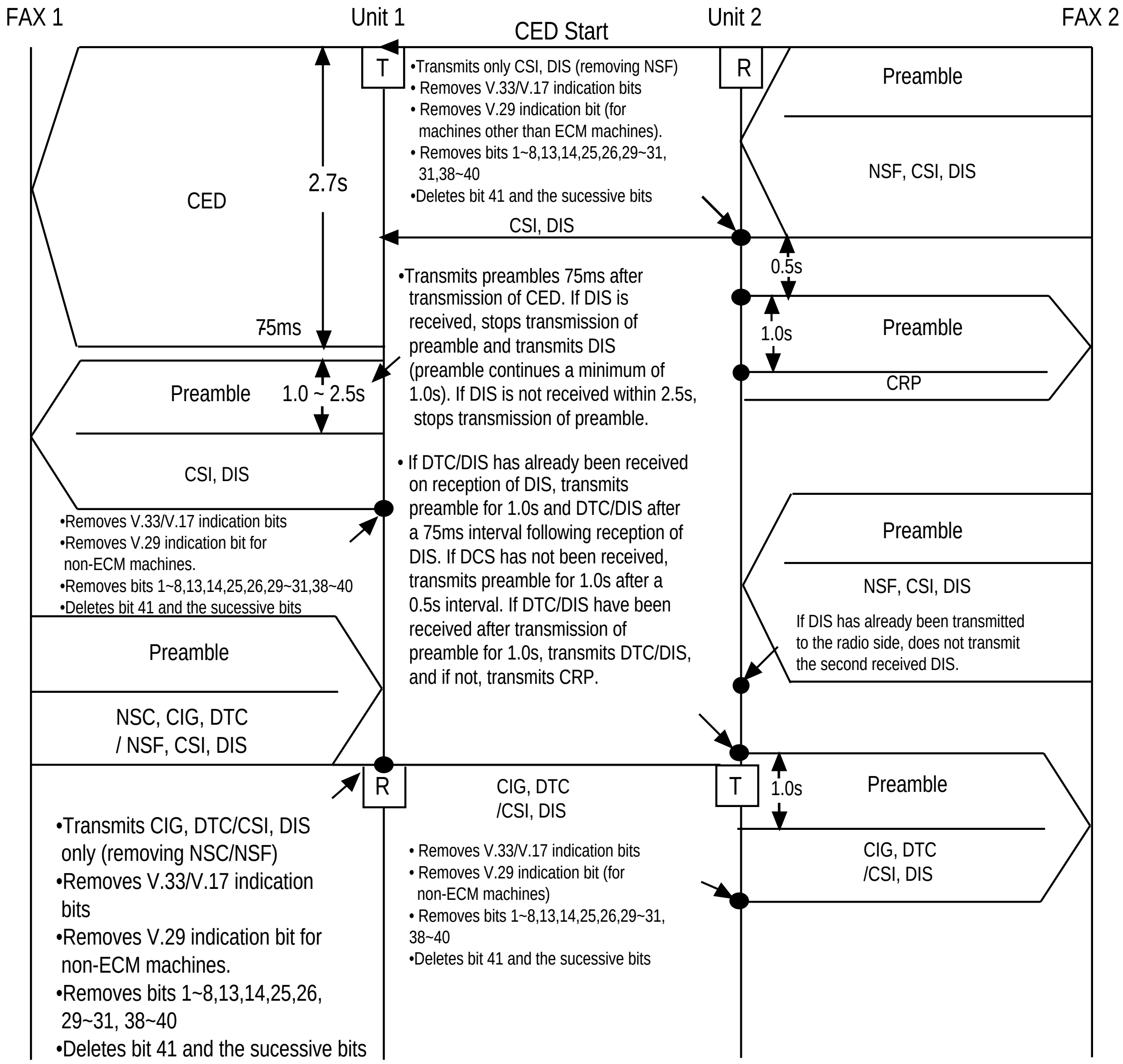


Fig. 5.2.2 : Phase B (Reception on the activating side)

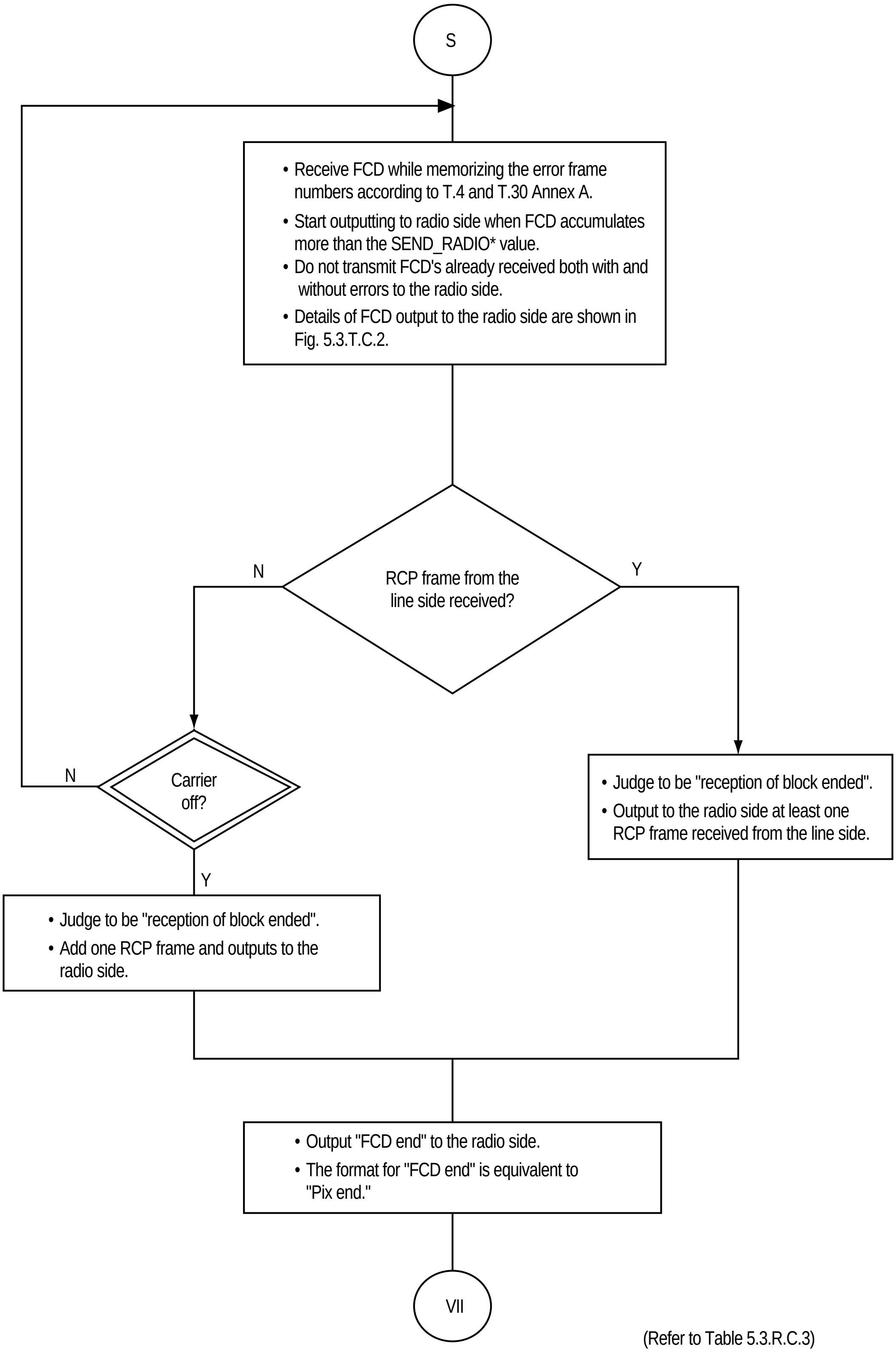
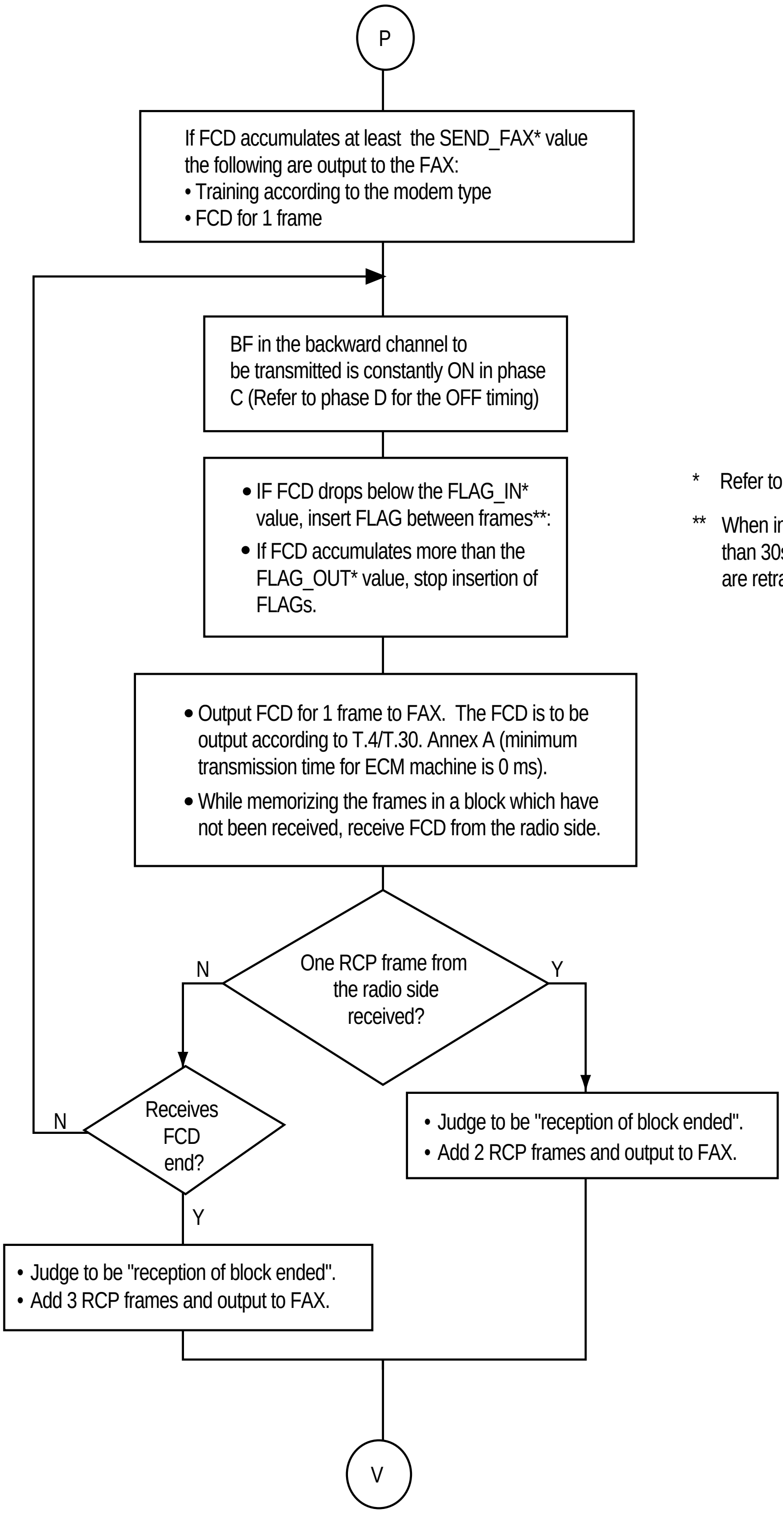


Fig. 5.3.T.C.1 : Transmission side unit, Phase C



* Refer to Table 5.3.R.C.3.

** When inserting FLAGs continuously for more than 30s, frames in the accumulated blocks are retransmitted. (Refer to Fig. 5.3.R.C.2.)

Fig. 5.3 R.C.1 : Reception unit, Phase C

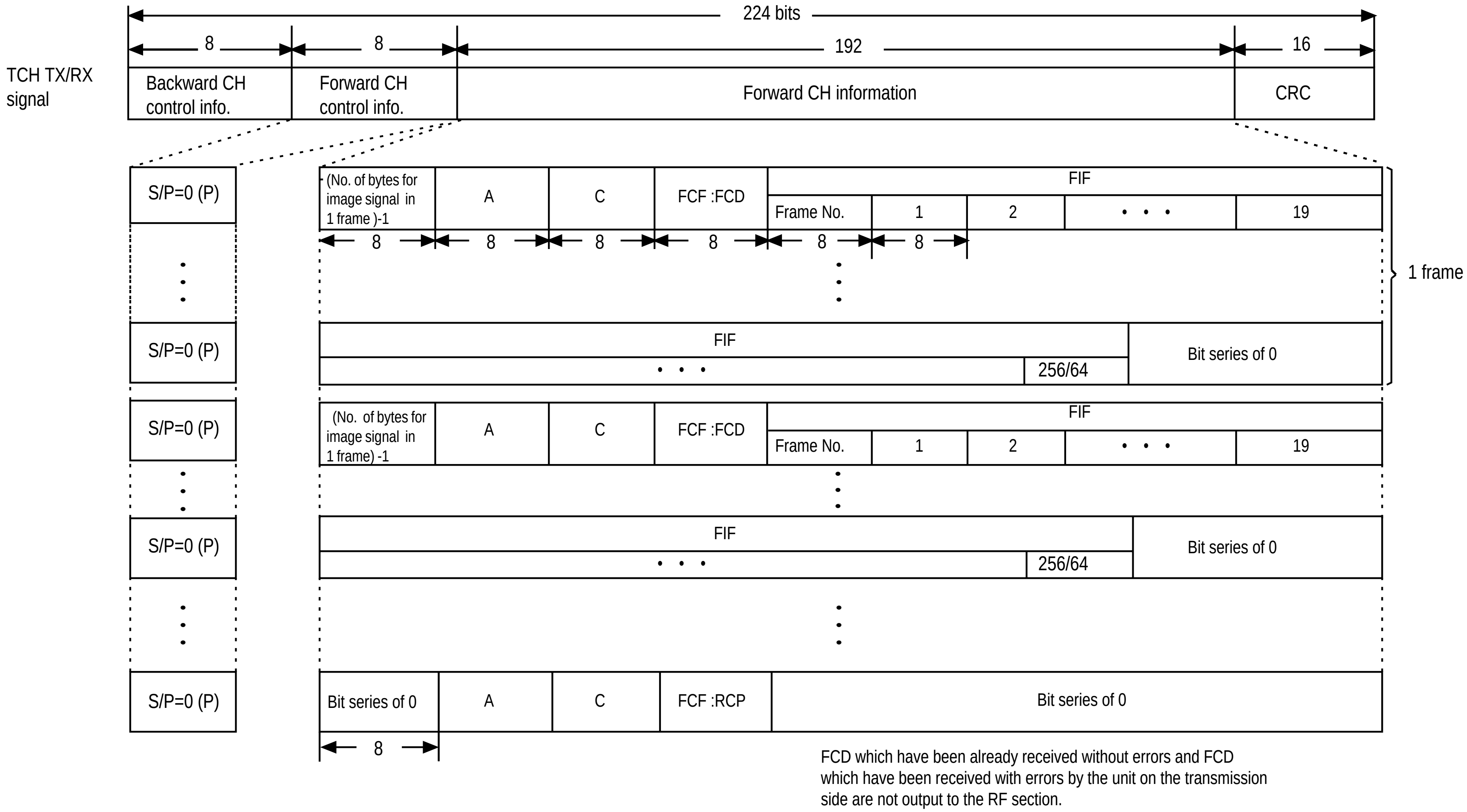


Fig. 5.3.T.C.2 : Format for image signals transmitted in the RF section with ECM

Flag Insertion Method

Processing method

As shown in the figure below, the last received frame is retransmitted. If it is impossible to transmit the next frame before the third 50s flag is completely transmitted, DCN is transmitted to both radio and line.

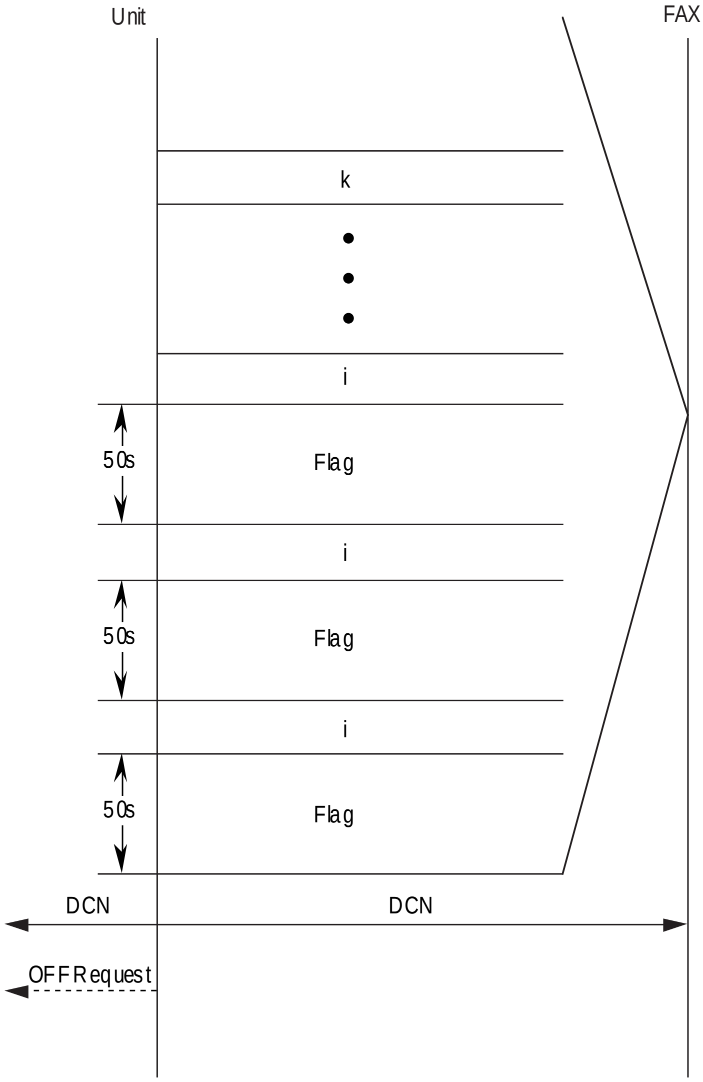


Fig. 5.3.R.C.2 : Flag insertion method

Table 5.3.R.C.3 : ECM : Threshold values on the ECM sequence

No	Name	Definition	Value
13	Flag insertion value [FLAG_IN]	Accumulation area value to start inserting flags between Pix signals to be transmitted to the FAX when Pix data in the Pix memory is insufficient for the image reception side unit during ECM service.	Accumulation area in the Pix memory is 0.28 k-byte or less
14	Flag insertion cancel value [FLAG_OUT]	Accumulation area value to cancel insertion of flags when the Pix data in the Pix memory increases in the image reception side unit during ECM service.	Accumulation area in the Pix memory exceeds 0.4 k-byte

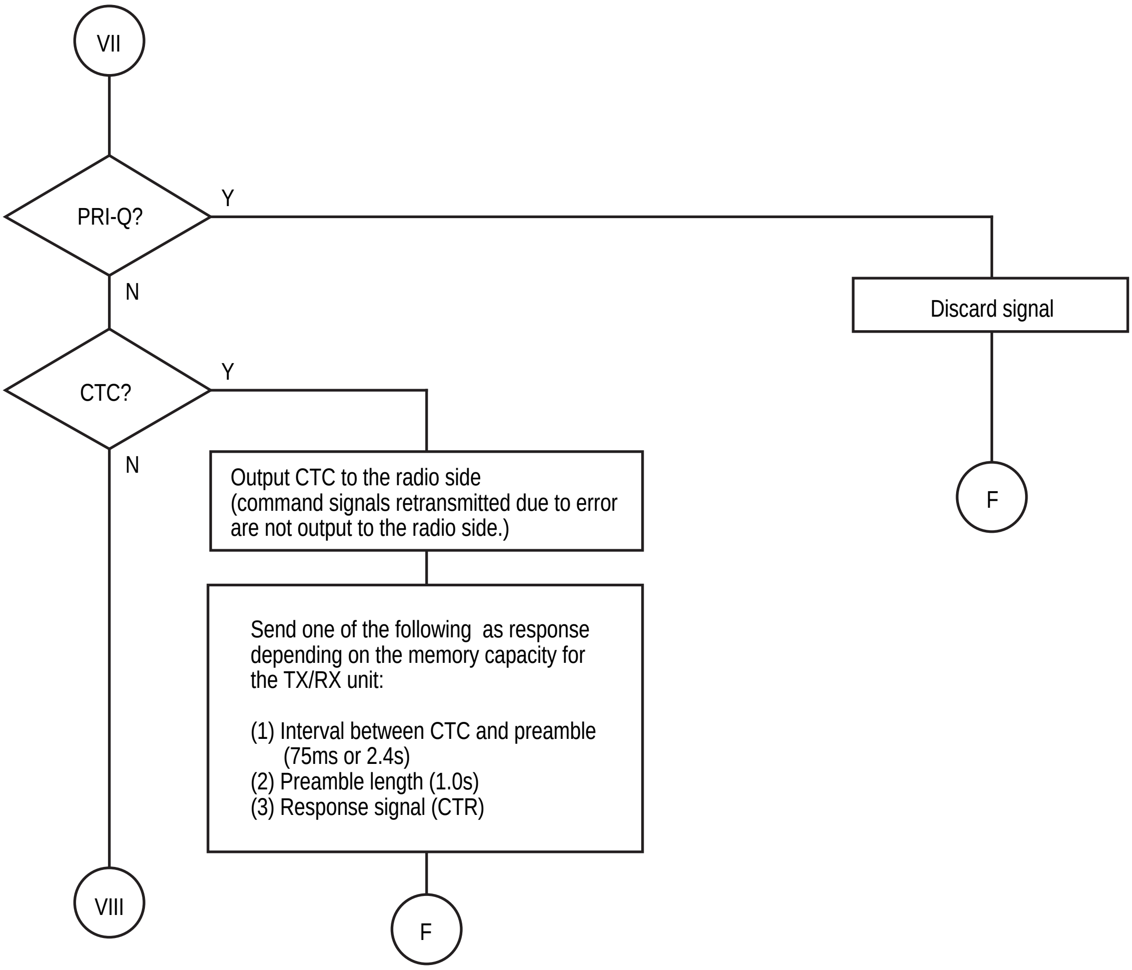


Fig. 5.4.T.D.1 : Transmission unit, Phase D (Basic control flow 1)

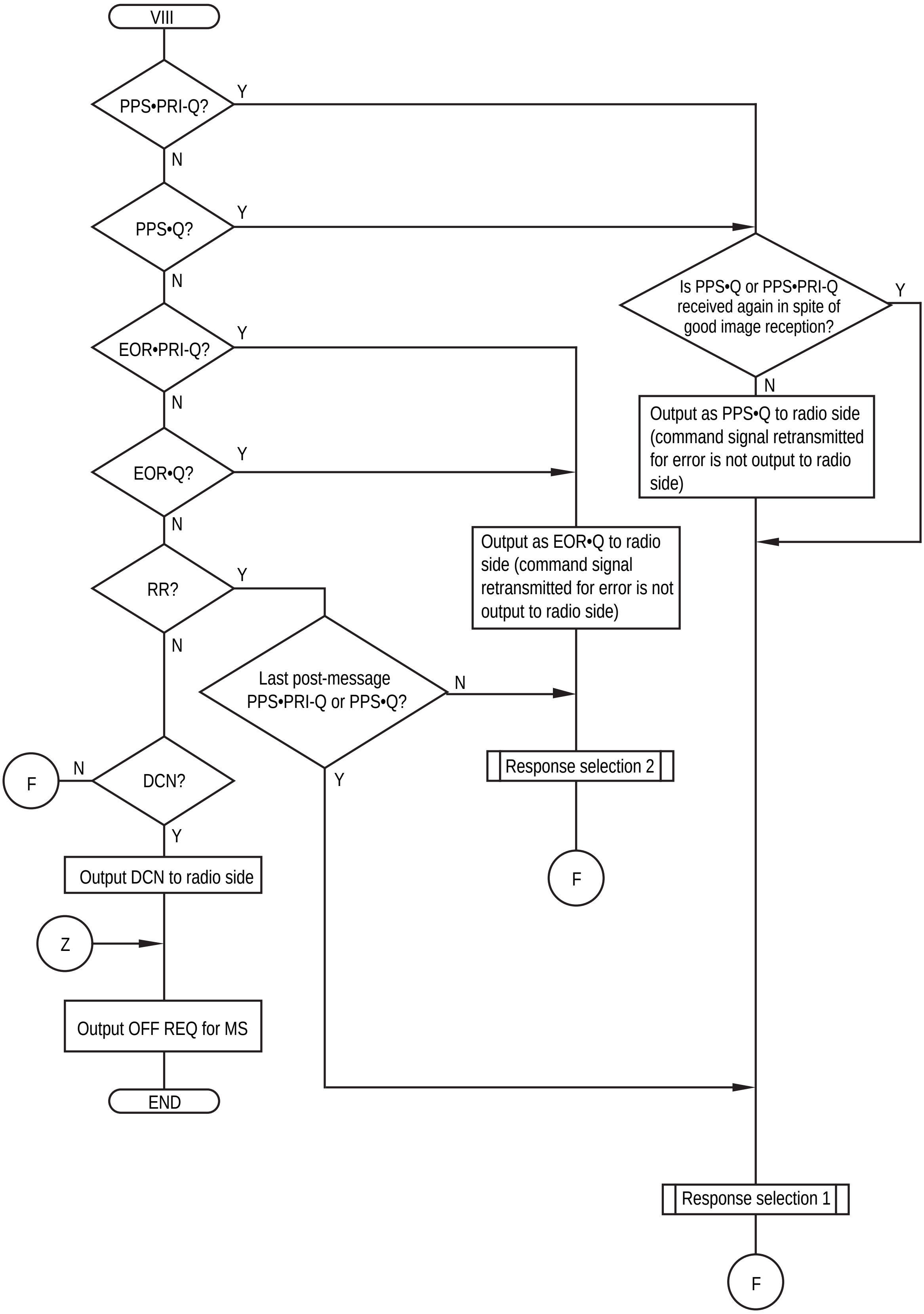


Fig. 5.4.T.D.2 : Transmission side unit, Phase D (Basic control flow 2)

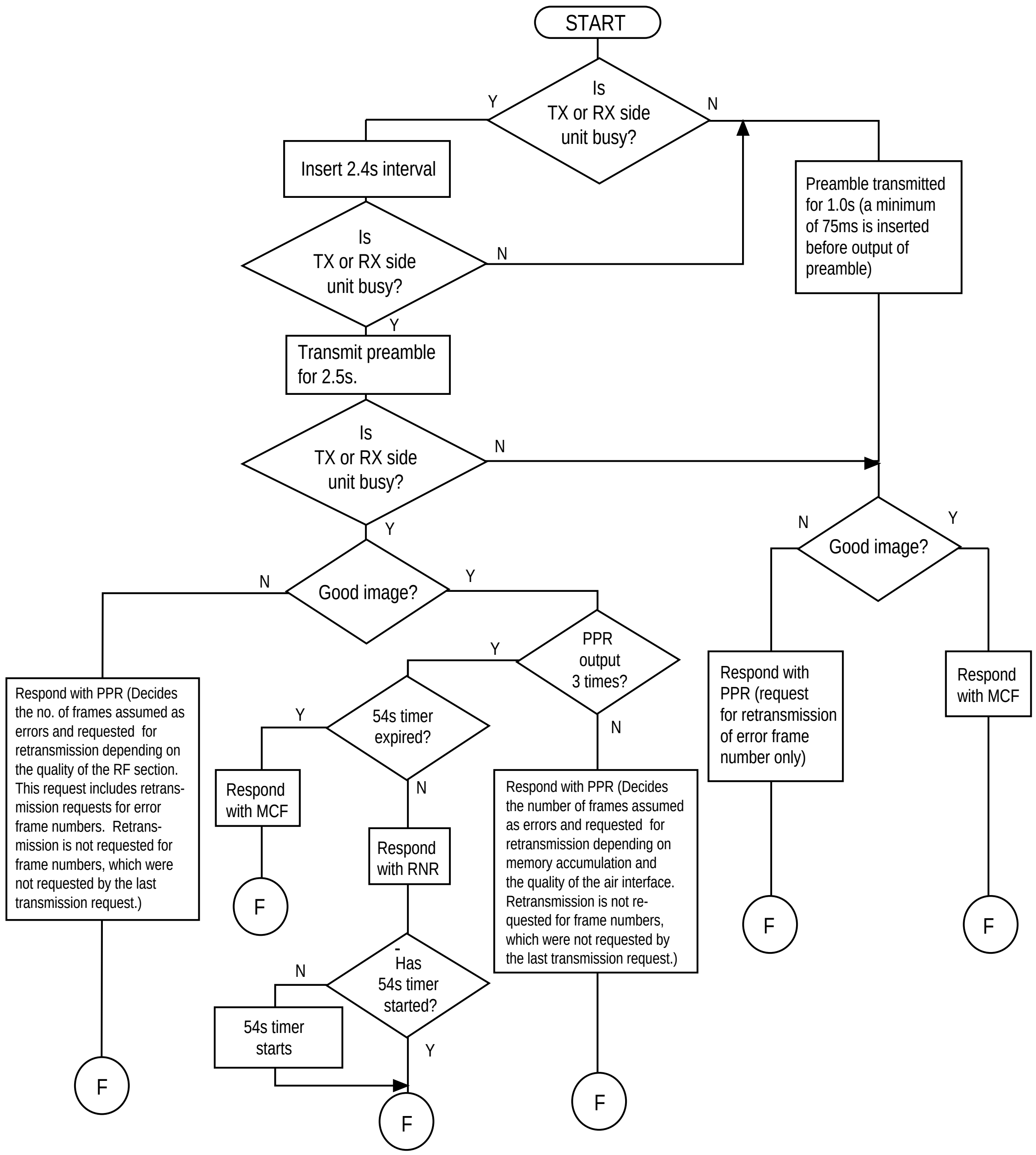


Fig. 5.4.T.D.3 : Response selection 1

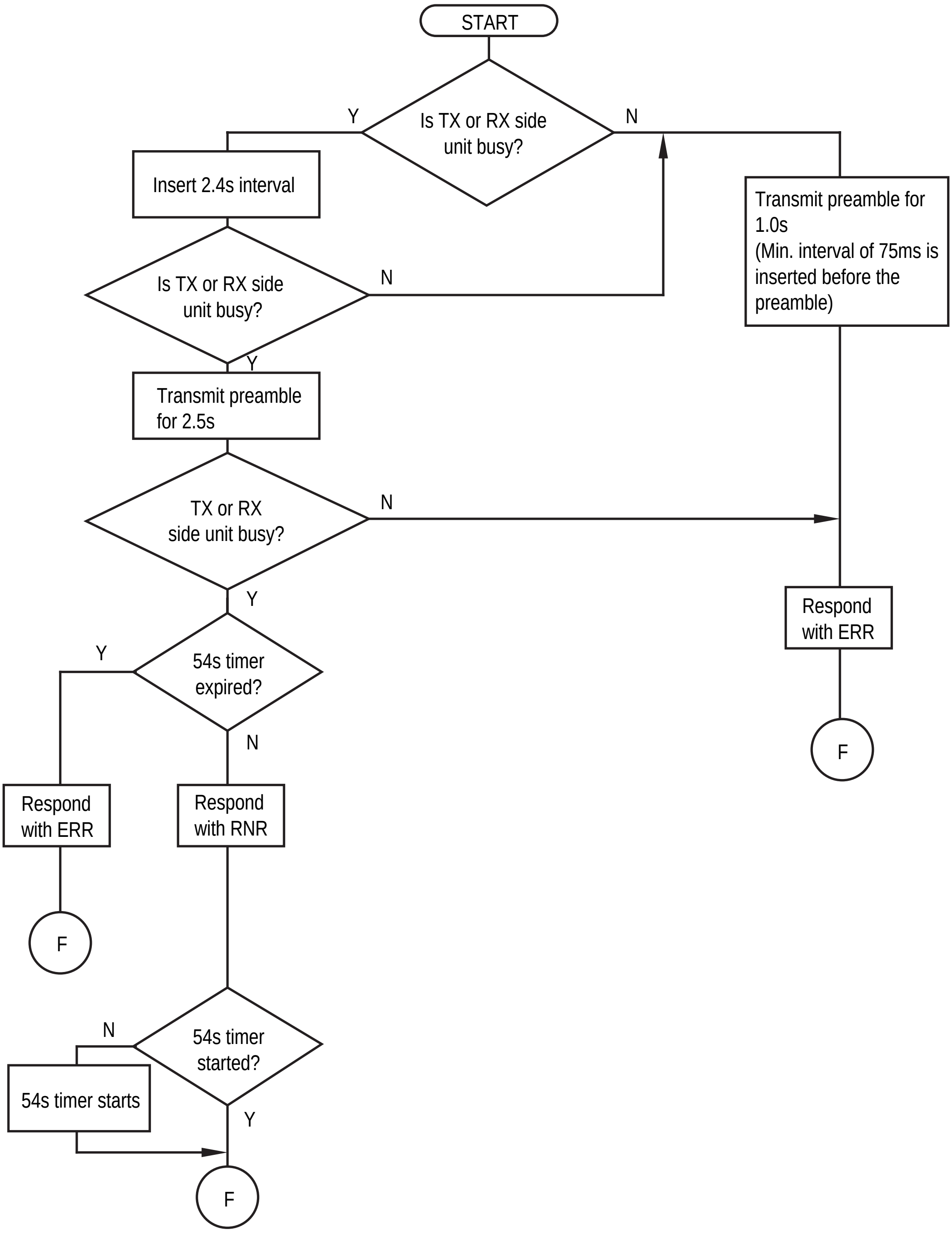


Fig. 5.4.T.D.4 : Response selection 2

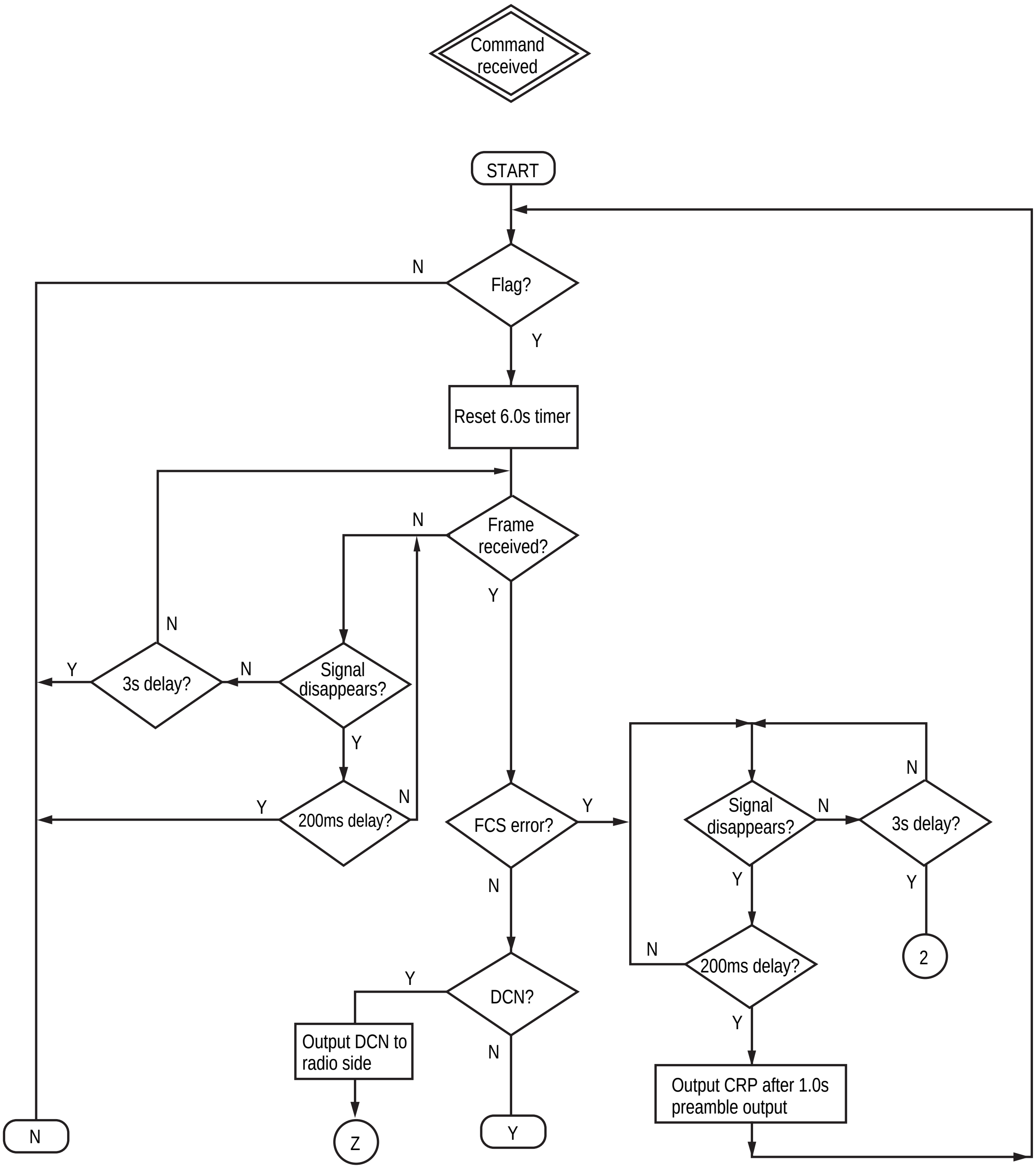


Fig. 5.4.T.D.5 : Command reception subroutine

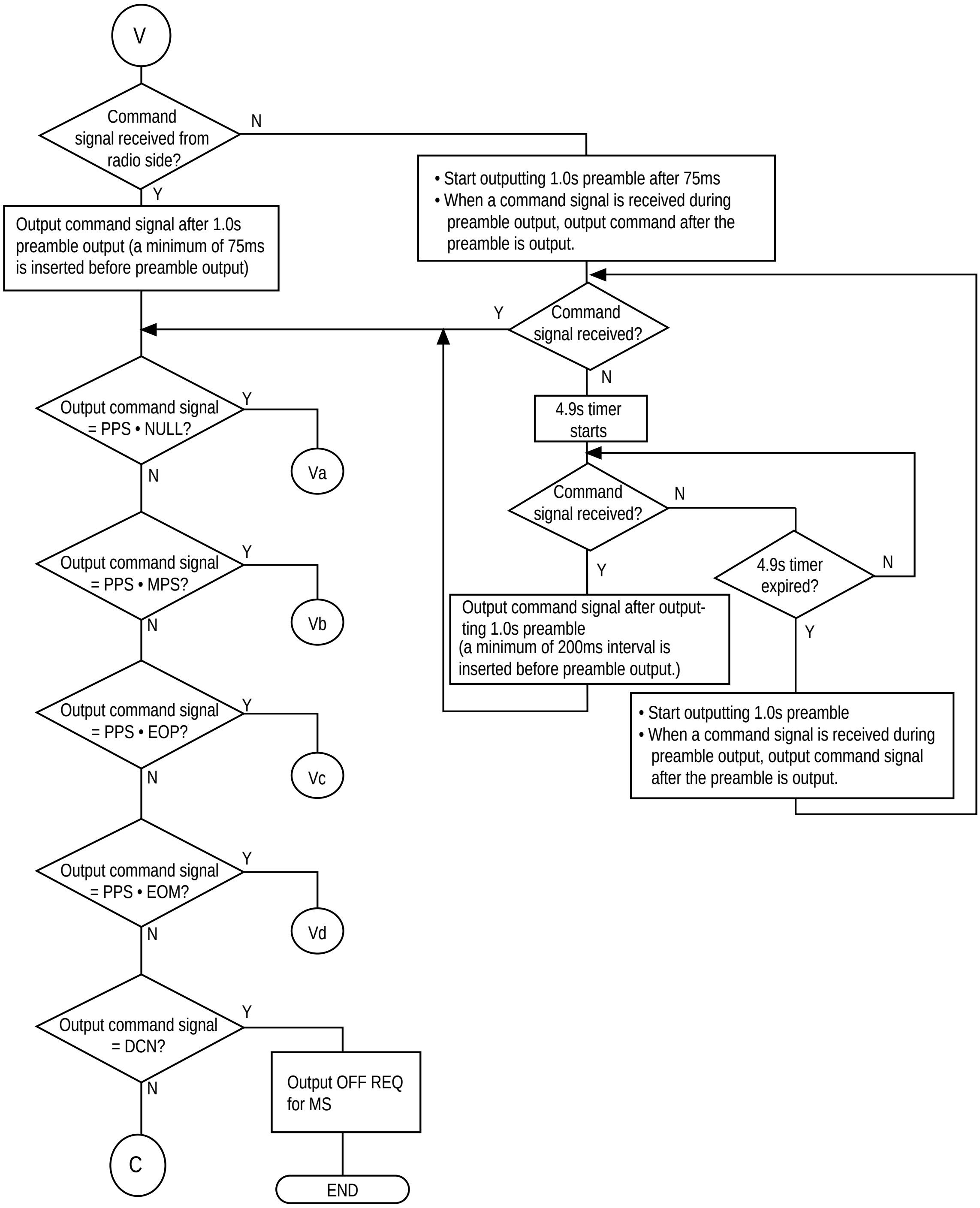


Fig. 5.4.R.D.1 : Reception side unit, Phase D (Basic control flow 1)

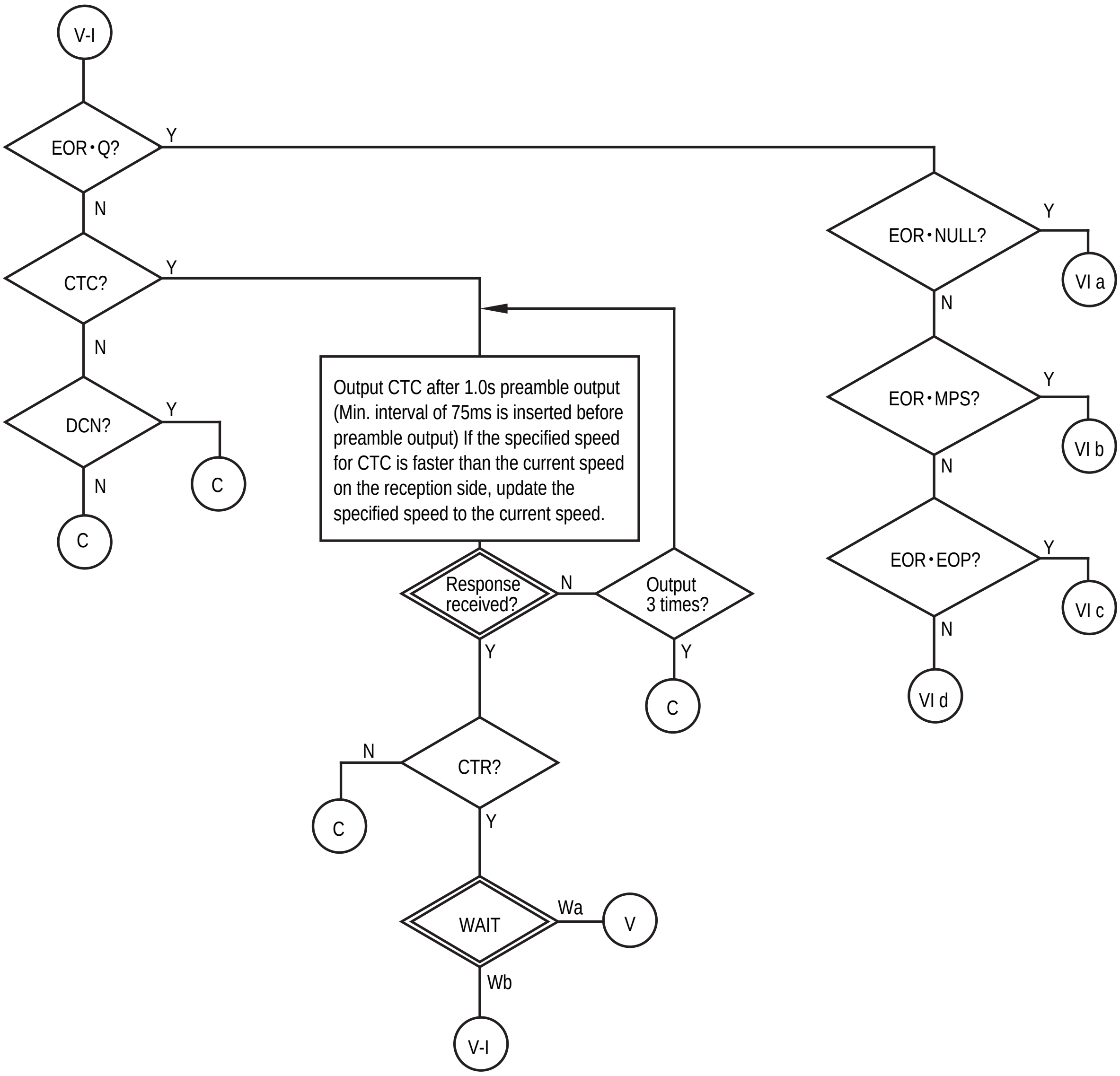


Fig. 5.4 R.D.2 : Reception side unit, Phase D (Basic control flow 2)

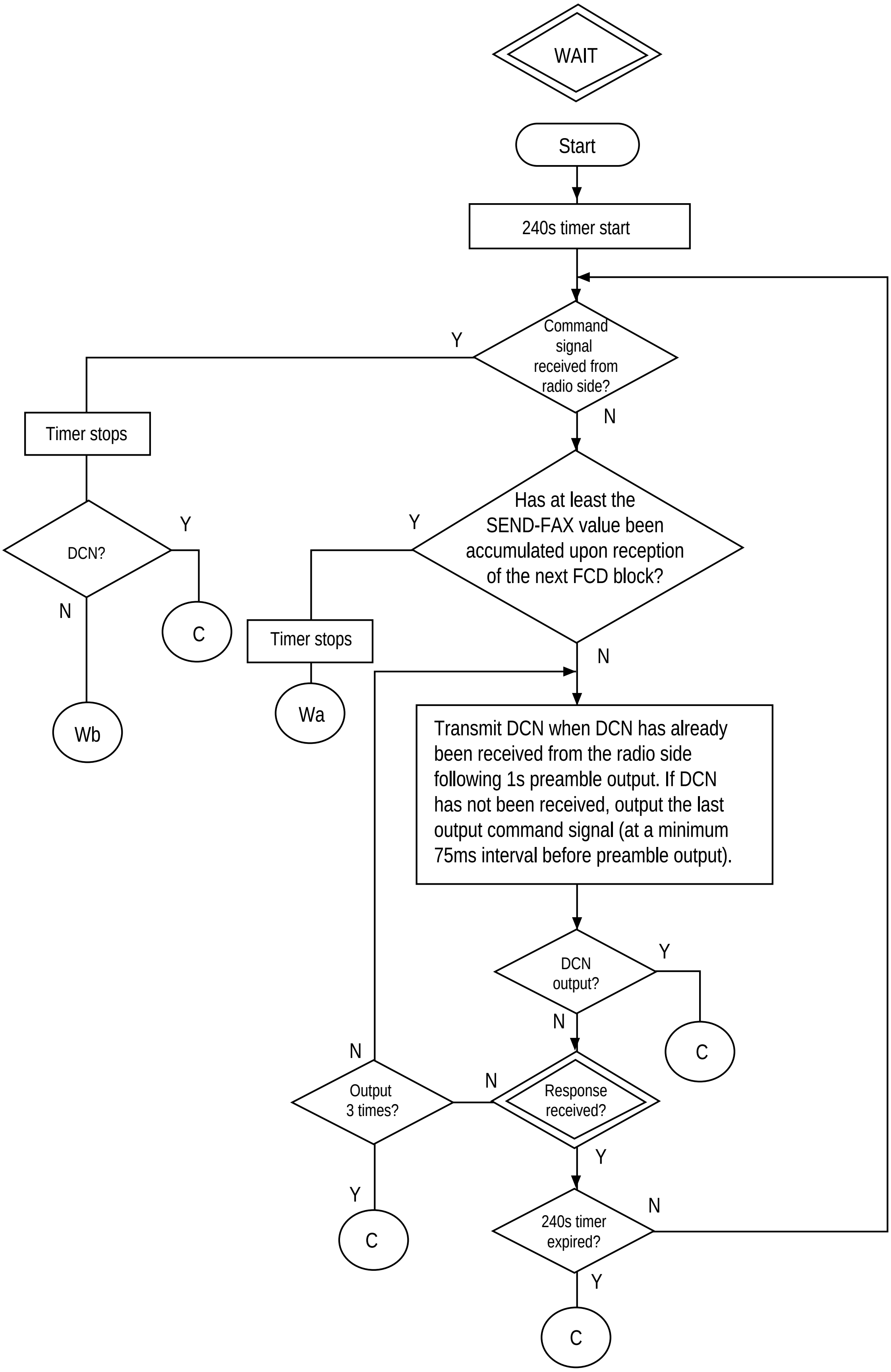


Fig. 5.4.R.D.3 : Wait subroutine

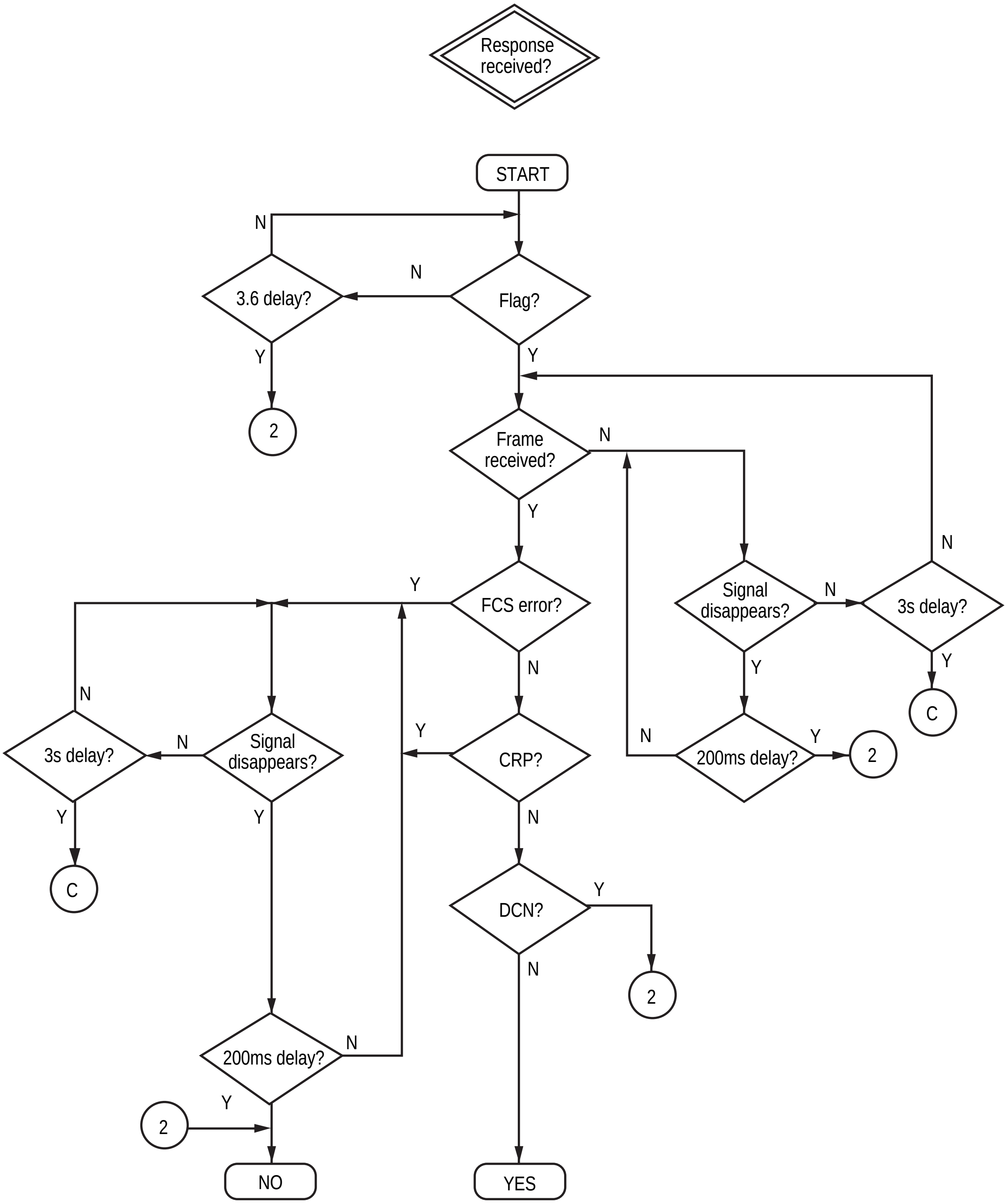


Fig. 5.4.R.D.4 : Response reception subroutine

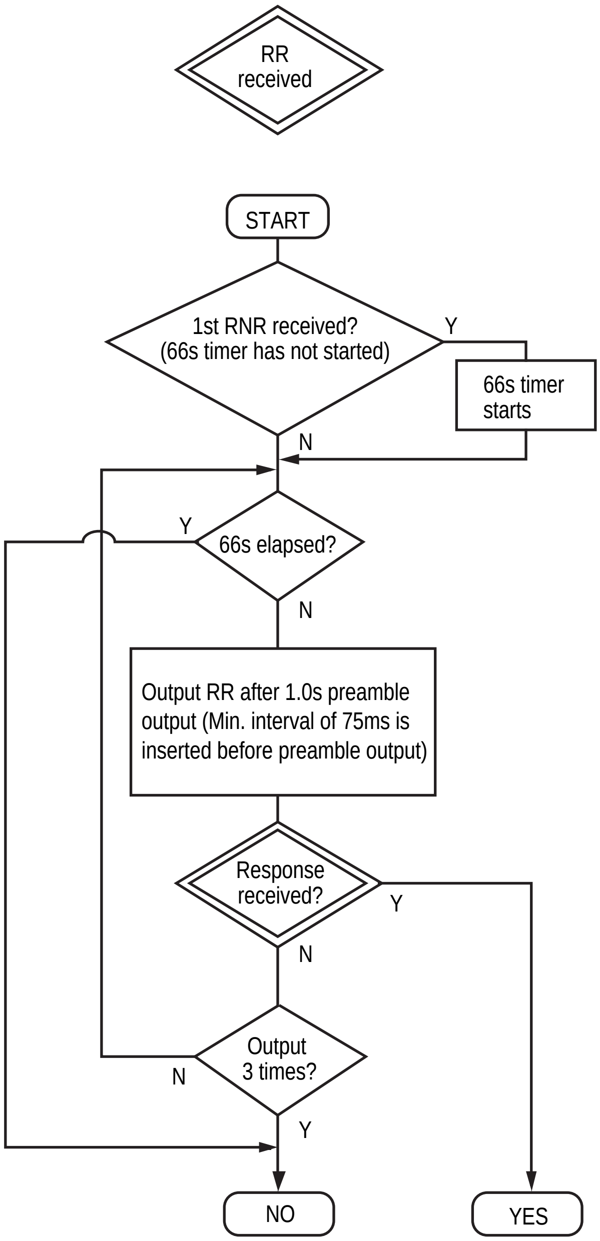


Fig. 5.4.T.D.5 : Command reception subroutine

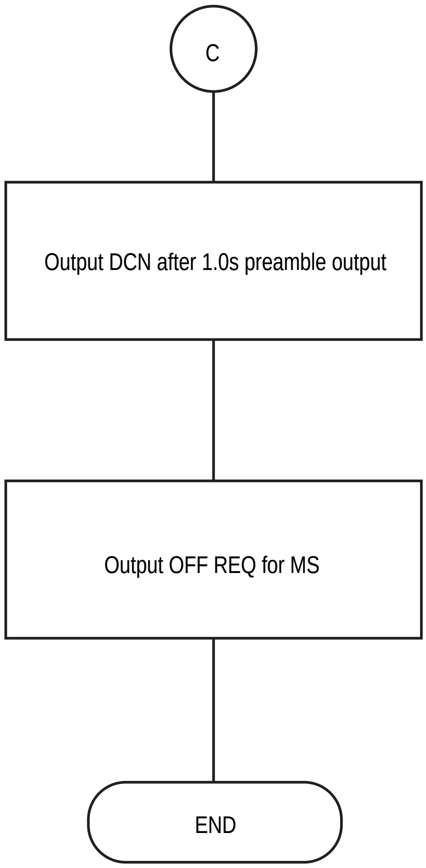


Fig. 5.4.R.E.1 : Reception side unit release flow

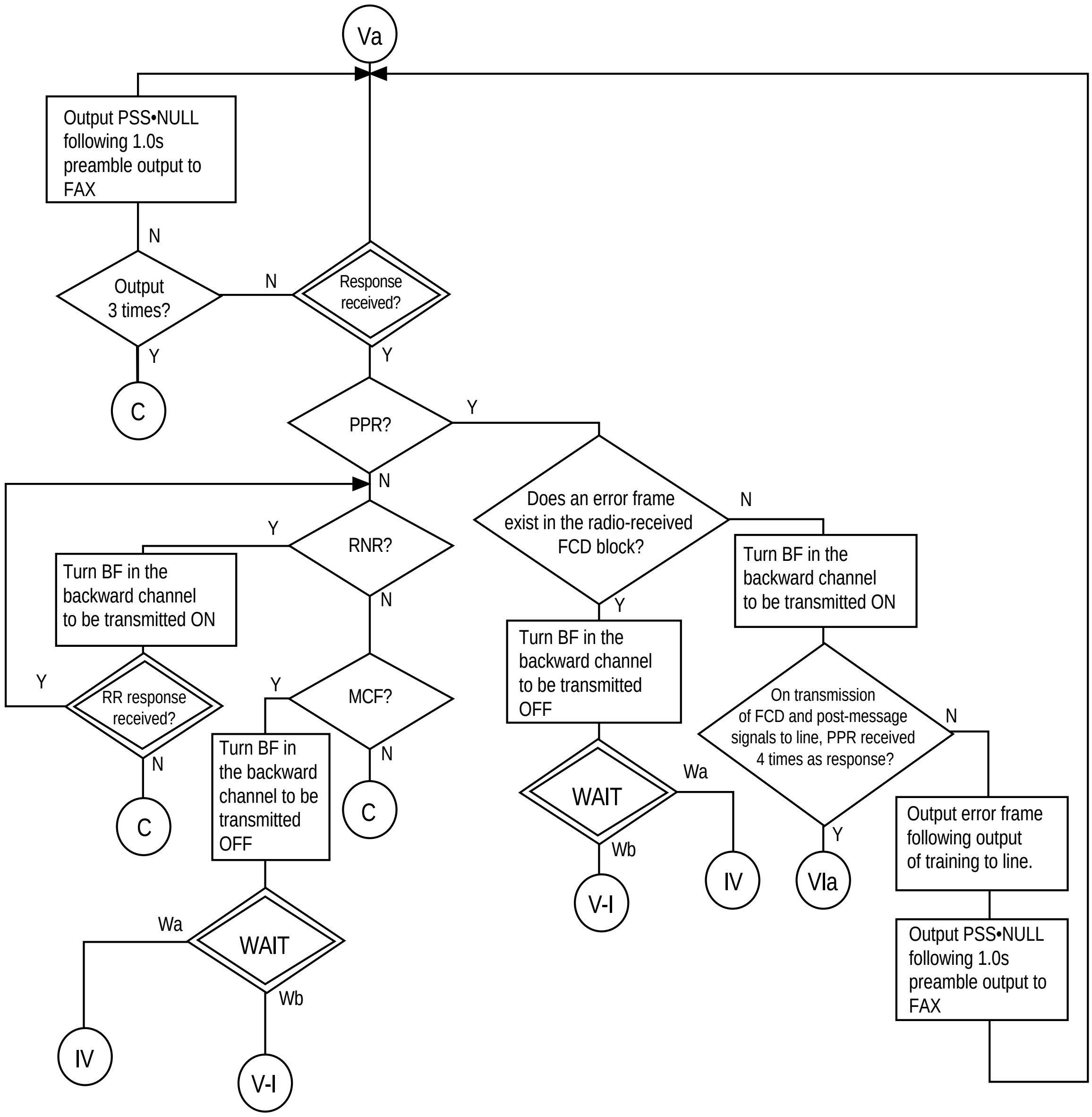


Fig. 5.4.1.R.D.1 : Reception unit, Phase D (PPS-NULL)

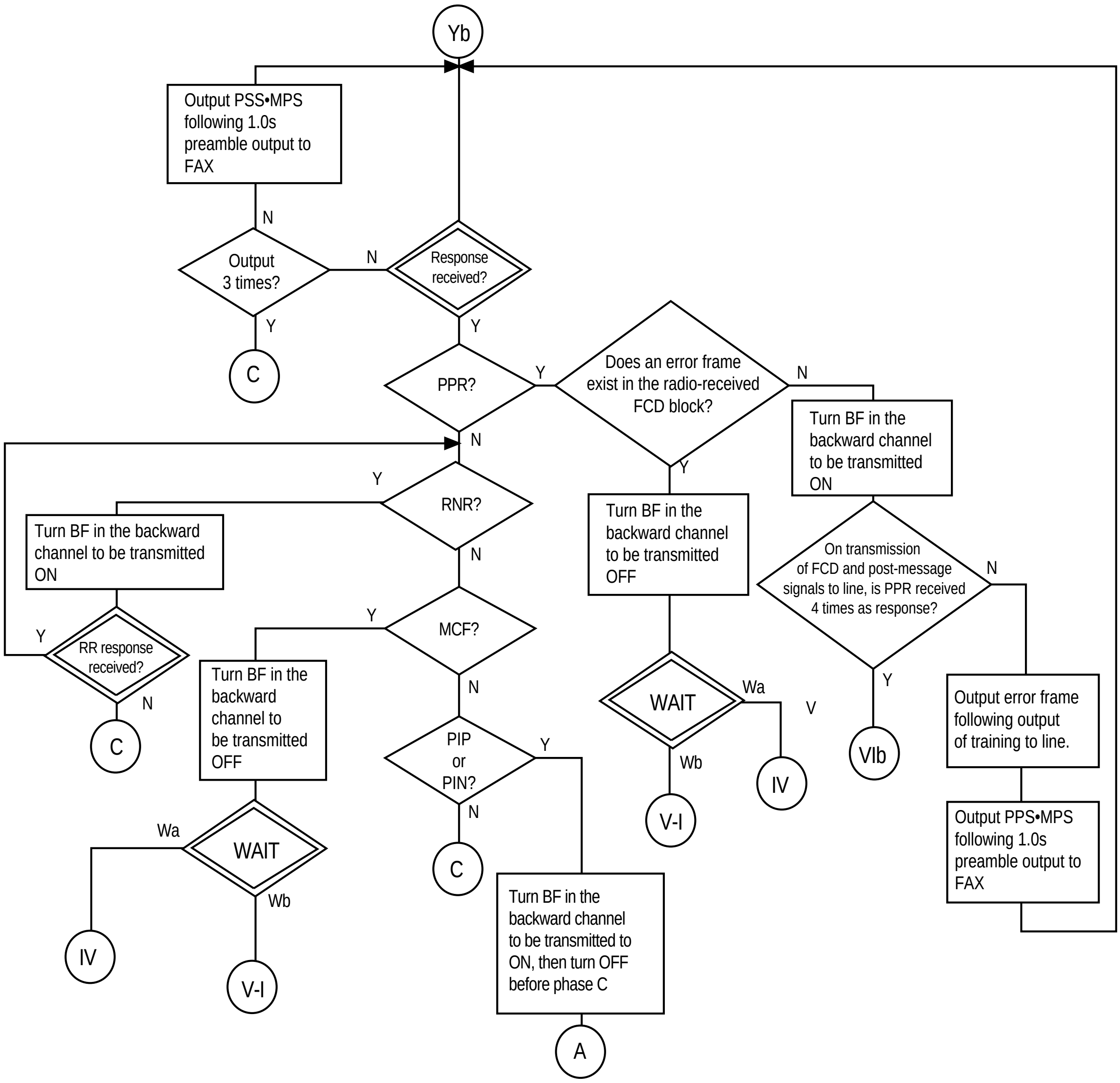


Fig. 5.4.2.R.D.1 : Reception unit, Phase D (PPS-MPS)

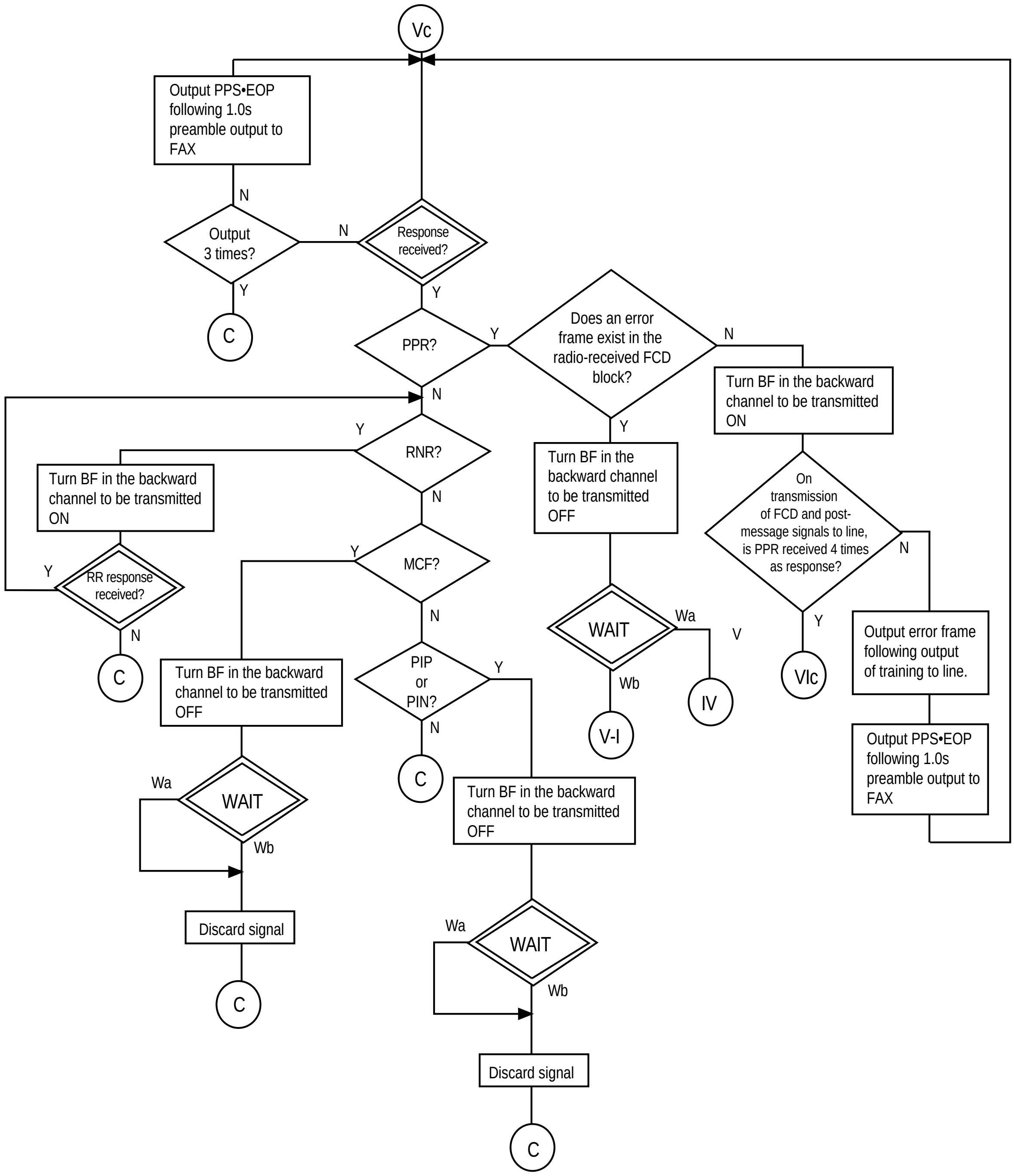


Fig. 5.4.2.R.D.1 : Reception unit, Phase D (PPS-EOP)

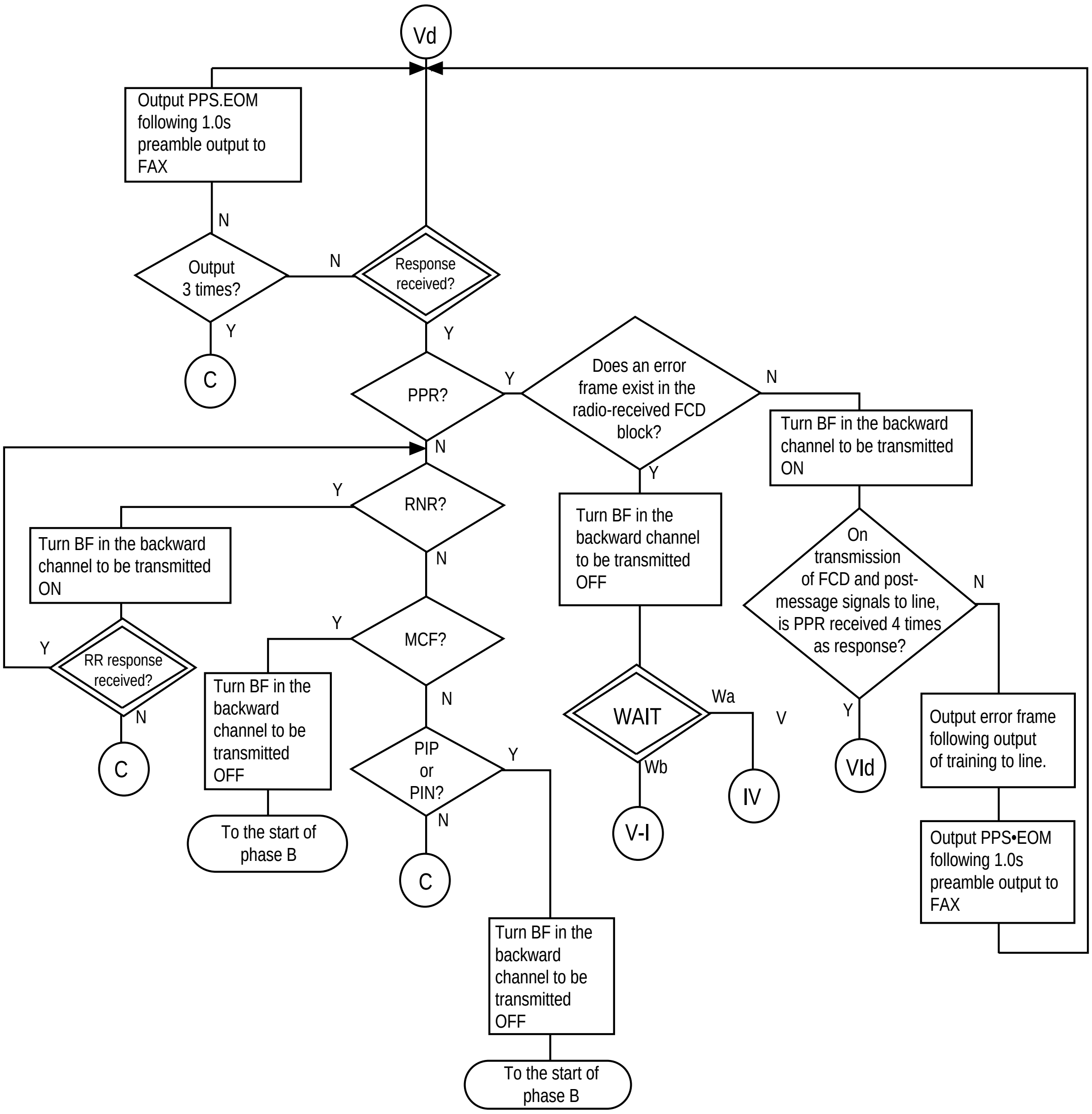


Fig. 5.4.4.R.D.1 : Reception unit, Phase D (PPS-EOM)

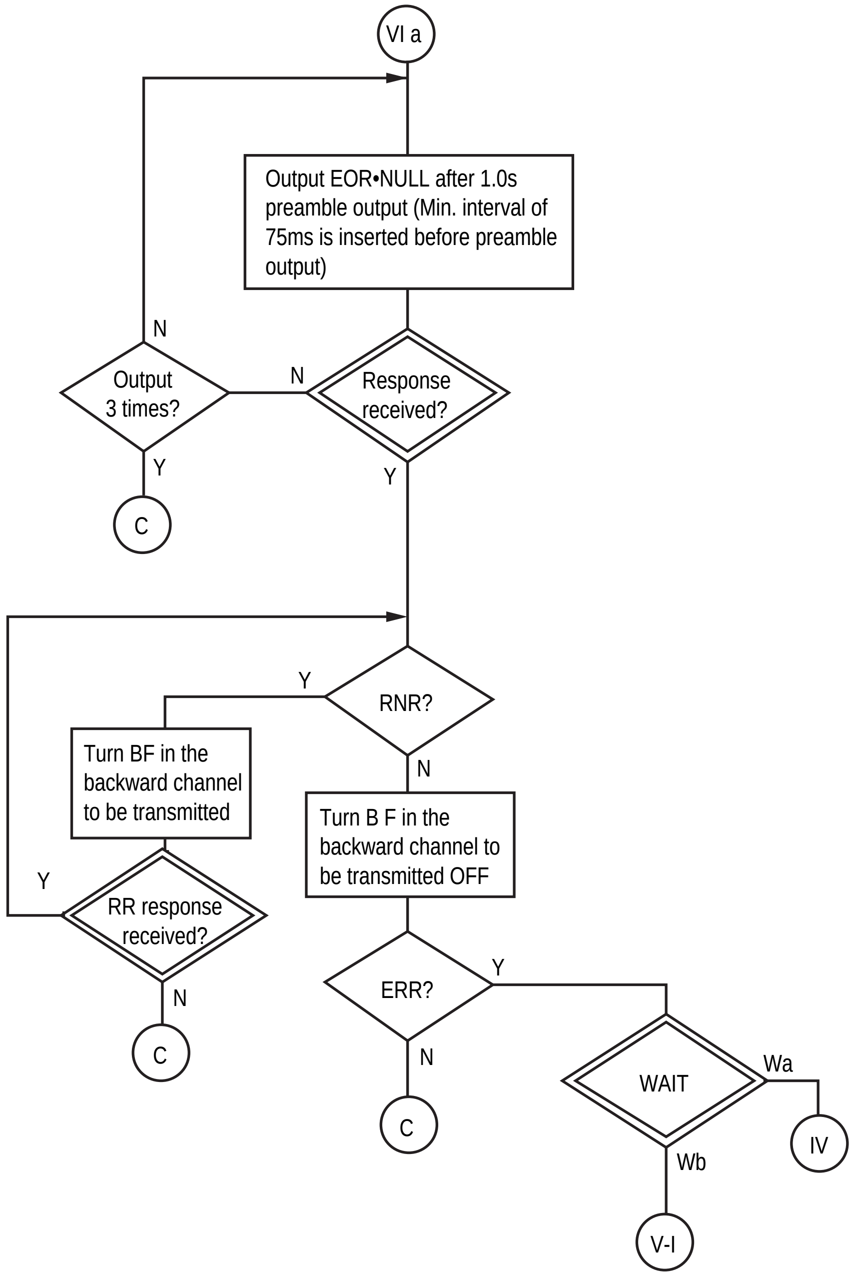


Fig. 5.4.5.R.D.1 : Reception side unit, Phase D (EOR-NULL)

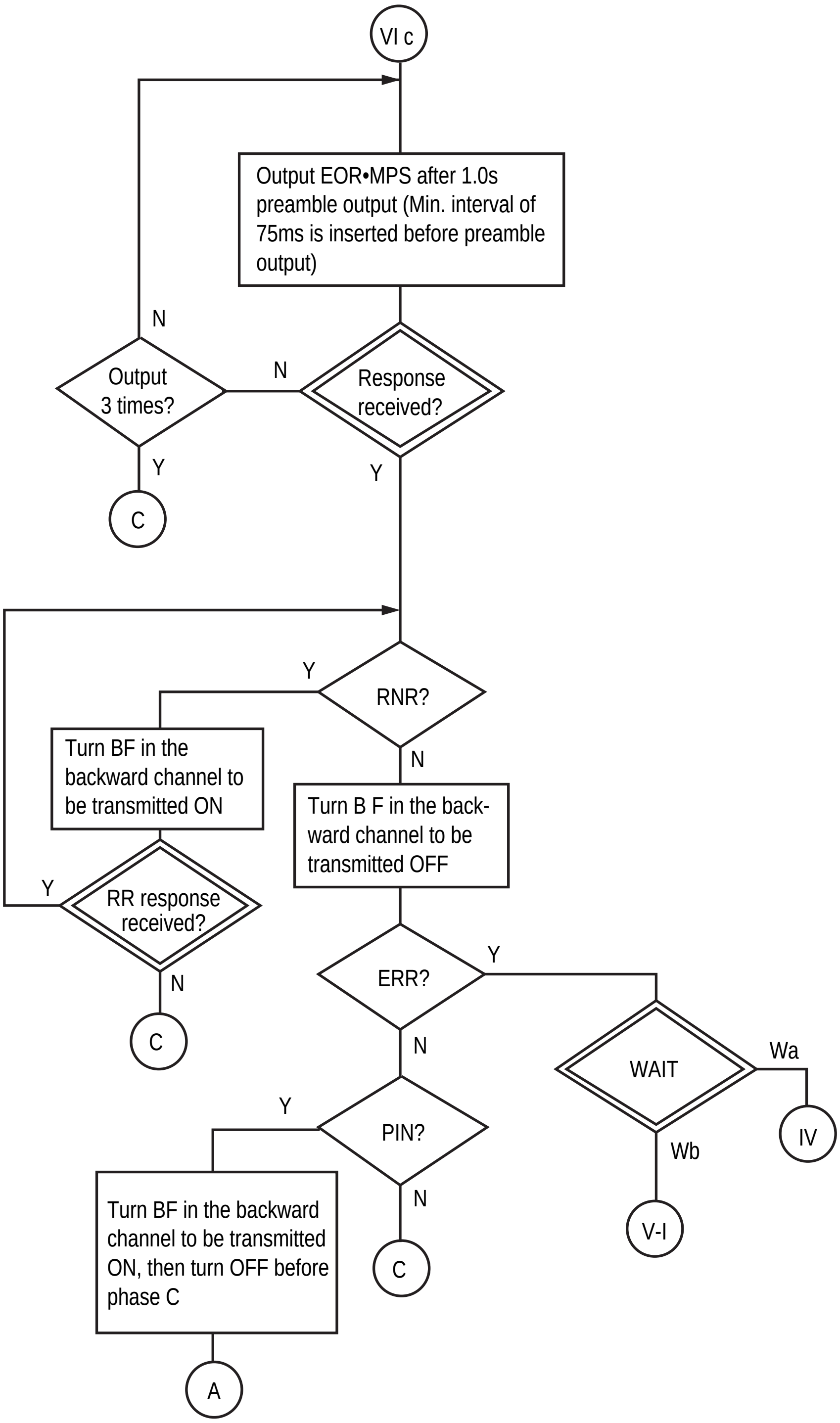


Fig. 5.4.5.R.D.2 : Reception side unit, Phase D (EOR-MPS)

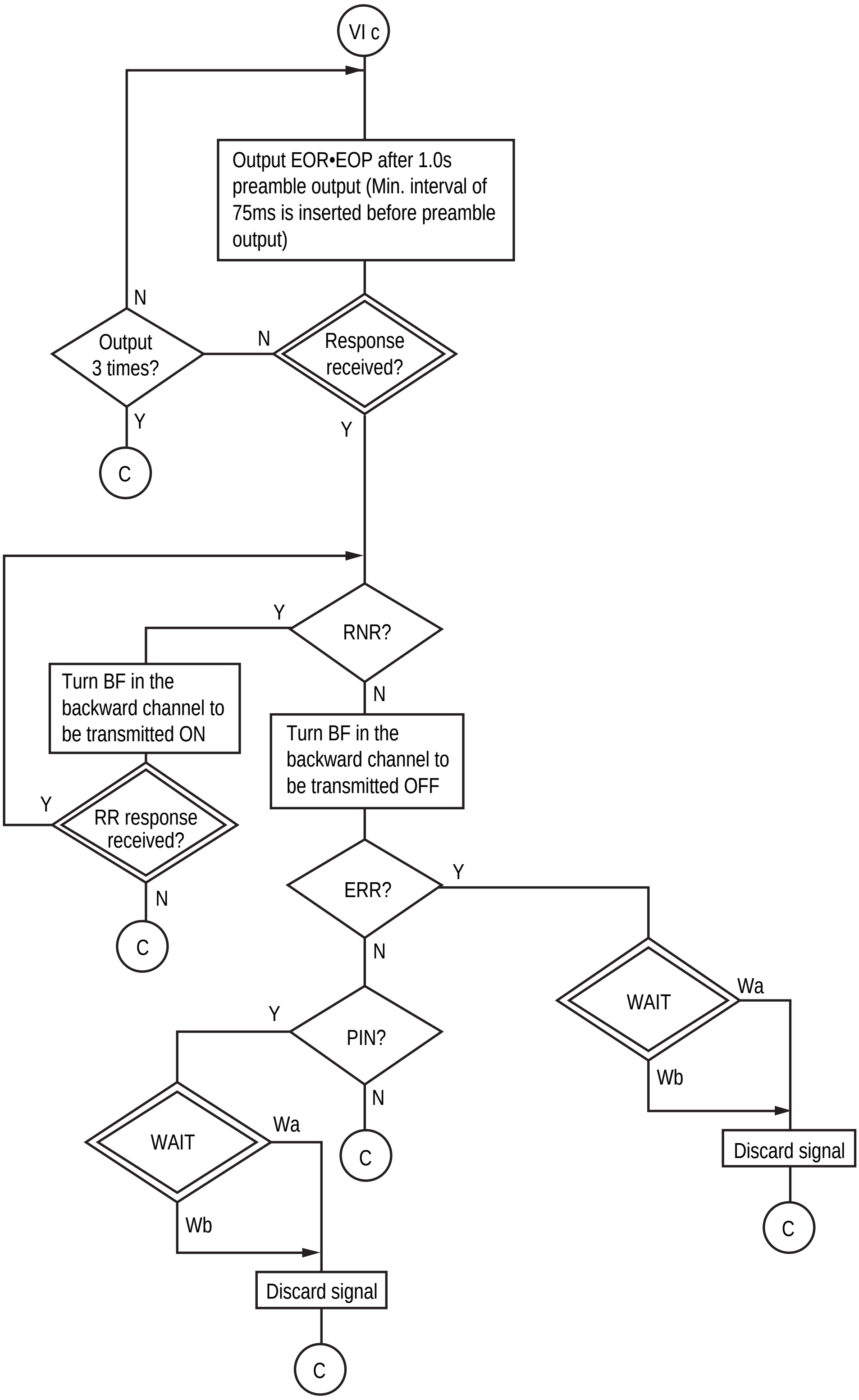


Fig. 5.4.5.R.D.3 : Reception side unit, Phase D (EOR-EOP)

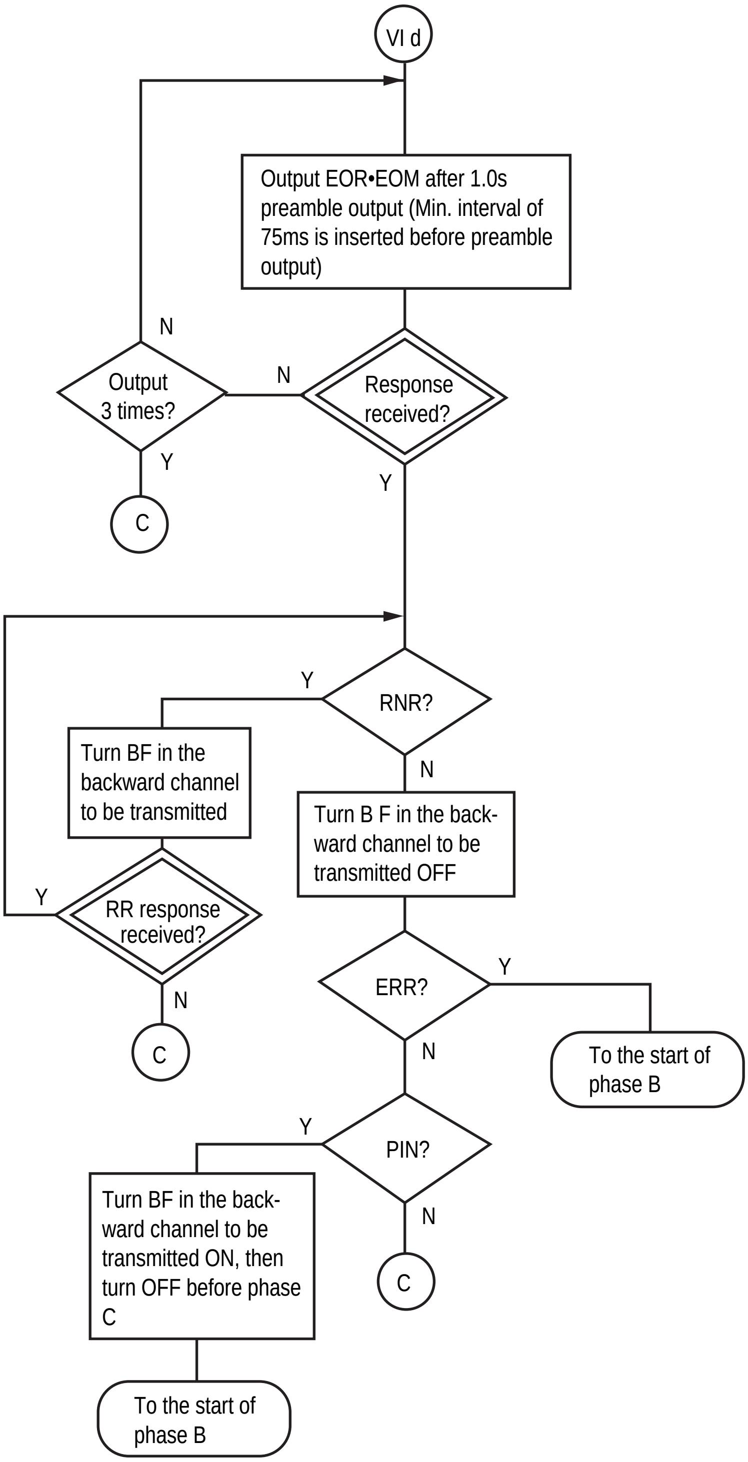


Fig. 5.4.5.R.D.4 : Reception side unit, Phase D (EOR-EOM)

Annex 3 High Speed Data Transmission Standard for the Personal Digital Cellular Telecommunication System

CONTENTS

1. General

1.1 Overview

This Standard specifies the procedure for asynchronous/non-procedure data transmission via the Personal Digital Cellular Telecommunication System. Figure 1.1.1 shows the system configuration where this transmission procedure can be used. This Standard covers transmission in the air interface and does not include the terminal and DCE control procedures.

The procedure has the following main features:

i) Easy connection to the generic DCE with asynchronous interface

ii) Error detection through double 16-bit length CRC setting

iii) Air interface error correction with automatic data re-transmission request (ARQ)

iv) Synchronous transmission through start-stop data conversion

v) Applied air interface data compression (optional)

1.2 Compatibility with other standards

The ARQ applicable in this Standard is identical to the procedure for the G3 FAX air interface protocol in Annex 2 except for some updated frame formats. The Standard refers to some ITU-T Recommendations, i.e. ITU-T V.24, V.42 (including Annex and Supplements), and V.42 bis.

2. Definitions

Figure 2.1 shows the functional structure of the procedure. In this document, the data communication units in the mobile station and the switching system are represented by ADP and IWF, respectively.

2.1 ADP

The ADP basically consists of four parts: the V.24 Interface part for the DTE interface, the Air Interface Error Control part to correct any radio errors, the Data Compressor/Expander to compress the data and the Protocol Control part to ensure the proper functioning of the other parts.

i) The DTE sends/receives data to/from the ADP via the V.24 interface. The data is in start/stop format.

ii) The Air Interface Error Control part implements the ARQ.

iii) The Data Compressor/Expander operates according to ITU-T V.42 bis.

iv) The Protocol Control part controls the entire ADP for normal operation. The Protocol Control part also sets up the DCE for special operation in ADP and IWF as specified by the users, and sets up the MSs for originating/ terminating calls. The control procedure for this controller depends on the installations of the users and is not covered by the Standard.

2.2 IWF

The IWF basically consists of five parts: the Air Interface Error Control part (remote part communicating with the ADP to correct radio errors), the Data Compressor/Expander DCE, the V.24 Interface part, and the Protocol Control part which ensures the proper functioning of the other parts.

i) The DCE sends/receives data to/from the Air Interface Error Control part and the Data Compressor/Expander via the V.24 interface. The data is in start/stop format.

ii) The Air Interface Error Control part implements the ARQ.

iii) The Data Compressor/Expander operates according to ITU-T V.42 bis.

iv) The Protocol Control part controls the entire IWF for normal operation. It also specifies the DCE and protocol types as instructed by the switch.

3. Abbreviations

The following acronyms are used in this Standard:

ADP	Data communication unit on the mobile station side
ARQ	Automatic Repeat reQuest (Procedure for error control procedure for radio interface)
CRC	Cyclic Redundancy Check
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network
IWF	Data communication unit on the switching system side
MNP	Microcom Networking Protocol
LAPM	Link Access Protocol for Modems
PSTN	Public Switched Telephone Network
UI	Unnumbered Information (frame) (transmission control during communication)
XID	eXchange IDentification (frame)

4. Air interface transmission control connection setup

The connection for the air interface control procedure setup between ADP and IWF requires operation in two phases. Firstly, the call is set up between the MS and network to provide the physical link between the ADP and IWF. This phase is described in section 4.3.7 ("Call Control Signal") of this Standard. The initial ARQ operation is initialized between ADP and IWF after call setup, and the air interface control channel is set up after parameter negotiation.

5. Interconnection circuit for air interface transmission control

Table 5.1 lists the interconnection circuit for the air interface control (V.24 interface). Fig. 5.1 and 5.2 show the ADP-IWF functional element connection.

6. General ADP/IWF operation

6.1 Outline

The ADP and IWF in Fig: 2.1 consist of the following four and five parts, respectively:

ADP:

- i) V.24 Interface part
- ii) Air Interface Error Control part
- iii) Data Compressor/Expander (optional)
- iv) Protocol Control part

IWF:

- i) DCE part
- ii) V.24 Interface part
- iii) Air Interface Error Control part
- iv) Data Compressor/Expander (optional)
- v) Protocol Control part

Chapter 7 describes the Protocol Control part. Chapter 9 describes the details of the air interface error control. Chapter 8 describes the optional Data Compressor/Expander, but as the details of the compression procedure are specified in ITU-T V.42 bis, this Standard only refers to the correspondence to the ITU-T V.42 bis procedure. The parameters for data compression are described in 10.3.

This chapter thus describes the general functions of the Protocol Control part and the Air Interface Error Control part.

6.2 Outline of the Protocol Control part

The Protocol Control part entirely controls the internal functions in the ADP or IWF.

6.2.1 ADP

The Protocol Control part at the ADP shall:

i) Notify the MS of data communication function selection information like DCE or protocol type before MS network call setup.

ii) Negotiate the parameters required for the communications.

iii) Help the parameter negotiation for the optional procedure (data compression).

iv) Initialize or reset the Data Compressor/Expander.

v) Help the data exchange between the V.24 Interface and Data Compressor/Expander or the Air Interface Error Control part to prevent data congestion on the DTE-ADP or ADP-IWF interface from resulting in missing data.

vi) Convert the start/stop format data received from the V.24 Interface into the synchronous transmission format for the air interface.

vii) Convert the synchronous data for the air interface received from the ADP-IWF interface into start/stop format for transmission to the V.24 Interface.

viii) Process the break (space) signals received from the V.24 Interface for synchronous transmission.

ix) Process break notifications received on the ADP-IWF interface.

x) Normally release the error correction link.

6.2.2 IWF

The Protocol Control part at the IWF shall:

i) Select the DCE type and set up the protocol type for the communication based on the data communication selection function notified by the switch before MS network call setup.

ii) Negotiate the parameters required for the communications.

iii) Help the parameter negotiation for the optional procedure (data compression).

iv) Initialize or reset the Data Compressor/Expander.

v) Help the data exchange between the V.24 Interface and the Data Compressor/Expander or the Air Interface Error Control part to prevent data congestion on the DCE and the Air Interface Error Control part, the Data Compressor/Expander, or the ADP-IWF interface from resulting in missing data.

vi) Convert the start/stop format data received from the V.24 Interface into the synchronous transmission format for the air interface.

vii) Convert the synchronous data for the air interface received from the ADP-IWF interface into start/stop format for transmission to the DCE via the V.24 Interface.

viii) Process the break (space) signals received from the DCE via the V.24 Interface for synchronous transmission.

ix) Process the break notifications received on the ADP-IWF interface.

x) Process the DCE mode switching instruction during communication received from the DCE via the V.24 Interface for synchronous transmission.

xi) Normally release the error correction link (per ARQ protocol).

6.3 Outline of the Data Compressor/Expander

The Data Compressor/Expander operates according to the ITU-T V.42 bis procedure. At the air interface, it allows ---- efficient coding before data transmission. It shall have the following functions:

i) Initialization of the Data Compressor/Expander

ii) Encoding/decoding for the data compression

iii) Transition between the transparent mode and the data compression mode

6.4 Outline of the Air Interface Error Control part

The Air Interface Error Control part is responsible for the ARQ protocol operation. The protocol shall :

i) Help the parameter negotiation required for communications.

ii) Help the parameter negotiation for the optional procedure (data compression).

iii) Set up the error correction link (per ARQ protocol).

iv) Transmit/receive data.

v) Detect and correct errors (per ARQ protocol).

vi) Transmit/receive break signals.

vii) Transmit the DCE mode switching instruction during communication.

viii) Normally release the error correction link (per ARQ protocol).

7. Operation of the Protocol Control part

The outline of the Protocol Control part is described in section 6.2. In this section, the operation of this part is described.

7.1 Radio link connection

The procedure to set up the ADP-IWF physical connection, i.e. the radio link connection, is described in the "Call control signal" section (4.3.7) of this Standard. The Protocol Control part at the ADP sends data communication function selection information such as DCE or protocol type to the MS unit before MS network call setup. The Protocol Control part at the IWF selects the DCE type and sets up the protocol type for communication based on this data communication function selection information notified by the switch unit. The data communication function selection information is sent from the ADP to the IWF during parameter negotiation after the radio link connection has been completed.

After the radio link connection has been completed, the ADP Protocol Control part shall have the following information:

i) Whether the ADP initiated/answered the call

ii) Information for transmission (DTE rate, data compressed or not)

iii) Character format used by the DTE

iv) DCE initial value setting command applicable or not

This specification does not cover how to obtain this information. The information is used to control the operation of ADP and IWF.

7.2 Error control protocol setup phase

Upon receiving the radio link setup report from the MS unit, the Air Interface Error Control parts at both ADP and IWF are instructed to initiate ARQ (SYNC setup).

7.3 Parameter negotiation

7.3.1 General

Upon reception of the ARQ setup report from the Air Interface Error Control part, the ADP Protocol Control part initiates the parameter negotiation with the counterpart at the IWF after the error control protocol setup phase. This negotiation consists of the XID command frame sent from the ADP to IWF, the XID response frame sent from the IWF to ADP in response to the XID command frame, and the notification XID frame used by the IWF to notify the ADP of the DCE call connection state etc. as necessity requires.

Chapter 9 describes the parameters applicable to negotiation and section 10.2 shows the content of the information field in the XID frame.

7.3.2 Negotiation procedure

The XID command frame includes two types of commands: the basic XID frame to convey the DTE information (rate, applied character format, DCE initial value setting command applied or not, data compression parameter etc.) and data communication function selection information, and the extended XID frame to carry the DCE initial value setting command.

When receiving the XID command frame from the ADP, the IWF checks the information field and, if the requested parameter can be set up by the IWF, returns the XID response frame with the code in its information field, indicating that it can be set up, to the ADP. If it cannot be set up, the IWF returns the XID response frame with the code in its information field, indicating that it cannot be set up, together with the relevant parameter. If the requested parameter has any error in its description, the IWF returns to the ADP the XID response frame with the code in its information field indicating the parameter error together with the relevant parameter. The XID response frame is returned at earliest after the XID command frame is received (in the case of the basic XID frame) and immediately after the response to the DCE initial value setting command has been received (in the case of the extended XID frame). If the DCE initial value setting command has such a long character string that the extended XID frame must be divided into more than one frame, the ADP sends the remaining XID command frame each time that the XID response frame is received.

When the negotiation with the XID frames is completed, the IWF issues the call initialization request command or response request command to the DCE according to the agreed parameters in order to perform the physical handshake with the remote DCE and set up the DCE-to-DCE protocol. When the DCE-to-DCE connection is completed, the IWF sends the notification XID frame to pass the DCE call connection information to the ADP and enter the data transmission mode. Upon receiving the notification XID frame, the ADP sends the call connection information to the DTE and enters the data transmission mode. Figure 7.3.2.1 and 7.3.2.2 show sample control sequences for the case where the automatic call initialization request command is generated by the DTE. In Figure 7.3.2.1, the DCE initial value setting command is not available and the DCE initial value should be applied, whereas in Figure 7.3.2.2, the DCE initial value setting command can be used. Figure 7.3.2.3 shows a sample control sequence when the DCE initial value setting command is used in the case of manual call initialization and manual or automatic response.

7.3.3 Parameter negotiation failure

In the negotiation procedure mentioned in 7.3.2, if the XID response frame notifies that the parameters cannot be set or that there is a parameter error, the ADP swiftly sends the call disconnection request to the MS unit and releases the physical connection. During this operation, the ADP may send a failure cause indicator to the DTE. Figure 7.3.3.1 shows a sample connection sequence for a failed parameter negotiation.

7.4 Data transfer

After the parameter negotiation has been completed, the ADP and IWF Protocol Control parts both request the Air Interface Error Control part to transmit the data received from the V.24 Interface. If the air interface compression is also applied, the data is transmitted via the Data Compressor/Expander. Only user data are targeted to be compressed. Whatever character format is applied, any characters (except for start and stop bits) can be sent via the ADP/IWF interface as eight-bit characters if received from the V.24 Interface.

The mapping from various character formats to eight-bit character format should comply with ITU-T V.42, Annex B.

Note : The timing of the data transmission request by the Protocol Control part to the Air Interface Error Control part is not covered by this Standard. Appendix II of the ITU-T V.42 contains some comments on this issue.

When data is received from the Air interface Error Control part, the Protocol Control part sends the received data to the V.24 Interface. The characters are in the format of the appropriate start-stop frame agreed upon during parameter negotiation.

7.4.1 Flow control

Flow control can be performed in the following three areas:

i) DTE-ADP

ii) ADP-IWF

iii) IWF Air Interface Error Control part - DCE

Among them, the notification for flow control in i) and iii) is performed by using the RS/CS control or the X-ON/X-OFF control. The ADP and IWF should have the both functions but the user can select either one. Flow control in ii) can be performed with the busy flag defined in the control field of the ARQ frame.

Figures 7.4.1.1 and 7.4.1.2 show the RS/CS and X-ON/X-OFF flow control sequences, respectively.

7.4.2 Interface information transfer

In the data transfer phase, the status of the V.24 interface lines of ADP and IWF is transmitted, i.e. the ER line at the ADP and CD and DR lines at the IWF. These status indications should be transmitted promptly in idle state and synchronously with the user data, if the transfer data is available.

The status of the interface lines above can be transmitted with the bit maps defined in the information field of the ARQ frame.

7.5 Break signal transfer

When the V.24 Interface at the ADP or IWF receives the Break signal from the DTE or DCE, respectively, the Protocol Control part should decide whether to discard or distribute the data not transmitted to the V.24 Interface or air interface. The break process option and its operation are shown in Table 7.5.1. The Protocol Control part which has received the Break signal should send the UI frame to the remote Protocol Control part. The UI frame contains the Break (BRK) ON message notification in its information field.

After sending the UI frame to indicate the BRK, the Protocol Control part should not send another UI frame until it receives the UI frame with the BRKACK message from the remote Protocol Control part. If the V.24 Interface detects another break before BRKACK is received, the Protocol Control part may discard or ignore this Break signal.

If BRKNAK is received, it should not retransmit the UI frame and return to the state before break detection. Figure 7.5.1 shows a sample transmission control sequence when Break is sent.

Note : It is desirable to set up the break process option as that set up in the DCE part if the DCE part can perform the same break operation. This option can be set up in the Protocol Control part when the DCE initial value setting commands are entered at the ADP or the DCE initial value setting commands are received with the extended XID frame at the IWF.

7.6 Break reception

If the ADP and the IWF receive the UI frame with BRK set up, the Protocol Control part distributes the Break signal to the DTE (DCE) as optionally defined by the user and sends the UI frame. The UI frame contains the Break Acknowledgement (BRKACK) message in its information field (see Figure 7.5.1). If the Protocol Control part cannot distribute the Break signal to DTE (DCE) for some reasons, the Protocol Control part should send the UI frame with the Break Non-acknowledgement (BRKNAK) message set up. Table 7.6.1 lists the operation at Break reception.

7.7 DCE mode change during communication

If the ADP V.24 Interface receives the DCE mode switching instruction during communication (Escape order) command from the DTE , the ADP Protocol Control part sends the UI frame to the IWF Protocol

Control part. This UI frame contains the Escape (ESC) ON message notification in its information field. If the Protocol Control part transmits the UI frame to indicate ESC, it should not send another UI frame until it receives the UI frame with the ESCACK message from the remote Protocol Control part. If the V.24 Interface detects another Escape order before receiving ESCACK, the Protocol Control part may discard or ignore successive Escape orders. If the Protocol Control part receives the ESCNAK message, it should not retransmit the UI frame and should return to the state before Escape detection.

If the IWF Protocol Control part receives the UI frame to indicate ESC, it sends the Escape order to the DCE as well as the UI frame after getting a response from the DCE, after which it changes to the online command mode. This UI frame contains the Escape Acknowledgement (ESCACK) message in its information field. If the Protocol Control part cannot send the Escape order to the DCE or if it receives no response from the DCE for some reasons, it should send the UI frame with the Escape Non-Acknowledgement (ESCNAK) message. Figure 7.7.1 shows a sample transmission control sequence for sending the DCE mode switching instruction during communication.

Note : In order to prevent the Escape order code from being directly sent to the DCE with the user data frame after being sent from the DTE, the ADP should remove it if receiving from the DTE.

As an optional procedure, Figure 7.7.2 shows a sample of a transmission control sequence for transmitting a command to the DCE in the on-line command mode. The command transmitted from the DTE is transferred to the IWF with an extended XID frame. In the IWF, the command is transmitted to the DCE and the response to the command is received from the DCE, while notification is sent to the ADP with an XID response frame.
Either an extended XID frame or a notification XID frame is used as the XID response frame.

Note: The choice between the two types of XID frames, as well as the information field coding of the frame, depends on the network.

In the online command mode, when the V.24 Interface on the ADP side receives a command to return to the active state (online), the Protocol Control part on the ADP side transmits the return-to-online order command to the Protocol Control part on the IWF side via an XID command frame. The information field of the XID command frame contains return-to-online command codes received by the V.24 Interface as extended parameters.

When the Protocol Control part on the IWF side receives the XID command frame, the Protocol Control part issues a return-to-online command to the DCE. Upon receiving the return-to-online command, the DCE transmits the call connection information after which the IWF transmits the notification XID frame to the ADP.

Figure 7.7.3 shows a sample of a transmission control sequence for the return-to-on-line command.

7.8 Normal release of air interface transmission control connection

If the air interface transmission control connection has been set up, the Protocol Control part can release this connection by releasing the physical connection between the ADP and the IWF. The procedure is specified in 4.3.7 "Call control signal" section of this Standard.

Note : The normal procedure with which the Protocol Control part releases the air interface transmission control connection is not covered in this Standard.

After releasing the air interface transmission control connection, the Protocol Control part changes the state of the V.24 interface accordingly.

8. Data Compressor/Expander operation

8.1 General

The Data Compressor/Expander operates in accordance with the ITU-T V.42 bis procedure. This section describes the Protocol Control part operation compared with the control part operation specified in the ITU-T V.42 bis procedure, Chapter 5, to apply for this Standard.

8.2 Correspondence to ITU-T V.42 bis

i) Data Compressor/Expander communication (see 5.1, ITU-T V.42 bis)

The use and parameters of the Data Compressor/Expander should be selected during the parameter negotiation for the air interface transmission control connection. During the connection, the Data Compressor/Expander will be used in the same way and parameters remain unchanged. Data compression should be applied to both directions, e.g. for transmission and reception if applied. See 10.3 for the parameters for the data compression.

ii) Data Compressor/Expander initialization (see 5.2, ITU-T V.42 bis)

After the parameter exchange for data compression, the Protocol Control part sends to the Data Compressor/Expander the C-INIT REQ primitive which is used to notify agreed parameter values.

iii) Connection setup (see 5.3, ITU-T V.42 bis)

If the C-INIT CON primitive is received from the Data Compressor/Expander, the Protocol Control part notifies the DTE of the start of the data transfer.

iv) Coordination of the transfer of data between the V.24 Interface and Data Compressor/Expander (see 5.4, ITU-T V.42 bis)

After the connection has been set up, the Protocol Control part requests encoding of the data received from the V.24 Interface. For this encoding, it sends the C-DATA REQ primitive to the Data Compressor/Expander which instructs the data encoding.

If the Control part receives the C-DATA IND primitive from the data compressor, it sends the decoded data to the V.24 Interface.

Flow control is required to protect the data from buffer overflow. The control procedure described in section 7.4.1 of this Standard applies to the flow control.

v) Coordination of the transfer of data between Data Compressor/Expander and Air Interface Error Control part (see 5.5, ITU-T V.42 bis)

If the Protocol Control part receives the C-TRANSFER IND primitive from the Data Compressor/Expander, it requests the Air Interface Error Control part to transmit the compressed data.

If the Protocol Control part receives the data from the Air Interface Error Control part, it generates the C-TRANSFER REQ primitive to the Data Compressor/ Expander.

vi) Data Compressor/Expander re-initialization (see 5.6, ITU-T V.42 bis)

Not applicable.

vii) Improvement of data transfer rate (see 5.7, ITU-T V.42 bis)

The Protocol Control part transmits the C-FLUSH REQ primitive to the Data Compressor/Expander in accordance with the V.42 bis procedure.

viii) Operation upon C-ERROR reception (see 5.8, ITU-T V.42 bis)

The C-ERROR IND is used to notify the Protocol Control part of error detection by the Data Compressor/Expander (e.g., manual input error or frame-out-of-sync). Upon receiving this report, the Protocol Control part immediately releases the air interface transmission control connection. The decoder generates the C-ERROR IND primitive in accordance with the V.42 bis procedure.

9. Air Interface Error Control part operation - ARQ procedure

9.1 Outline

This section describes the Air Interface Error Control part operation. The following features are included in this Standard:

i) Frame structure

ii) Transmission error detection

iii) Sequence control (at the transmitter and the receiver)

9.2 Frame structure and field format

One frame consists of a TCH 1 burst (224 bits). The frame structure and the field format/CRC coding are shown in Figures 9.2.1 and 9.2.2, respectively. The sequence for the bit transmission is specified as follows:

i) ARQ control information: Send it to the radio link and the CRC encoder (CRC-16 and CRC-CCITT) preceded by the MSB (b7) in each control information message.

ii) Forward channel information: Send it to the radio link and CRC encoder (CRC-16 and CRC-CCITT) beginning from the LSB (b0) in each byte. Send the control information defined in the forward channel information with the same procedure. The user data compressed in accordance with the V.42 bis procedure should be sent starting from the LSB (b0) of compressed data (code word).

iii) CRC-16 bit: Send the operation result by the CRC encoder (shift register state) to the radio link and the CRC encoder (CRC-CCITT) starting from the MSB (b15).

iv) CRC-CCITT bit: Send the operation result by the CRC encoder (shift register state) to the radio link starting from the MSB (b15).

Figures 9.2.3 and 9.2.4 show the control parameters at the data transmitter and receiver, respectively. The parameters used by both transmitter and receiver are as follows.

Modulo number: 64

Number of frames equivalent to a round-trip delay (RTF): Depends on the network.

9.3 ARQ synchronization control

Figures 9.3.1 and 9.3.2 show the control operation for the synchronization at the data transmitter and the data receiver, respectively.

9.4 Data transmission control

Figures 9.4.1 to 9.4.4 show the data transmission control sequence.

9.5 Data reception control

Figures 9.5.1 to 9.5.3 show the data reception control sequence.

10. System parameters

This chapter specifies the following for the parameters required to execute the functions:

i) Which of the ADP/IWF Protocol Control part or the Data Compressor/Expander that will use these parameters

ii) Definition of parameters

iii) In the case of availability of the XID frame for the transmission of parameter information, which of the XID command frame or XID response frame that is to be used.

iv) Negotiation rules for the parameters which should be negotiated with the XID frame

10.1 Control part parameters

The following parameters are notified by the ADP to the IWF with the XID command frame. The IWF enters the notified value into the relevant field and returns it to the ADP.

10.1.1 DCE Operation identifier

This identifier specifies the DCE operation mode (call initialization or response).

10.1.2 Extended Parameter Availability identifier

This identifier specifies whether the extended XID frame should be used for the parameter negotiation using the XID.

10.1.3 User identifier

This identifier is used to identify the user.

10.2 DTE parameters

The following parameters are notified by the ADP to the IWF with the XID command frame. The IWF determines whether the individual parameters can be set up after notification and, if so, returns the notified parameters to the ADP with the XID response frame. Otherwise, it returns the value "255".

10.2.1 Communication Procedure identifier

This identifier is used to specify the communication procedure, i.e. to set the system to "asynchronous".

10.2.2 DTE-ADP Communication Rate identifier

Notifies the physical rate between the DTE and ADP.

10.2.3 Character Length identifier

Specifies the character length in DCE initial value setting command and user data if the Communication Procedure identifier is set to "Asynchronous".

10.2.4 Parity Type identifier

Specifies the presence/non-presence and type of parity attached to the characters in the "asynchronous" mode.

10.2.5 Stop-Bit Length identifier

Specifies the stop-bit length of the characters in the "asynchronous" mode.

10.3 Data compressor parameters

The following parameters are notified by the ADP to the IWF with the XID command frame. The IWF determines whether the individual parameters can be set up after notification and, if so, returns the notified parameters to the ADP with the XID response frame. Otherwise, it returns the value "255".

10.3.1 Total number of code words (parameter P1)

Specifies the parameter P1 for the V.42 bis. The value "0" indicates data compression is not performed.

10.3.2 Maximum character string length (parameter P2)

Specifies the parameter P2 for the V.42 bis. If parameter P2 is set to "0", length "0" is specified.

10.3.3 Data communication function selection information

This information has the same content as the parameter defined in octet 3, 4, 5 or 6 in the information element transmitted from the calling user to the network for call control.

11. Information field coding

11.1 Information field in the user data frame

The information field in the user data frame is coded in order to transfer the user data from the V.24 interface. The S/P flag should be set to "0" (user data) in the ARQ control information, and the number of bytes in the user data should be set to LI (significant byte length in the forward channel information).

11.2 Information field in the XID frame

Figure 11.2.1 shows the format of the information field in the XID frame. The XID frame should be coded to the octets 2 to 22 in the forward channel information in the ARQ frame. The S/P flag in the ARQ control information should be set to "1" (radio link definition control signal) and the significant byte length LI in the forward channel information should be set to "21".

The following information field should be coded and transmitted starting from the least significant bit (LSB), i.e. bit 1.

11.2.1 Control Information Type identifier

Coded as shown in Table 11.2.1.1. This identifier determines whether the XID frame was sent from the ADP (XID command frame) or IWF (XID response frame or notification XID frame).

11.2.2 Control Information Content identifier

Coded as shown in Table 11.2.2.1.

11.2.3 Parameter field

11.2.3.1 Parameter values and coding of the basic XID frame

The parameter field in the basic XID frame has the format in Figure 11.2.3.1.1 if the Control Information Content identifier is set to "1". Tables 11.2.3.1.1 to 11.2.3.1.11 list the parameter values and their coding.

11.2.3.2 Coding of the extended XID frame

The parameter field in the extended XID frame should have the format in Figure 11.2.3.2.1 if the Control Information Content identifier is set to "2". Table 11.2.3.2.1 lists the parameter values and their coding.

11.2.3.3 Parameter values and coding of the notification XID frame

The parameter field in the notification XID frame has the format in Figure 11.2.3.3.1 if the Control Information Content identifier is set to "3". Tables 11.2.3.3.1 to 11.2.3.3.4 list the parameter values and their coding.

11.3 Information field in the UI frame

The information field in the UI frame has the same structure as that of the XID frame (Figure 11.2.1).

The UI frame should be coded into the octets 2 to 22 in the forward channel information in the ARQ frame. The S/P flag in the ARQ Control Information should be set to "1" (radio link definition control signal) and the significant byte length LI in the forward channel information should be set to "4".

The following information field should be coded and transmitted starting from the least significant bit (LSB), i.e. bit 1. Figure 11.3.1 shows the format of the information field in the UI frame. Tables 11.3.1 to 11.3.4 list the parameter values and their coding.

Appendix I Parameter RTF value setup in the ARQ procedure

This section describes the setup procedure for the value of parameter RTF in the ARQ procedure. The network operator should have an idea of the specific values of the following items in order to specify the RTF value:

i) ADP and IWF internal process time for the ARQ operation (i.e. the period from frame reception to the ACK/NAK response transmission)

ii) Maximum buffer duration of a TCH frame in an MS unit (at transmission and reception)

iii) Maximum delay in the radio path (including the TCH frame process delay on the radio equipment at BS)

iv) Maximum delay in the inter-station transmission path from BS to IWF

The RTF value can be found by adding the values in items i) to iv) above in both directions, ADP to IWF and IWF to ADP, and indicating the sum in the number of ARQ frames.

Appendix II Example of DCE initial value setting command coding in the extended XID frame

This section shows an example of DCE initial value setting command coding in the extended XID frame field format as described in 11.2.3.2. In this example, the AT command is applied according to the following coding rules. Coding examples are shown in Figures II-1.1 and II-1.2:

Rule 1) The field should be always preceded by "AT".

Rule 2) Omit "0" for coding if the parameter is set to "0" in the command.

Rule 3) The command string should be always followed by <CR> and the idle field should be filled with <NULL>.

Rule 4) When dividing a command string into multiple frames, each frame has to contain the complete command string which satisfies Rules 1) to 3).

Rule 5) Use the upper case for all alphabetic character strings.

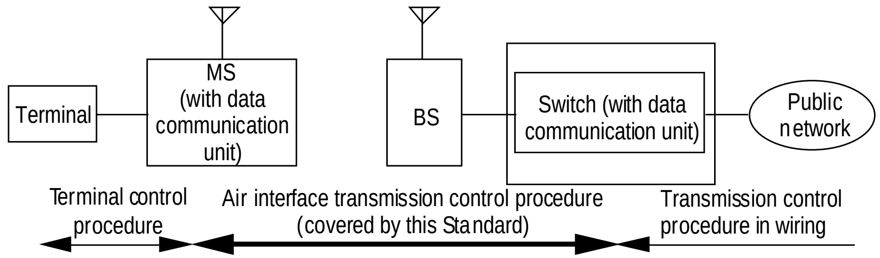


Fig. 1.1.1 : System Configuration

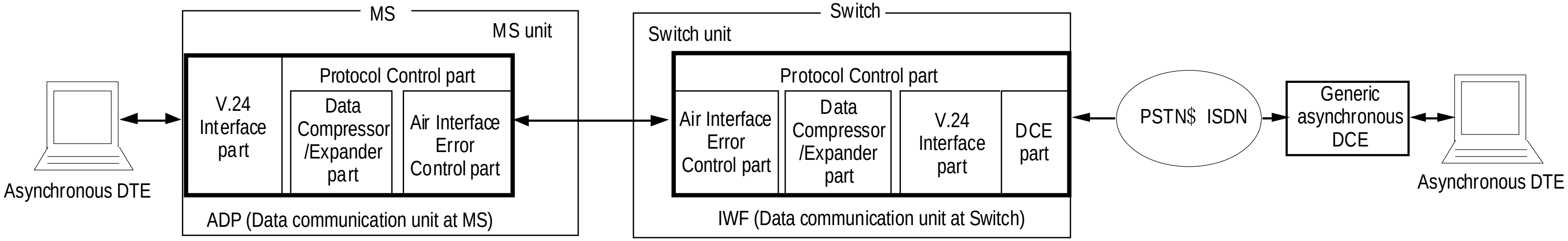


Fig. 2.1 : Functional Block Diagram

Table 5.1 : Interconnection Circuit for Air Interface Transmission Control

Circuit No.	Abbr.	Function
103	SD	Transmitted data
104	RD	Received data
106	CS	Ready for sending
107	DR	Data set ready
108	ER	Data terminal ready
109	CD	Data channel received line signal detector
133	RS	Ready for receiving

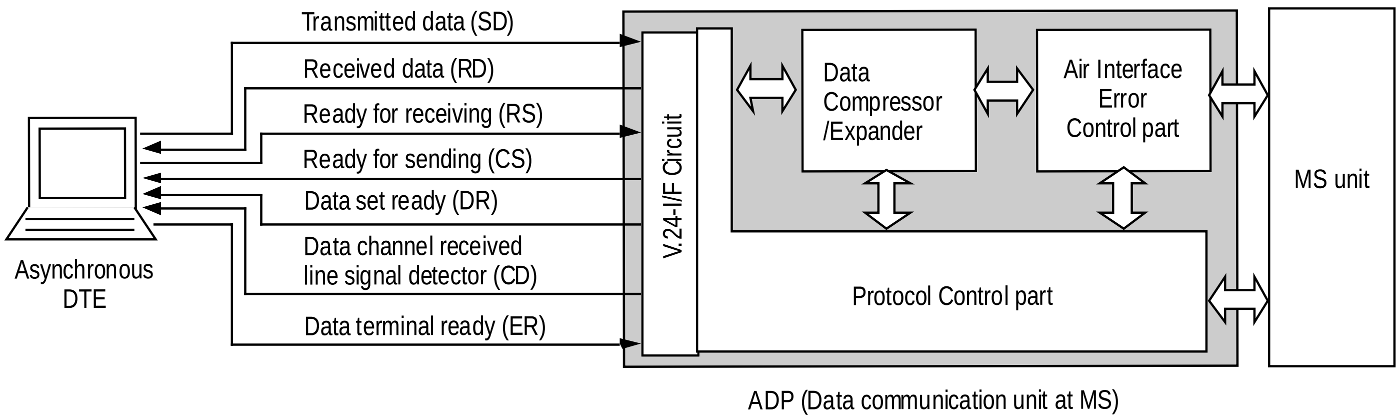


Fig. 5.1 : Interconnection Circuit for Air Interface Transmission Control (ADP)

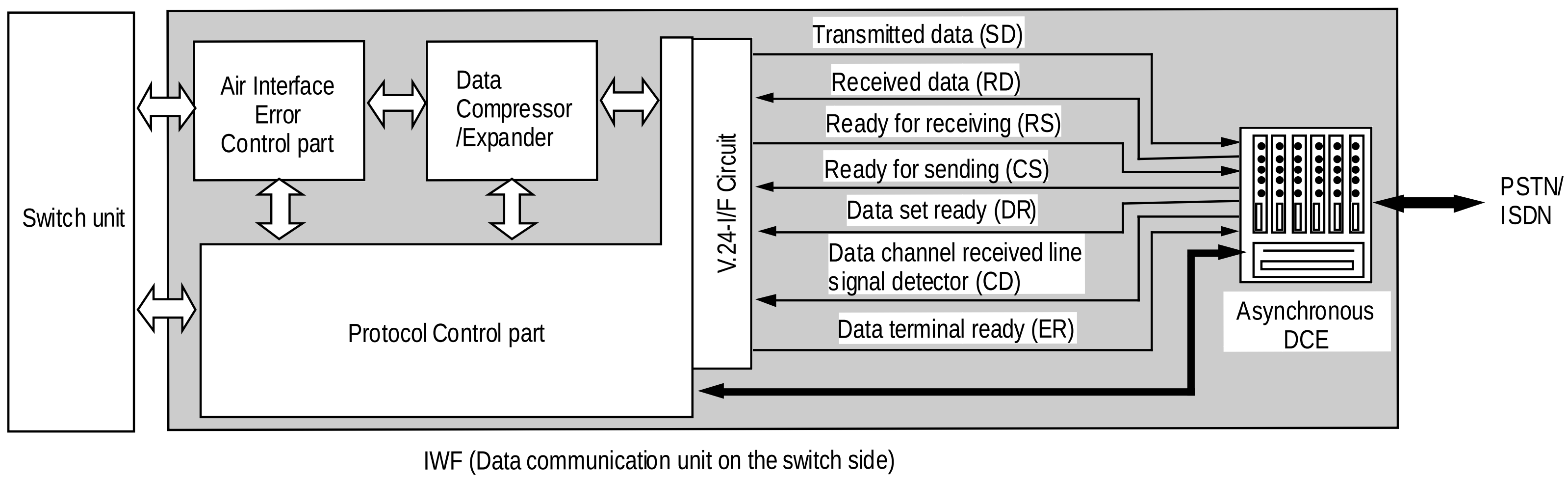
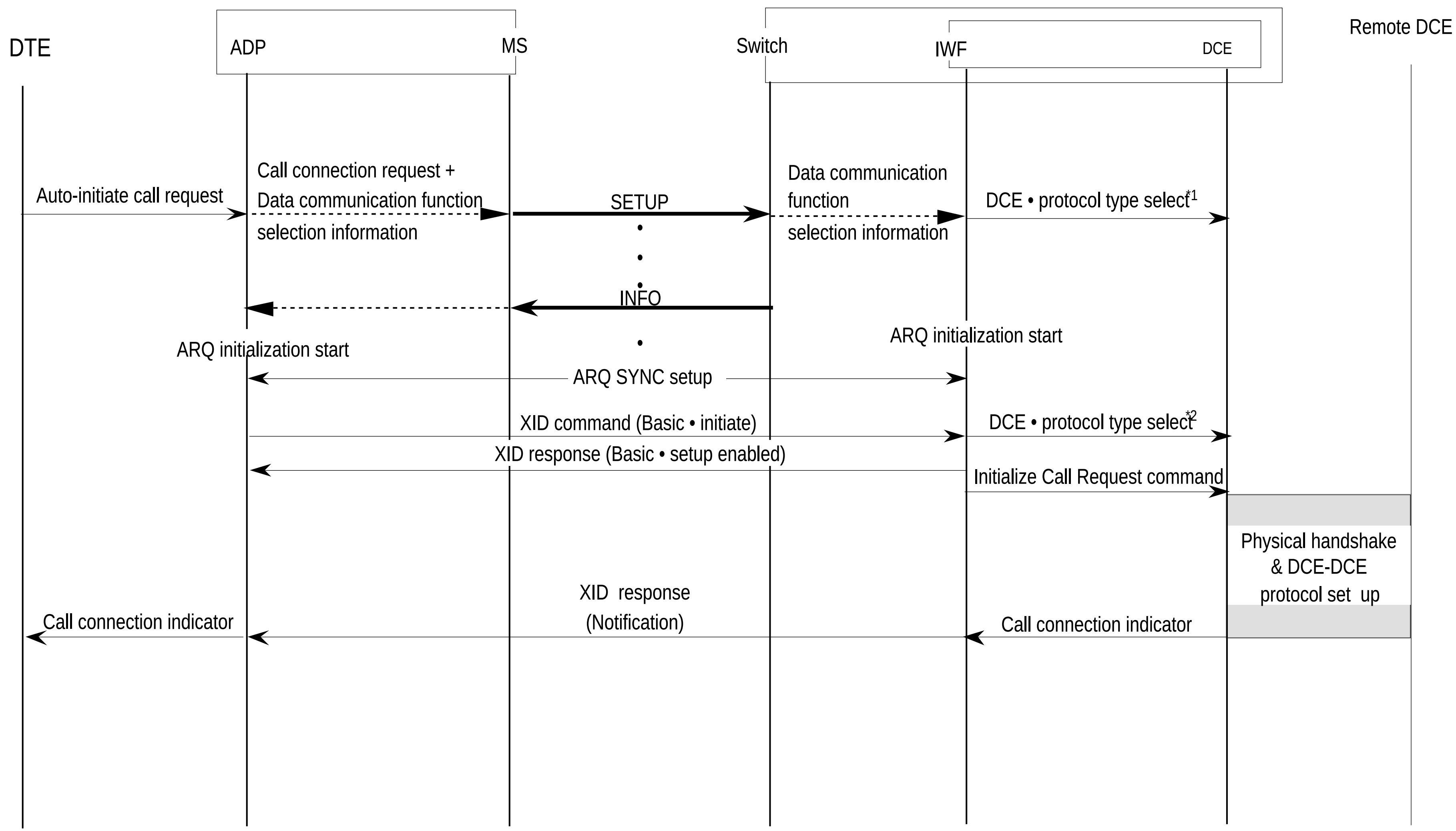


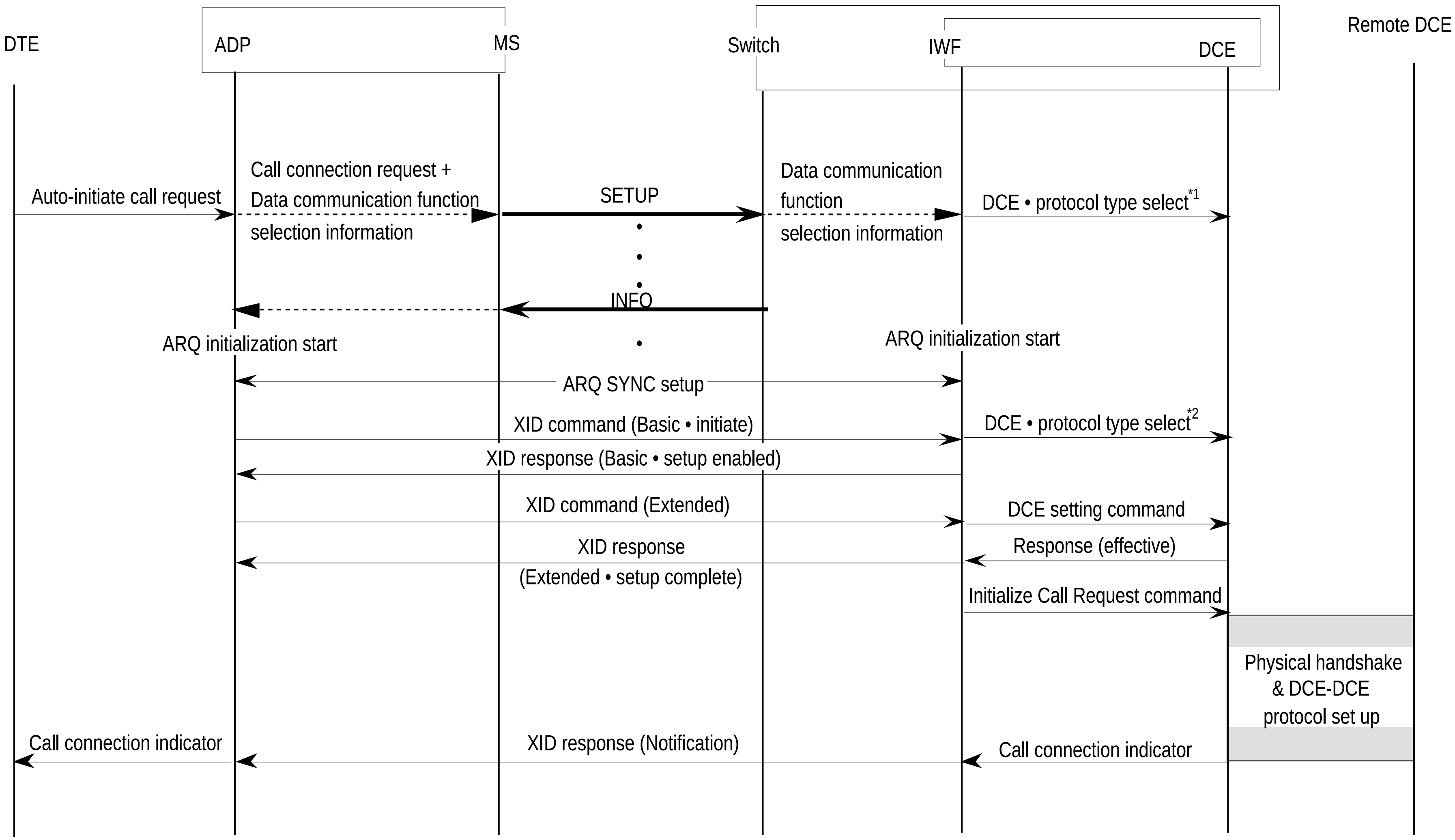
Fig. 5.2 : Interconnection Circuit for Air Interface Transmission Control (IWF)



*1 & 2 : Procedure *1 or/and *2 is performed.

Fig. 7.3.2.1 : Protocol Control Part Parameter Negotiation Control Sequence

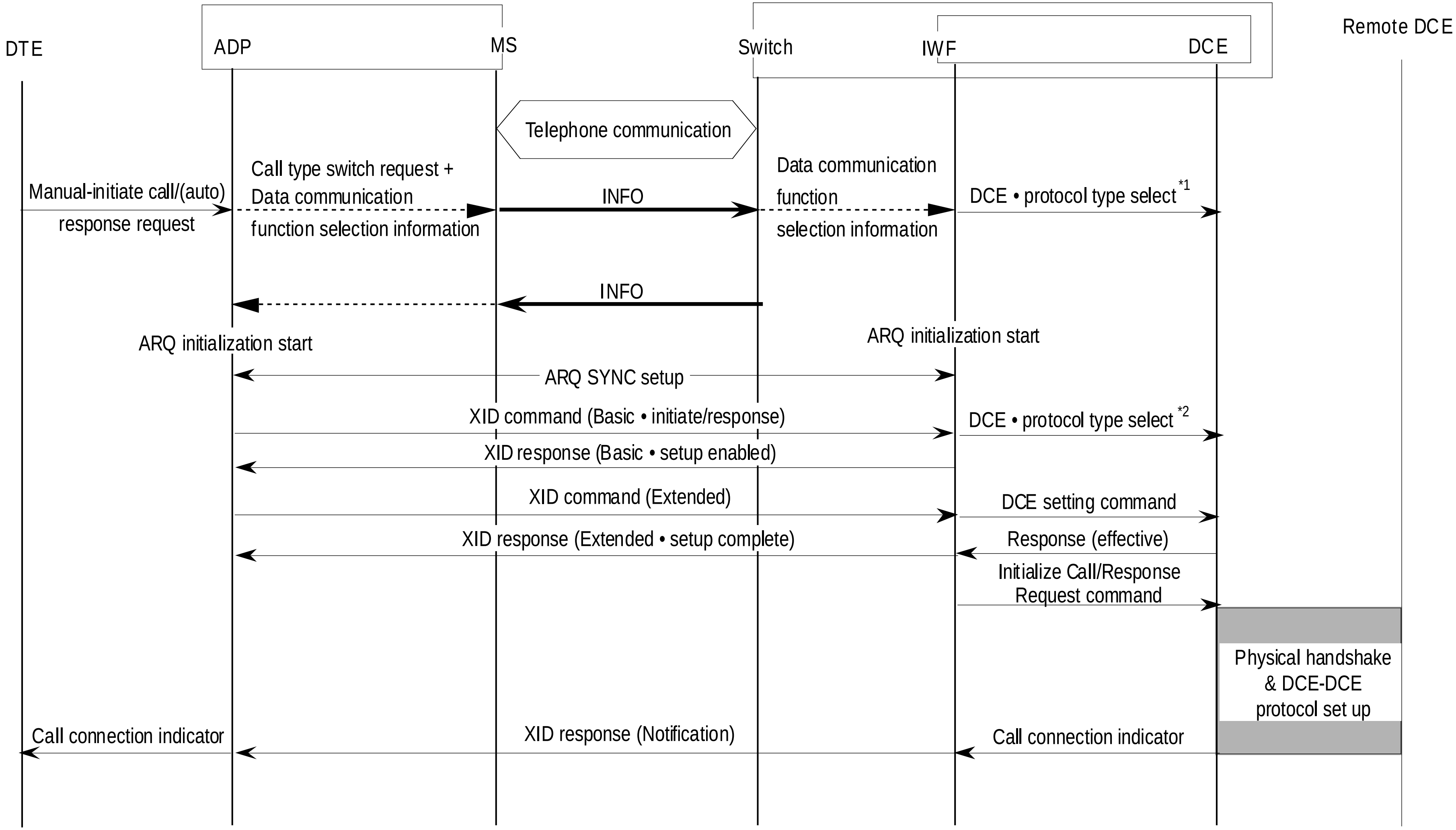
(Ex : Automatic Initiation Call & DCE Initial Value Setting Parameter Unavailable)



*1 & 2 : Procedure *1 or/and *2 is performed.

Fig. 7.3.2.2 : Protocol Control Part Parameter Negotiation Control Sequence

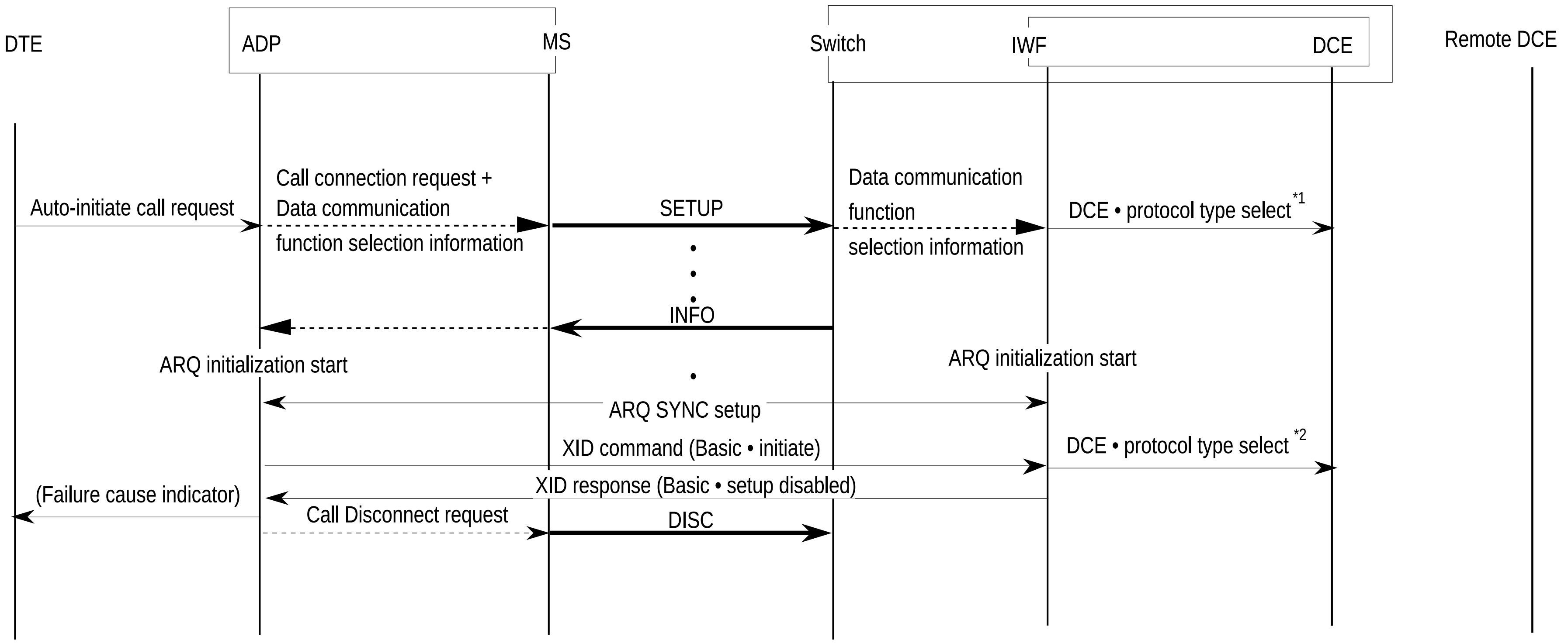
(Ex : Automatic Initiation Call & DCE Initial Value Setting Parameter Available)



*1 & 2 : Procedure *1 or/and *2 is performed.

Fig. 7.3.2.3 : Protocol Control Part Parameter Negotiation Control Sequence

(Ex : Manual Initiation Call/(Auto-) Response & DCE Initial Value Setting Parameter Available)



*1 & 2 : Procedure *1 or/and *2 is performed.

Fig. 7.3.3.1 : Protocol Control Part Parameter Negotiation Control Sequence

(Ex : Parameter Negotiation Failure)

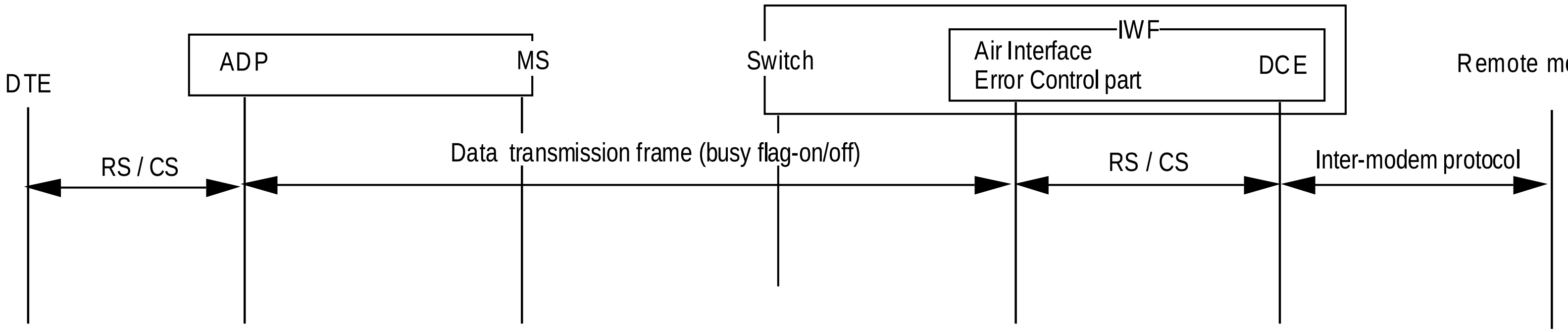


Fig. 7.4.1.1 : Flow Control with RS/CS

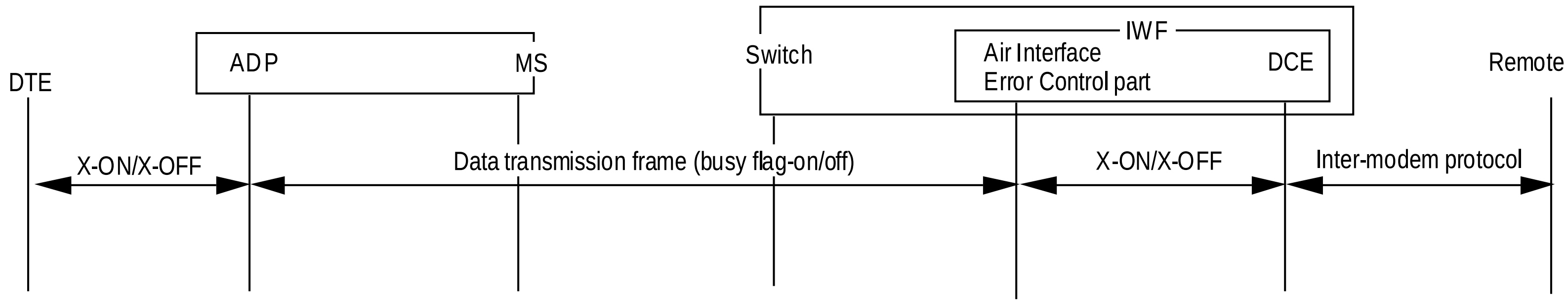


Fig. 7.4.1.2 : Flow Control with X-ON/X-OFF

Table 7.5.1 : Transmitter ADP/IWF Operation on Break Signal Reception at V.24 Interface

Break handling option	Data			
	Toward remote ADP/IWF	Toward local DTE/DCE	From remote ADP/IWF	From local DTE/DCE
Non-destructive/Expedited	* Complete the ongoing data transmission and send Break. * Hold data until the reception is confirmed.	* Transmit data.	* Transmit data.	* Transmit data.
Non- Non-destructive/ expedited	* Wait for the confirmation of transmitted data and send Break. * Hold data until confirmation is received.	* Transmit data.	* Transmit data.	* Transmit data.

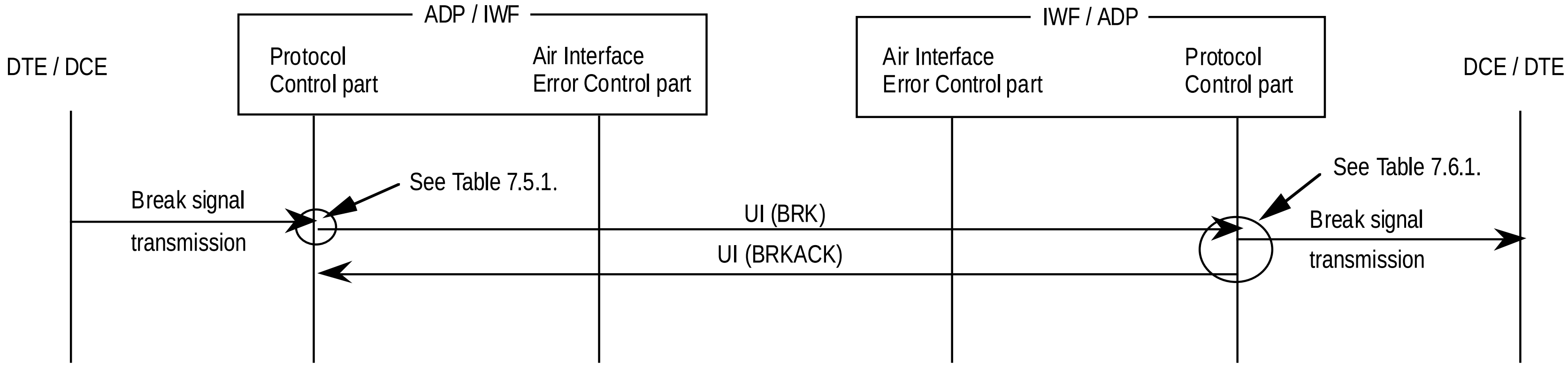


Fig. 7.5.1 : Break Signal Transmission Control Sequence

Table 7.6.1 : Receiver ADP/IWF Operation on Break Signal Reception from Remote ADP/IWF

Break handling option	Data	
	Toward remote ADP/IWF	Toward local DTE/DCE
Non-destructive/Expedited	* No change * Send Break Transmit Confirmation.	* Distribute Break at once. * Resume data distribution.
Non-destructive/Non-expedited	* No change * Distribute Break to DTE/DCE and then send Break Transmit Confirmation.	* Distribute Break and data in specified order.

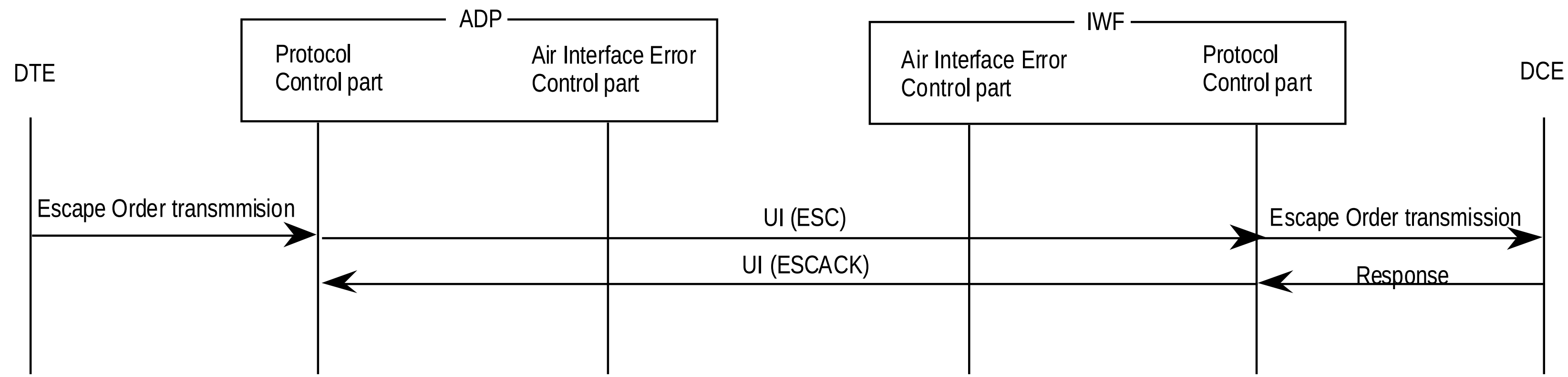
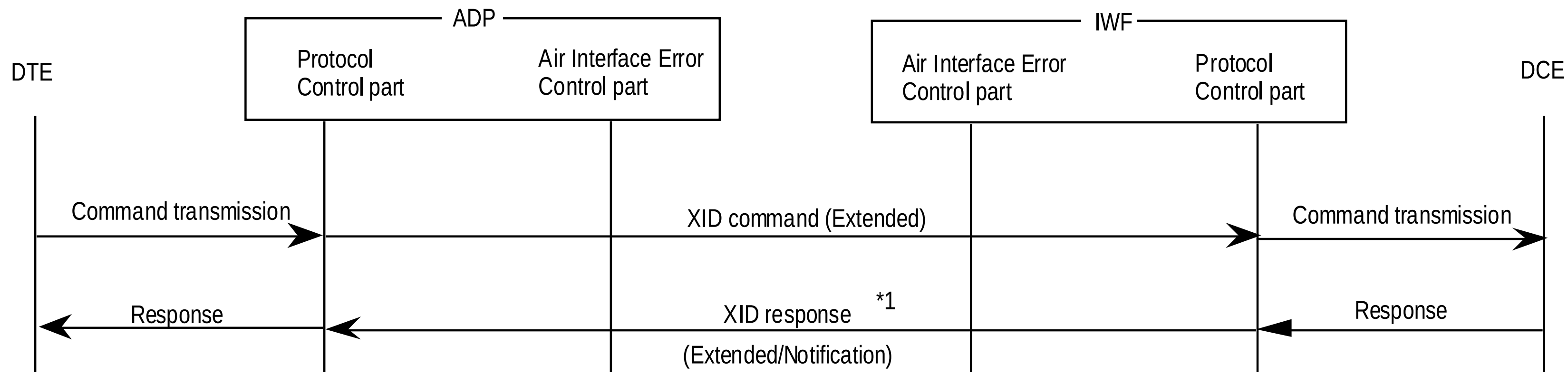


Fig. 7.7.1 : Transmission Control Sequence for DCE Mode Switching Instruction during Communication



*1 XID selection (Extended XID or Notification XID) responding to DCE Response depends on the network.

Fig. 7.7.2 : Transmission Control Sequence for DCE Command during Communication (Optional)

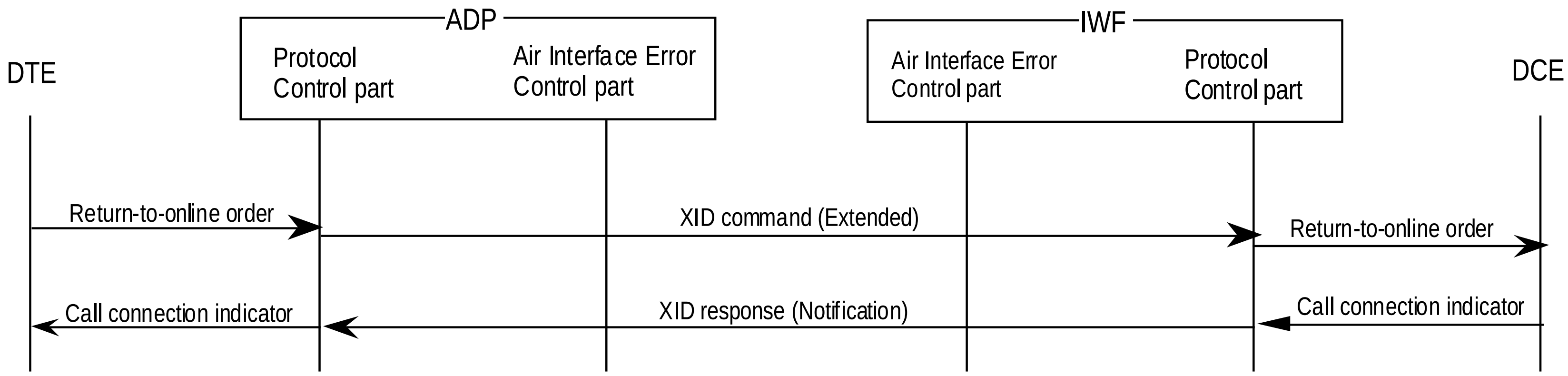
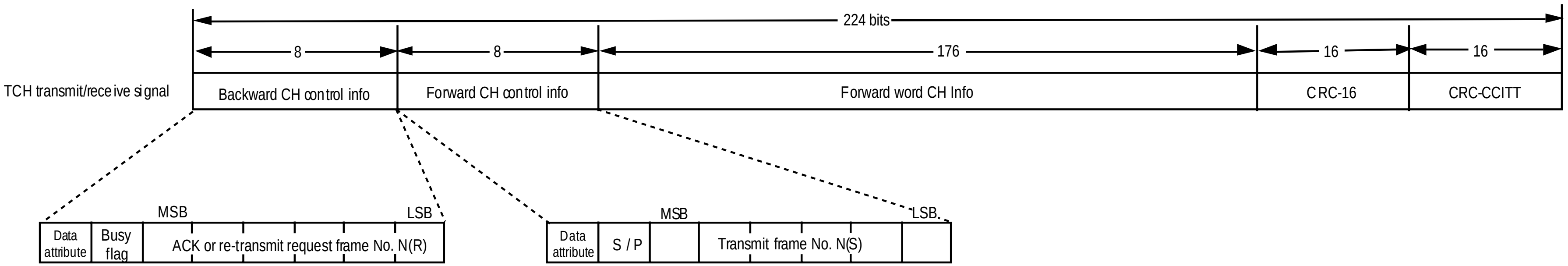


Fig. 7.7.3 : Return-to-online Command Transmission Control Sequence



* Data attribute in backward CH Control Info
0=ARQ info (ACK)
1=ARQ info (NACK)

* Busy flag
1=busy
0=not busy

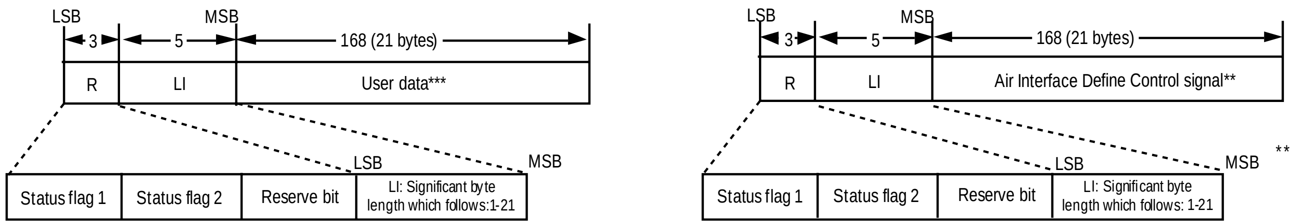
* Data attribute in forward CH control info
0=ARQ info (SR)
1=ARQ info (GBN)

* S/P flag
0=P (user data)
1=S (air interface define control signal)

Forward CH Info

* If S/P=P:

* If S/P=S:



** Send the control signal in step of frame.

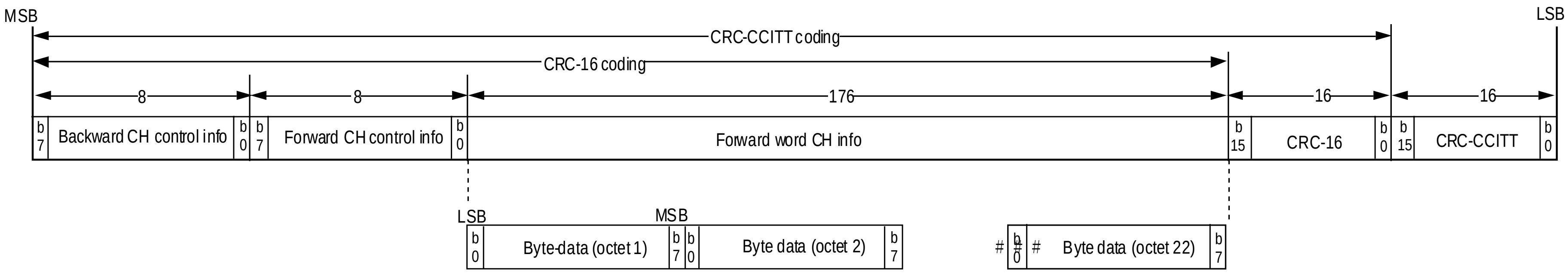
*** Send user data after removing start /stop bits.

* Enter FFh info in invalid fields if the number of significant bytes is less than 21.

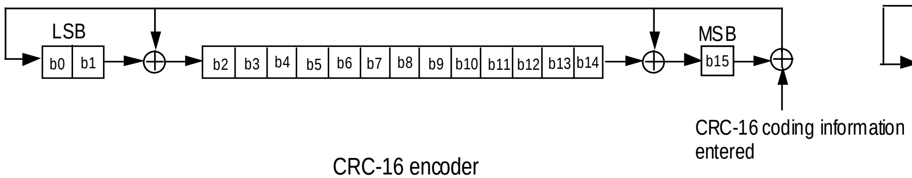
* Status flag 1 (ER/DR)
1=on
0=off

* Status flag 2 (CD)
1=on
0=off

Fig. 9.2.1 : ARQ Frame Structure

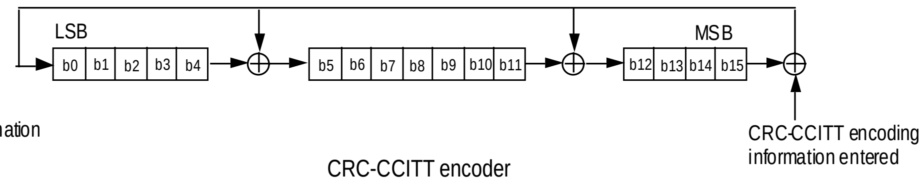


Field Format



CRC-16 encoder

Generator polynomial: $1 + X^2 + X^{15} + X^{16}$
Initial values of shift register: all 0



CRC-CCITT encoder

Generator polynomial: $1 + X^5 + X^{12} + X^{16}$
Initial values of shift register: all 0

CRC Coding

Fig. 9.2.2 : Field Format and CRC Coding

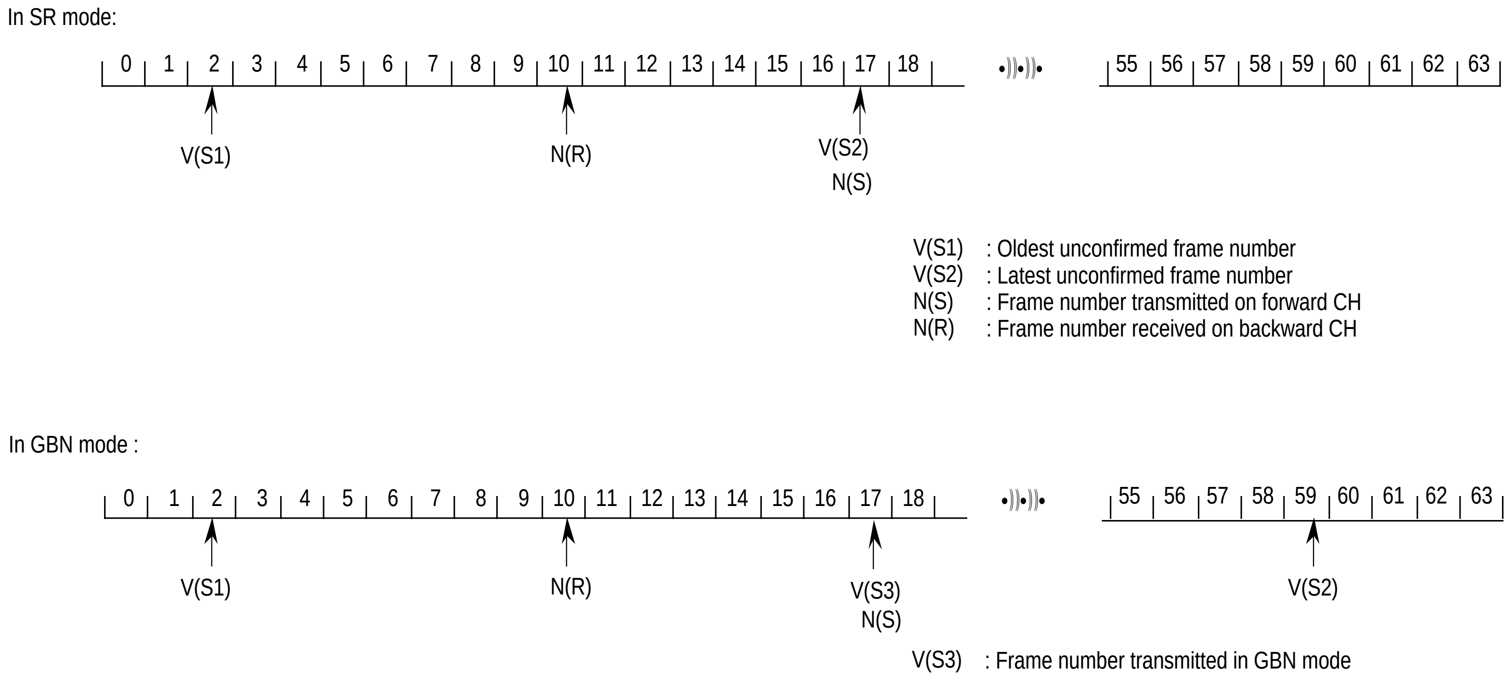


Fig. 9.2.3 : Transmitter Control Parameter

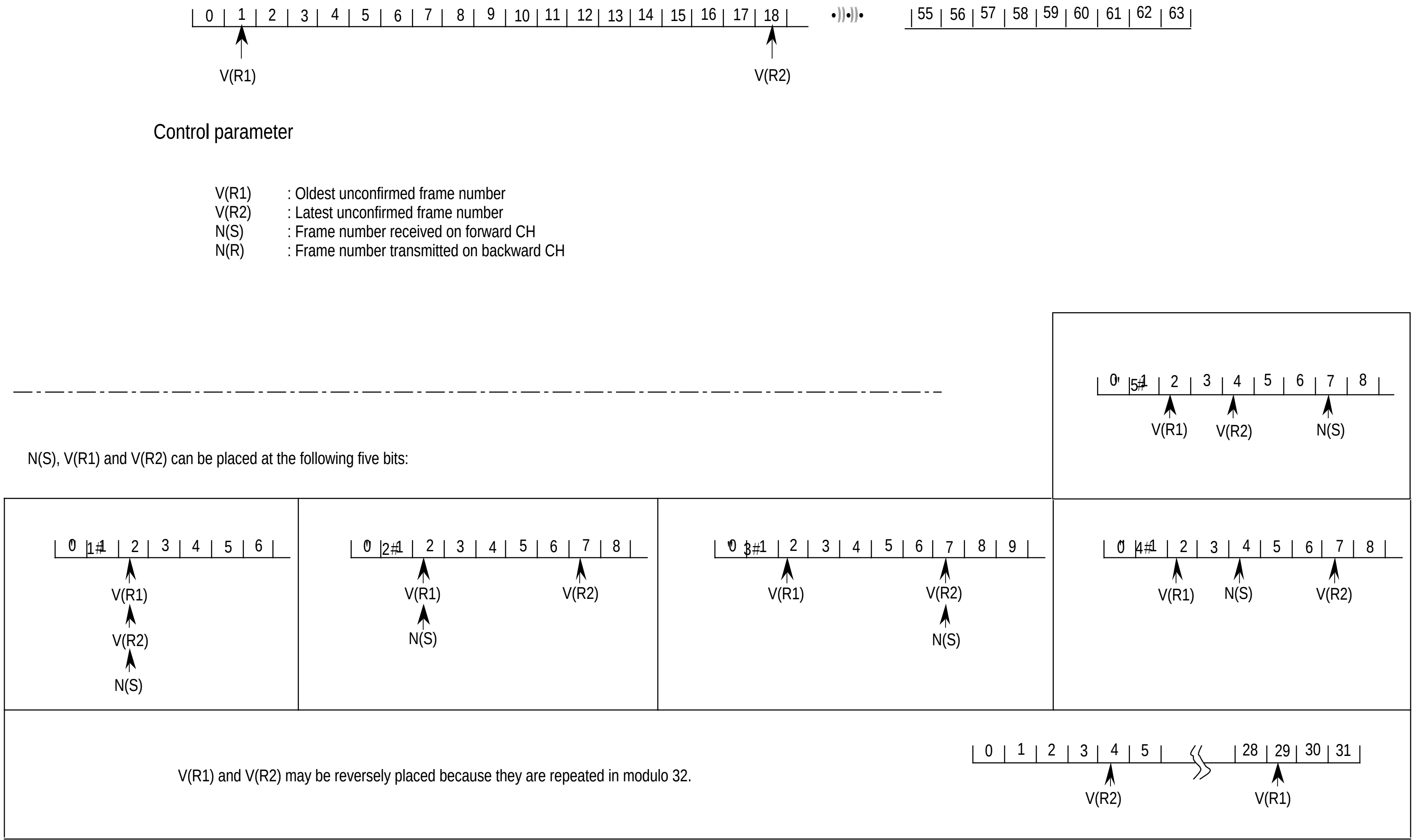


Fig. 9.2.4 : Receiver Control Parameter

ARQ Initialization (Synchronization) Protocol (Transmitter side)

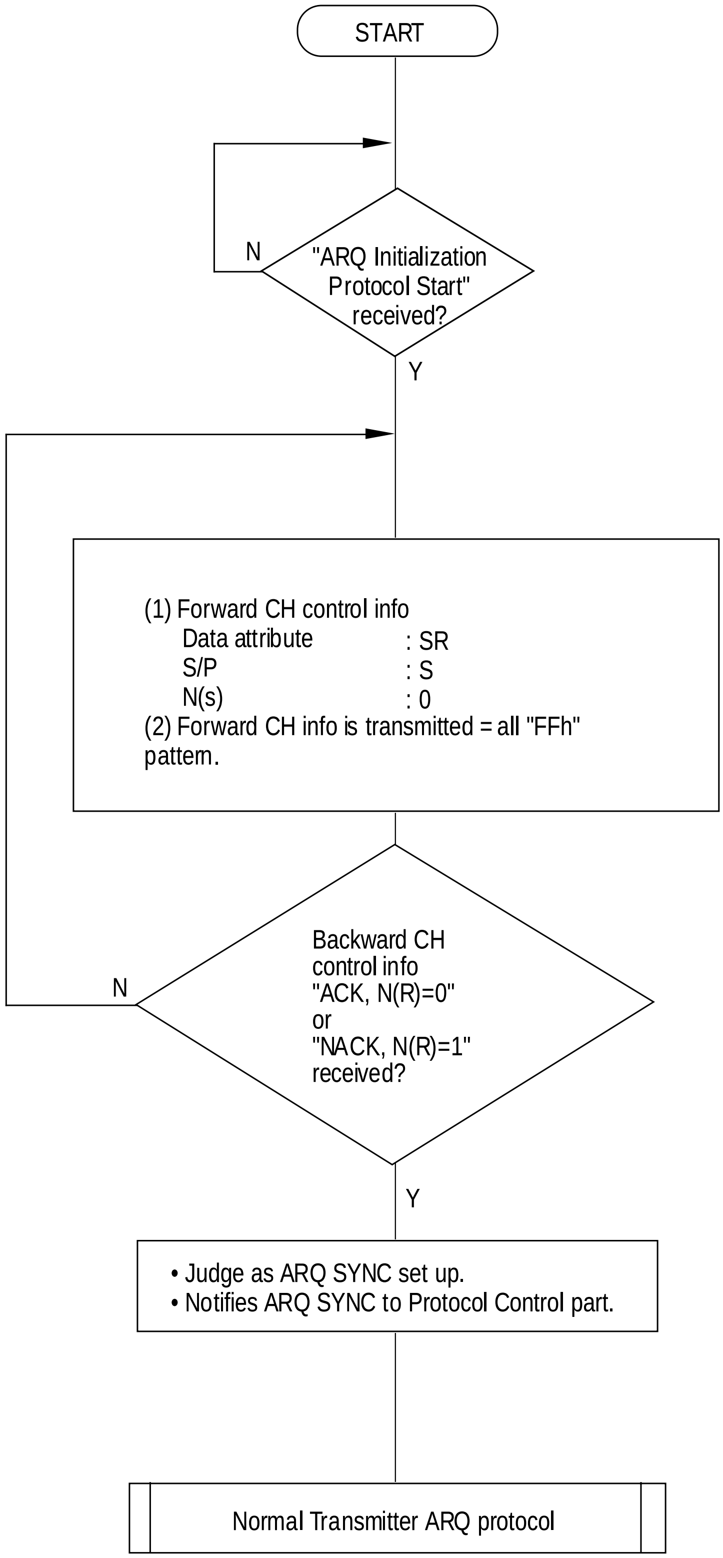


Fig. 9.3.1 : ARQ Initialization (Synchronization) Protocol (Transmitter side)

ARQ Initialization (Synchronization) Protocol (Receiver side)

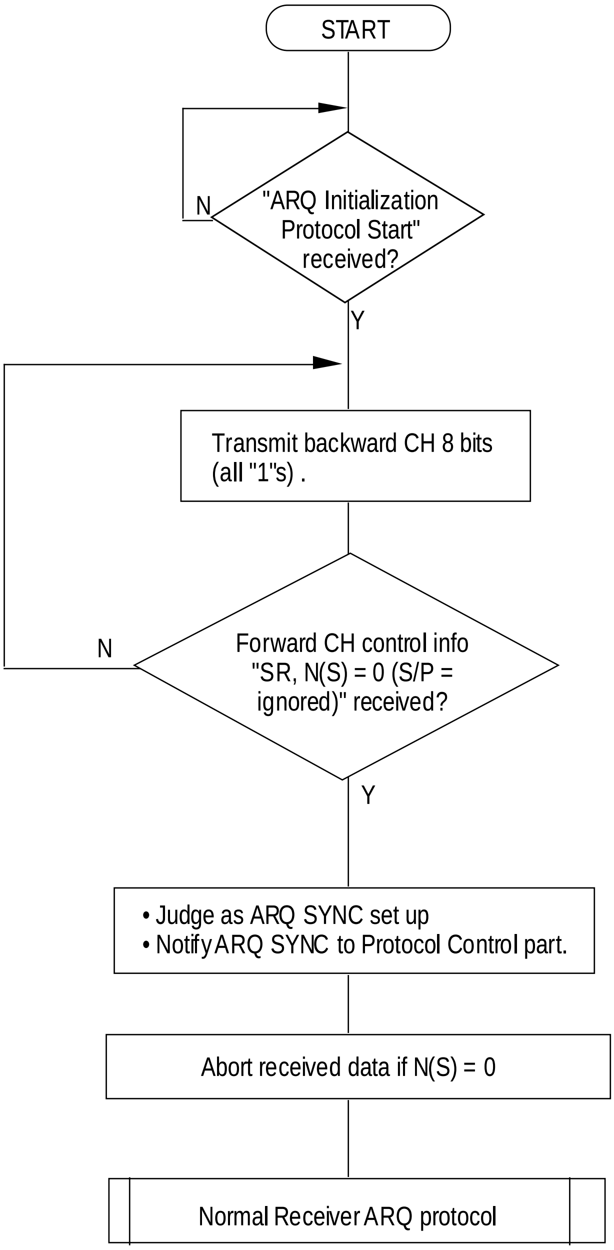
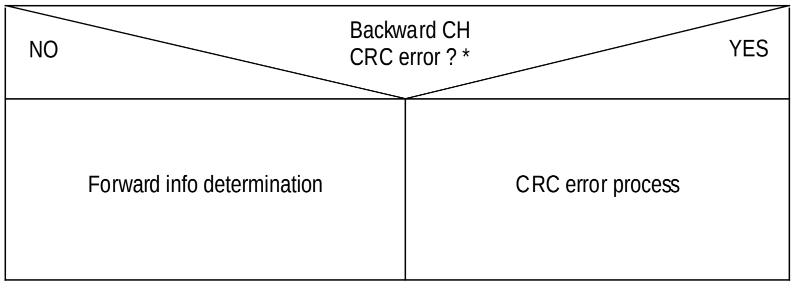
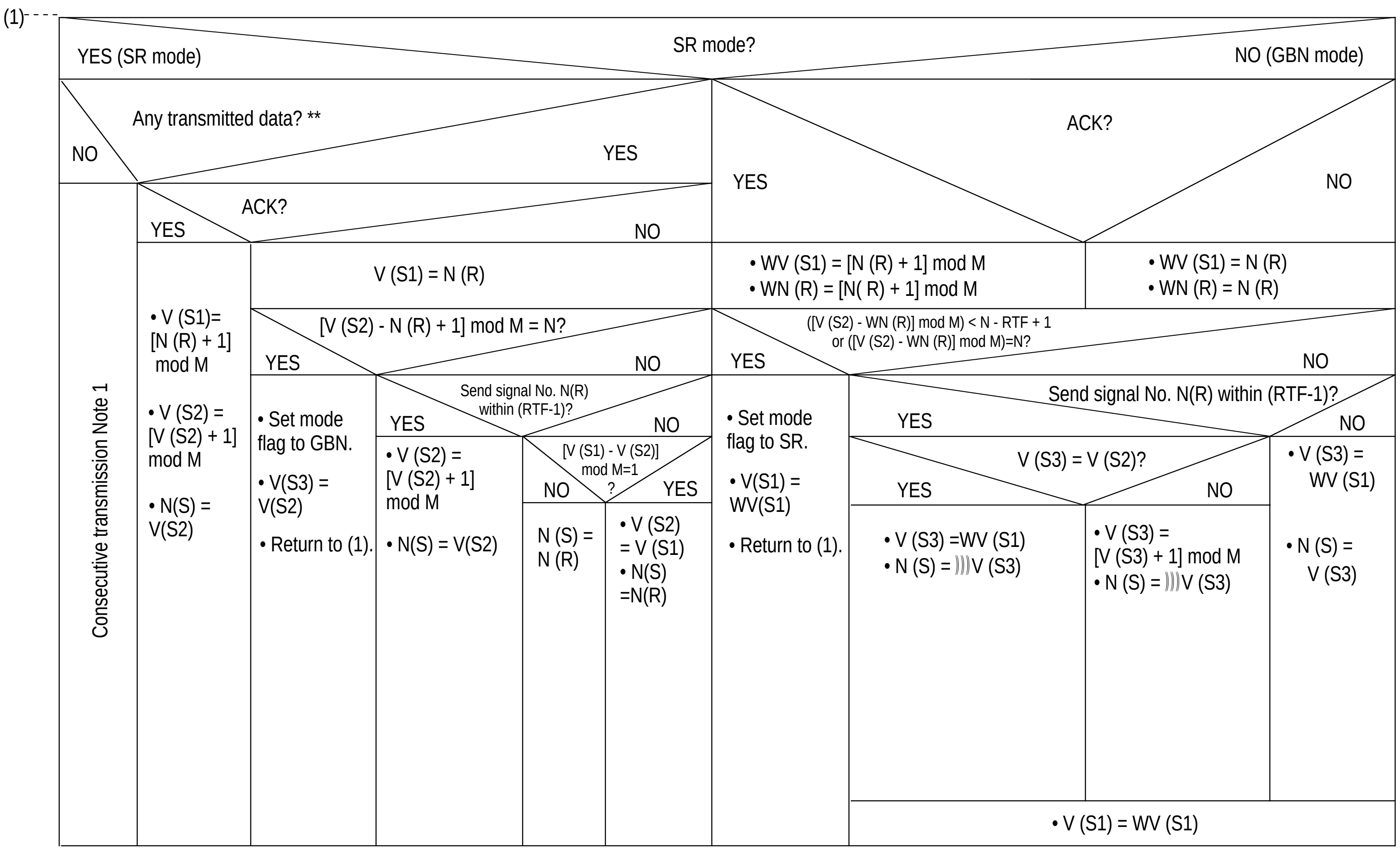


Fig. 9.3.2 : ARQ Initialization (Synchronization) Protocol (Receiver side)



*CRC OK : Both CRC-16 and CRC-CCITT are O.K.
CRC NG : 1) CRC-16 or/and CRC-CCITT is N.G.
2) 224 bit with all "0"s pattern is received.

Fig. 9.4.1 : Data Transmission Control Sequence (CRC Error Determination)

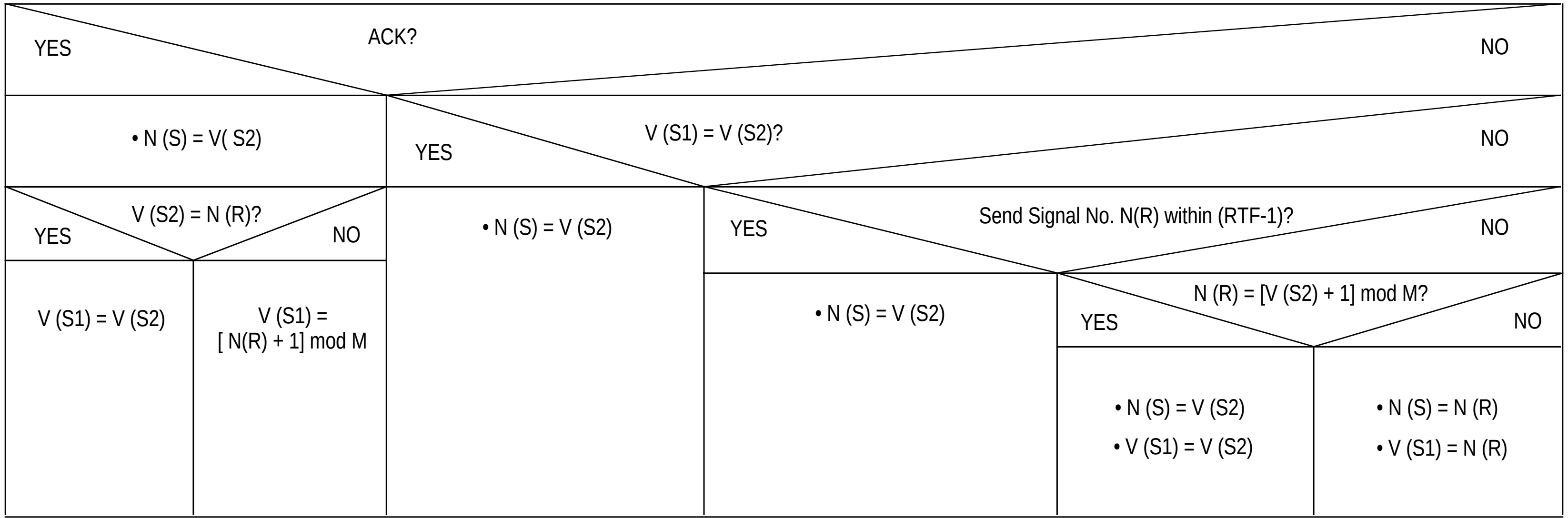


** If any status flag is changed, or if new user data or an air interface definition control signal to be sent is available.

Note 1 : If no data is to be transmitted :

WV(S1) : Temporary V(S1) buffering area
WN(R) : Temporary N(R) buffering area
N : Number of outstanding frame (= M-1)

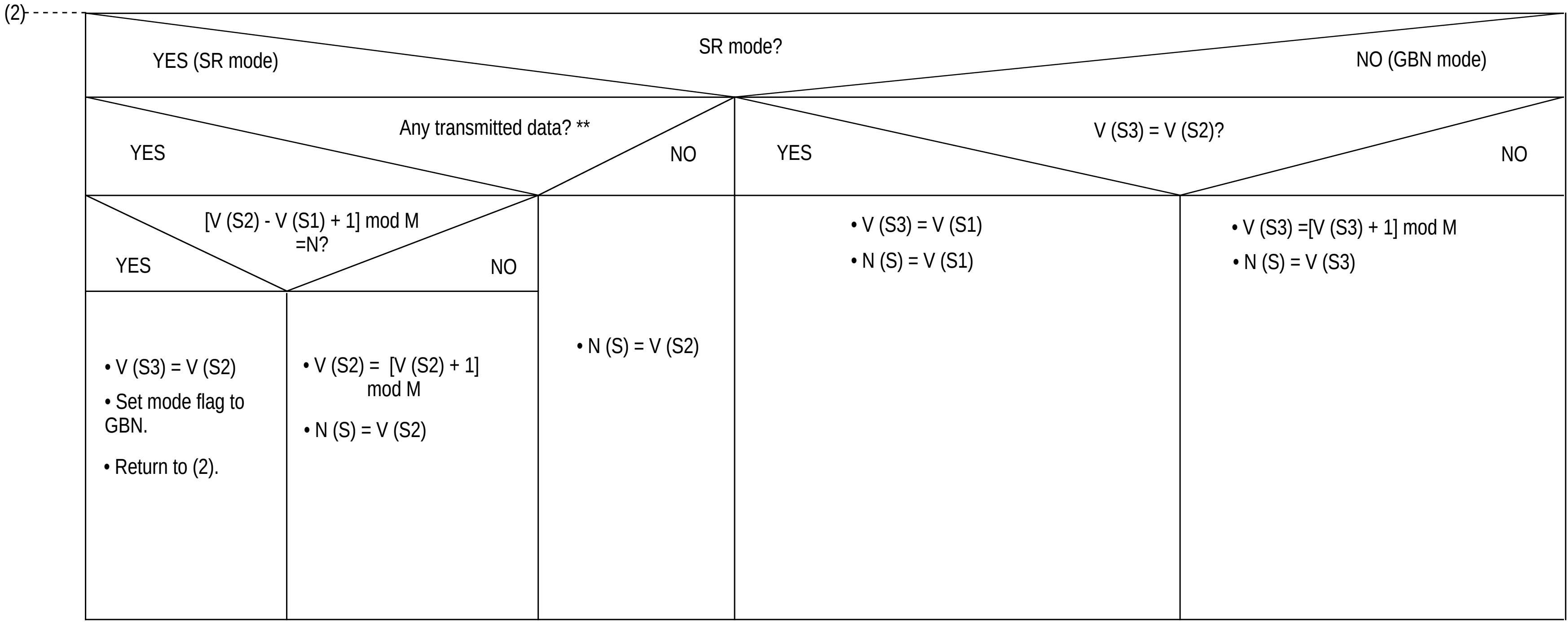
Fig. 9.4.2 : ARQ Control Protocol (Forward Information Determination)



<u>Data handling at transmitter during consecutive transmission</u>
Send the user data and air interface definition control signal in the frame transmitted with final unconfirmed frame No. V(S2) (If N(S) = V(S2))

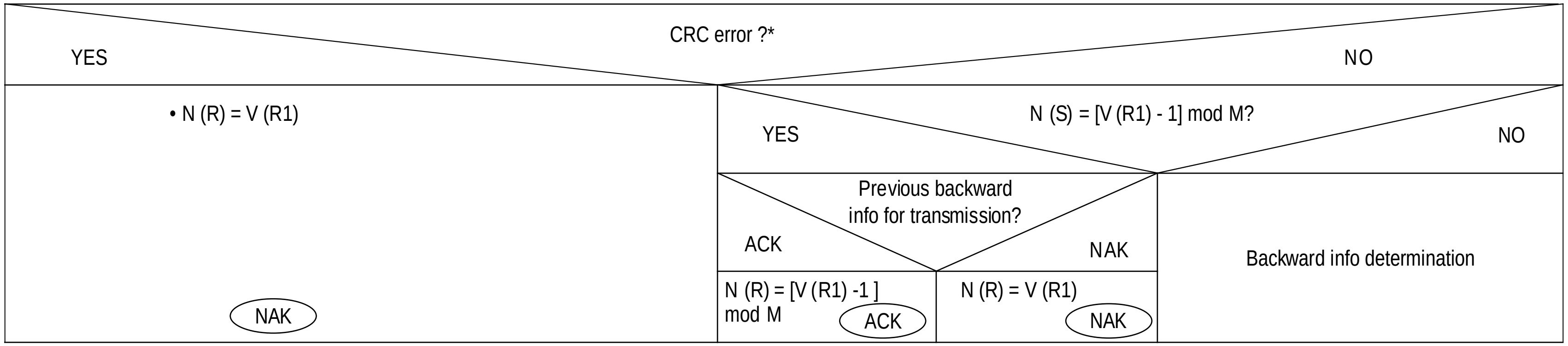
<u>Data handling at receiver during consecutive transmission</u>
If identical reception frame numbers N(S) are consecutively received, pick up the user data and air interface definition control signal from the N (S) frame first received without an error.

Fig. 9.4.3 : ARQ Control Protocol (Consecutive Transmission)



** If any status flag is changed, or if new user data or an air interface definition control signal to be sent is available

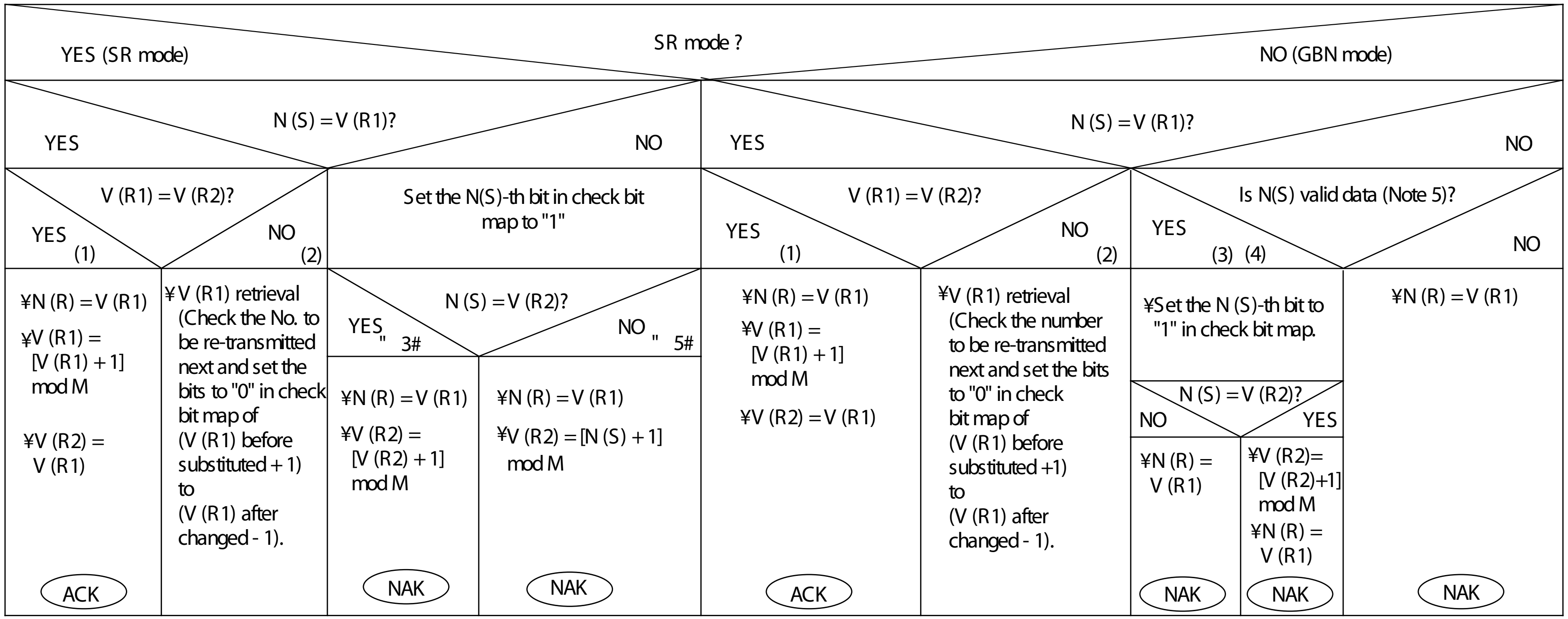
Fig. 9.4.4 : ARQ Control Protocol (CRC Error Handling)



* CRC OK : CRC-16 and CRC-CCITT are O.K.
CRC NG : 1) CRC-16 or/and CRC-CCITT is N.G.
2) 224 bits with all "0"s pattern is received.

Fig. 9.5.1 : ARQ Control Protocol (CRC Error Determination)

The numbers (1) to (5) correspond to 5 types of the location among N(S), V(R1), and V(R2)



Note 5 : Valid data :

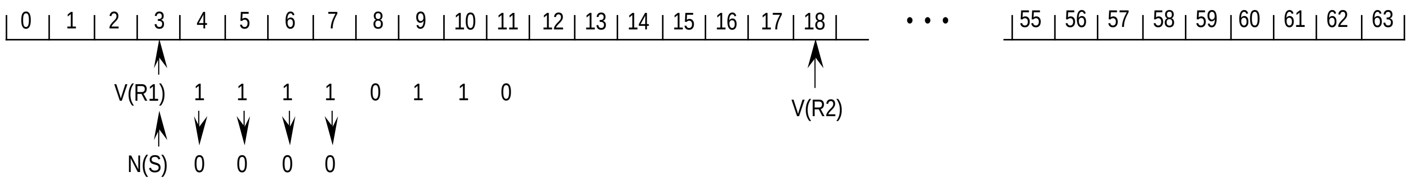
(a) If V (R1) = V (R2) , then no valid data

(b) If V (R1) < V (R2) , then V (R1) < N (S) ≦ V (R2)

(c) If V (R2) < V (R1) , then
0≦ N (S) ≦ V (R2) or
V (R1) < N (S) ≦ M-1

Fig. 9.5.2 : ARQ Control Protocol (Backward Information Determination)

Reception check bit map



Reception check bit map

Content of bit • • • "0" : Not confirmed

"1" : Confirmed

Valid range of bits • • • • V(R1) to V(R2)

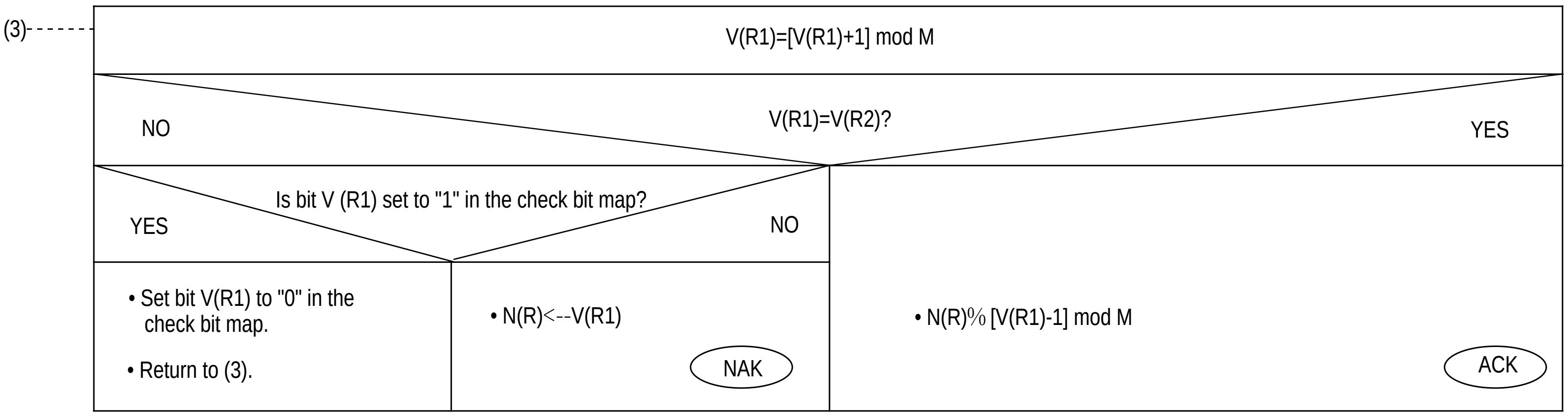


Fig. 9.5.3 : ARQ Control Protocol (V(R1) Retrieval)

Control Information Type Identifier	Octet 2
Control Information Content Identifier	3
Parameter Information Field	
	22

Fig. 11.2.1 : Typical Format of Information Field in XID Frame

Table 11.2.1.1 : Control Information Type Identifier Coding

Control Info Type ID		Meaning
Decimal	Binary	
191	10111111	XID (originator: ADP, XID command)
175	10101111	XID (originator: IWF, XID response)

Table 11.2.2.1 : Control Information Content Identifier Coding

Control Info Content ID		Meaning
Decimal	Binary	
1	00000001	Basic parameter
2	00000010	Extended parameter
3	00000011	Notification parameter

	Octet
Communication Procedure ID	Octet 4
DTE-ADP Communication Rate ID	5
	6
Character Length ID	7
Parity Type ID	8
Stop-Bit Length ID	9
Total Number of Code Words (parameter P1)	10
Maximum Character String Length (parameter P2)	11
DCE Operation ID	12
Extended Parameter Availability ID	13
User ID	14
Data Communication Function Selection Info (octet 3)	15
Data Communication Function Selection Info (octet 4)	16
Data Communication Function Selection Info (octet 5)	17
Data Communication Function Selection Info (octet 6)	18
Reserved	19
Reserved	20
Reserved	21
Parameter terminator (for command) /Parameter analysis result (for response)	22

Note: Set the "Reserved" octet to "11111111"

Fig. 11.2.3.1.1 : Information Field Format in Basic XID Frame

Table 11.2.3.1.1 : Communication Procedure Identifier Coding

Communication Procedure ID		Setting
Decimal	Binary	
0	00000000	Asynchronous/Non-procedure
1-255 for other than above		Reserved

Table 11.2.3.1.2 : DTE-ADP Communication Rate Identifier

DTE-ADP Communication Rate ID (Note 1)		Setting
Decimal	Binary	
3	00000000 00000011	300bit/s
6	00000000 00000110	600bit/s
12	00000000 00001100	1200bit/s
24	00000000 00011000	2400bit/s
48	00000000 00110000	4800bit/s
72	00000000 01010000	7200bit/s
96	00000000 01100000	9600bit/s
120	00000000 01111100	12000bit/s
144	00000000 10010000	14400bit/s
192	00000000 11000000	19200bit/s
384	00000001 10000000	38400bit/s
Rate x 1/100		Others

Note 1 : Upper: Octet 5
Lower: Octet 6

Table 11.2.3.1.3 : Character Length Identifier Coding

Character Length ID		Setting
Decimal	Binary	
0	00000000	7 bit
1	00000001	8 bit

Table 11.2.3.1.4 : Parity Type Identifier Coding

Prity Type ID		Setting
Decimal	Binary	
0	00000000	None
1	00000001	EVEN
2	00000010	ODD

Table 11.2.3.1.5 : Stop-Bit Length Identifier Coding

Stop-bit length ID		Setting
Decimal	Binary	
0	00000000	1 bit
1	00000001	2 bit

Table 11.2.3.1.6 : Total Number of Code Words (P1) Coding

Total Code Words		Setting
Decimal	Binary	
0	00000000	No compression
1	00000001	512
2	00000010	1024
3	00000011	2048
4	00000100	4096

Table 11.2.3.1.7 : Maximum Character String Length (P2) Coding

MAX Character Length		Setting
Decimal	Binary	
0	00000000	No compression
6-250	00000110 | 11111010	6-250 (Initial value 32)

Table 11.2.3.1.8 : DCE Operation Identifier Coding

Message type	Bits 8	7	6	5	4	3	2	1
Call Initiate mode	0	0	0	0	0	0	0	0
Response mode	1	0	0	0	0	0	0	0
Others	Reserved							

Table 11.2.3.1.9 : Extended Parameter Availability Identifier Coding

Message type	Bits 8	7	6	5	4	3	2	1
Extended parameter not available	0	0	0	0	0	0	0	1
Extended parameter available	0	0	0	0	0	0	1	0
Others	Reserved							

Table 11.2.3.1.10 : User Identifier Coding

Message type	Bits 8	7	6	5	4	3	2	1
General user	0	0	0	0	0	0	0	0
Others	Reserved							

Table 11.2.3.1.11 : Basic XID, Parameter Terminator/Parameter Analysis Result Coding

Message type		Bits 8	7	6	5	4	3	2	1
XID command	Parameter terminator	0	0	0	0	0	0	0	0
XID response	Setting enable(OK)	0	0	0	0	0	0	0	0
	Setting disable (NOT READY)	0	0	0	0	0	0	0	1
	Description error (ERROR)	0	0	0	0	0	0	1	0

	Octet 4
	5
	6
	7
	8
	9
	10
	11
	12
Note DCE Initial Value Setting Command Character Strings	13
	14
	15
	16
	17
	18
	19
	20
	21
Successive parameter presence ID (for command)/ Parameter analysis result (for response)	22

Note : The used commands depend on the network.

Fig. 11.2.3.2.1 : Information Field Format in Extended XID Frame

Table 11.2.3.2.1 : Extended XID, Successive Parameter Presence Identifier/Parameter Analysis Result Coding

Message type		Bits 8	7	6	5	4	3	2	1
XID command	Character string successive	0	0	0	0	0	0	0	0
	Character string end	0	0	0	0	0	0	0	1
XID response	Setting completion (OK)	0	0	0	0	0	0	0	0
	Setting disable (NOT READY)	0	0	0	0	0	0	0	1
	Description error (ERROR)	0	0	0	0	0	0	1	0

Bits

8"	7"	6"	5	4"	3"	2"	1	
Don't care				Connection notification				Octet 4
DCE-DCE rate notification				Protocol notification				5
1	1	1	1	1	1	1	1	6
1	1	1	1	1	1	1	1	7
1	1	1	1	1	1	1	1	8
1	1	1	1	1	1	1	1	9
1	1	1	1	1	1	1	1	10
1	1	1	1	1	1	1	1	11
1	1	1	1	1	1	1	1	12
1	1	1	1	1	1	1	1	13
1	1	1	1	1	1	1	1	14
1	1	1	1	1	1	1	1	15
1	1	1	1	1	1	1	1	16
1	1	1	1	1	1	1	1	17
1	1	1	1	1	1	1	1	18
1	1	1	1	1	1	1	1	19
1	1	1	1	1	1	1	1	
1	1	1	1	1	1	1	1	20
1	1	1	1	1	1	1	1	21
Parameter terminator								22

Fig. 11.2.3.3.1 : Information Field Format of Notification XID Frame

Table 11.2.3.3.1 : Connection Notification Coding

Message type	Bits							
	8	7	6	5	4	3	2	1
Connection completion	-	-	-	-	0	0	0	1
Reserved	-	-	-	-	Others			

Table 11.2.3.3.2 : DCE-DCE Rate Notification Coding

Message type	Bits							
	8	7	6	5	4	3	2	1
No rate notification	0	0	0	0	-	-	-	-
300 bit/s	0	0	0	1	-	-	-	-
1200 bit/s	0	0	1	0	-	-	-	-
2400 bit/s	0	0	1	1	-	-	-	-
4800 bit/s	0	1	0	0	-	-	-	-
7200 bit/s	0	1	0	1	-	-	-	-
9600 bit/s	0	1	1	0	-	-	-	-
12000 bit/s	0	1	1	1	-	-	-	-
14400 bit/s	1	0	0	0	-	-	-	-
Others	Reserved							

Table 11.2.3.3.3 : Protocol Notification Coding

Message type	Bits							
	8	7	6	5	4	3	2	1
No protocol notification	-	-	-	-	0	0	0	0
No DCE-DCE protocol	-	-	-	-	0	0	0	1
MNP class 4 (V.42 ANNEX) or lower	-	-	-	-	0	0	1	0
MNP class 4 + V.42 bis	-	-	-	-	0	0	1	1
MNP class 5	-	-	-	-	0	1	0	0
MNP class 10	-	-	-	-	0	1	0	1
MNP class 10 + MNP class 5	-	-	-	-	0	1	1	0
MNP class 10 + V.42 bis	-	-	-	-	0	1	1	1
LAPM (V.42)	-	-	-	-	1	0	0	0
LAPM (V.42) + V.42 bis	-	-	-	-	1	0	0	1
Others	Reserved							

Table 11.2.3.3.4 : Parameter Terminator Coding

Message type	Bits							
	8	7	6	5	4	3	2	1
Call connection information completion	0	0	0	0	0	0	0	0

Break (BRK) Message Notification	Octet 4
Escape (ESC) Message Notification	5
Reserved	6
Reserved	7
Reserved	8
Reserved	9
Reserved	10
Reserved	11
Reserved	12
Reserved	13
Reserved	14
Reserved	15
Reserved	16
Reserved	17
Reserved	18
Reserved	19
Reserved	20
Reserved	21
Reserved	22

Note : Set the "Reserved" octet to "11111111".

Fig. 11.3.1 :Information Field Format of UI Frame

Table 11.3.1 : Control Information Type Identifier Coding for UI Frame

Control Info Type ID		Meaning
Decimal	Binary	
19	00010011	UI (Originator: ADP)
3	00000011	UI (Originator: IWF)

Table 11.3.2 : Control Information Content Identifier Coding for UI Frame

Control Info Content ID		Meaning
Decimal	Binary	
1	00000001	Basic parameter

Table 11.3.3 Break (BRK) Message Notification Coding

Message type		Bits							
		8	7	6	5	4	3	2	1
BRK sender	BRKOFF*	0	0	0	0	0	0	0	0
	BRKON	0	0	0	0	0	0	0	1
BRK receiver	BRKACK	0	0	0	0	0	0	1	0
	BRKNAK	0	0	0	0	0	0	1	1

*: Default value when the UI frame is used for the ESC message notification.

Table 11.3.4 : Escape (ESC) Message Notification Coding

Message type		Bits							
		8	7	6	5	4	3	2	1
ESC sender (ADP side)	ESCOFF*	0	0	0	0	0	0	0	0
	ESCON	0	0	0	0	0	0	0	1
ESC receiver (IWF side)	ESCACK	0	0	0	0	0	0	1	0
	ESCNAK	0	0	0	0	0	0	1	1

*: Default value when the UI frame is used for the BRK message notification.

If AT : E0F 10¥N5¥Q1¥K3S46 = 136 <CR> is entered from the DTE:

Frame 1

8 7 6 5 4 3 2 1		Octet	
‘A’		4	See Rule 1.
‘T’		5	
‘:’		6	
‘E’		7	See Rule 2.
‘F’		8	
‘1’		9	
‘0’		10	
‘¥’		11	
‘N’		12	
‘5’		13	
‘¥’		14	
‘Q’		15	
‘1’		16	
‘¥’		17	
‘K’		18	
‘3’		19	
<CR>	0X0D	20	See Rules 3 and 4.
<NULL>	0X00	21	
<AT charactersstring succession>	0X00	22	

Fig. II-1.1 : Coding Example of DCE Initial Value Setting Command (1)

Frame 2

8 7 6 5 4 3 2 1			
‘A’		Octet 4	See Rule 1.
‘T’		5	
‘S’		6	
‘4’		7	
‘6’		8	
‘=’		9	See Rule 4.
‘1’		10	
‘3’		11	
‘6’		12	
<CR>	0X0D	13	
<NULL>	0X00	14	
<NULL>	0X00	15	
<NULL>	0X00	16	
<NULL>	0X00	17	See Rule 3.
<NULL>	0X00	18	
<NULL>	0X00	19	
<NULL>	0X00	20	
<NULL>	0X00	21	
<AT character string end>	0X01	22	

Fig. II-1.2 : Coding Example of DCE Initial Value Setting Command (2)

Annex 4 Standard for Interface between Mobile Station and Subscriber Information Module

CONTENTS

1. General

This Standard specifies the interface between the ME and subscriber information module (IC card) used in the PDC system.

2. Scope

The items specified by the standard are listed below.

- the physical characteristics of the IC card
- the electrical characteristics and the transmission protocols of the IC card;
- the logical structure model of the IC card;
- the security features of the IC card;
- the interface functions
- the commands, file contents, and application protocol

This standard does not specify any aspects related to the issuance and administrative management phases of the IC card.

Moreover, the IC card and the ME can be designed so that they comply with the above items specified in ETSI TS 102 221. For the IC card and the ME in order to comply with ETSI TS 102 221, the operation of some items needs to be specified, which are described in this Standard. When the IC card is active, the operation mode is either that specified in this Standard (excluding specified in compliance with ETSI TS 102 221) or specified in ETSI TS 102 221. The operation mode cannot be changed while the IC card is active.

Compliance with ETSI TS 102 221 is optional for both the IC card and the ME.

3. Normative references

ISO 7810 : "Identification cards - Physical characteristics".

ISO 7811-1 : "Identification cards - Recording technique - Part 1: Embossing".

ISO 7811-3 : "Identification cards - Recording technique - Part 3: Location of embossed characters".

ISO 7816-1 : "Identification cards - Integrated circuit(s) cards with contacts, Part 1: Physical characteristics".

ISO 7816-2 : "Identification cards - Integrated circuit(s) cards with contacts, Part 2: Dimensions and locations of the contacts".

ISO/IEC 7816-3 : "Identification cards - Integrated circuit(s) cards with contacts, Part 3: Electronic signals and transmission protocols".

CCITT Recommendation T.50 : "International Alphabet No. 5".

ETSI TS 102 221
Smart cards; UICC-Terminal interface; Physical and logical characteristics

Note: Section numbers, etc., of ETSI TS 102 221 referred in this Standard are based on v3.5.0; in cases when the reference numbers, etc., are changed in the subsequent versions of v3.5.0, the pertinent sections, etc., which have been moved, shall be referred.

4. Definitions and abbreviations

Access right:	: a right to read and use data.
Access conditions	: information that defines the environment required for accessing the IC card.
Application	: an application consists of a set of security mechanisms, files, data and procedures (excluding transmission protocols).
Embossing process	: a process of making concave and convex the surface of a thin plate to show letters, codes, and signs.
Current DF/EF	: the latest DF or EF selected.
Management phase	: period of time or stage of producing and initializing the IC card.
Issuance phase	: period of time or stage to prepare the IC card for use.
File identifier (file ID)	: 2 byte binary number iused to designate a file.
File status	: property such as PIN valid/invalid, clock stop condition, etc. specified in Section 10.
Plug-in IC card	: an IC card in the form specified in Section 4.
Full size IC card	: an IC card in the form of ID-1 card specified in ISO7816-1.
Record	: a string of bytes within an EF handled as a single entity.
Record number	: the number which identifies a record within an EF.
Record pointer	: the pointer which addresses a record in an EF.
ALW	: aLWays: always allowed
ATR	: Answer To Reset: initial response including information about IC card type.
CLA:	: CLAss
DF (Dedicated File)	: a file including the file control information and randomly selected memories that can be assigned.
DTMF	: Dual Tone Multiple Frequency
EF (Elementary File)	: a set of data units or records that have a common file identifier.

etu (Elementary Time Unit)	:	a unit that indicates the transmission time of a bit on the I/O contact.
IC	:	Integrated Circuit
ID	:	IDentifier
lgth	:	data length
LSB	:	Least Significant Bit
ME	:	Mobile Equipment
MF (Master File)	:	the unique mandatory dedicated file that is the core of the file structure.
MSB	:	Most Significant Bit
PIN	:	Personal Identification Number
PIN status	:	it indicates the condition regarding a PIN such as allowed number of verifications.
PIN valid/invalid indication	:	an indication whether PIN verification is required or not to obtain the right to access. Valid = PIN verification required, invalid = PIN verification not required.
RFU	:	Reserved for Future Use.
SW1/SW2 (Status Word 1/Status Word 2)	:	Indicates the processing condition within an IC card (status word).

5. Physical characteristics

Two types of IC card with distinct physical characteristics are specified in this Standard. These shall be the "Full size IC card" and the "Plug-in IC card".

The physical characteristics of both types of IC card shall be in accordance with ISO 7816-1,2. Specifications that are not included in the ISO standard are described in this document.

For the IC card which complies with ETSI TS 102 221, refer also to ETSI TS 102 221 (4. Physical characteristics).

5.1 Material

The material of the IC card shall be in accordance with ISO7810.

5.2 Dimension and contact layout

5.2.1 Full size IC card

The dimension and contact layout of the Full size IC card shall be in accordance with ISO 7816-1, 2.

The ME shall accept Full size IC cards that are embossed in accordance with ISO 7811.

The contacts of the Full size IC card are located on the front (embossed face).

5.2.2 Plug-in IC card

The Plug-in IC card has a width of 25 mm, a height of 15mm, the same thickness as that of a full size IC card and a feature for orientation.

Figure 5.1 shows the details of the dimensions of the card and location of the contacts.
Annexex A.1 and A.2 of ISO 7816-1 do not apply to the Plug-in IC card.

Annex A of ISO 7816-2 applies to the Plug-in IC card. The contact layout shall be determined with the three reference points P1, P2 and P3 shown in Figure 5.1 which measure 7.5 mm, 3.3 mm and 20.8 mm, respectively, from 9.

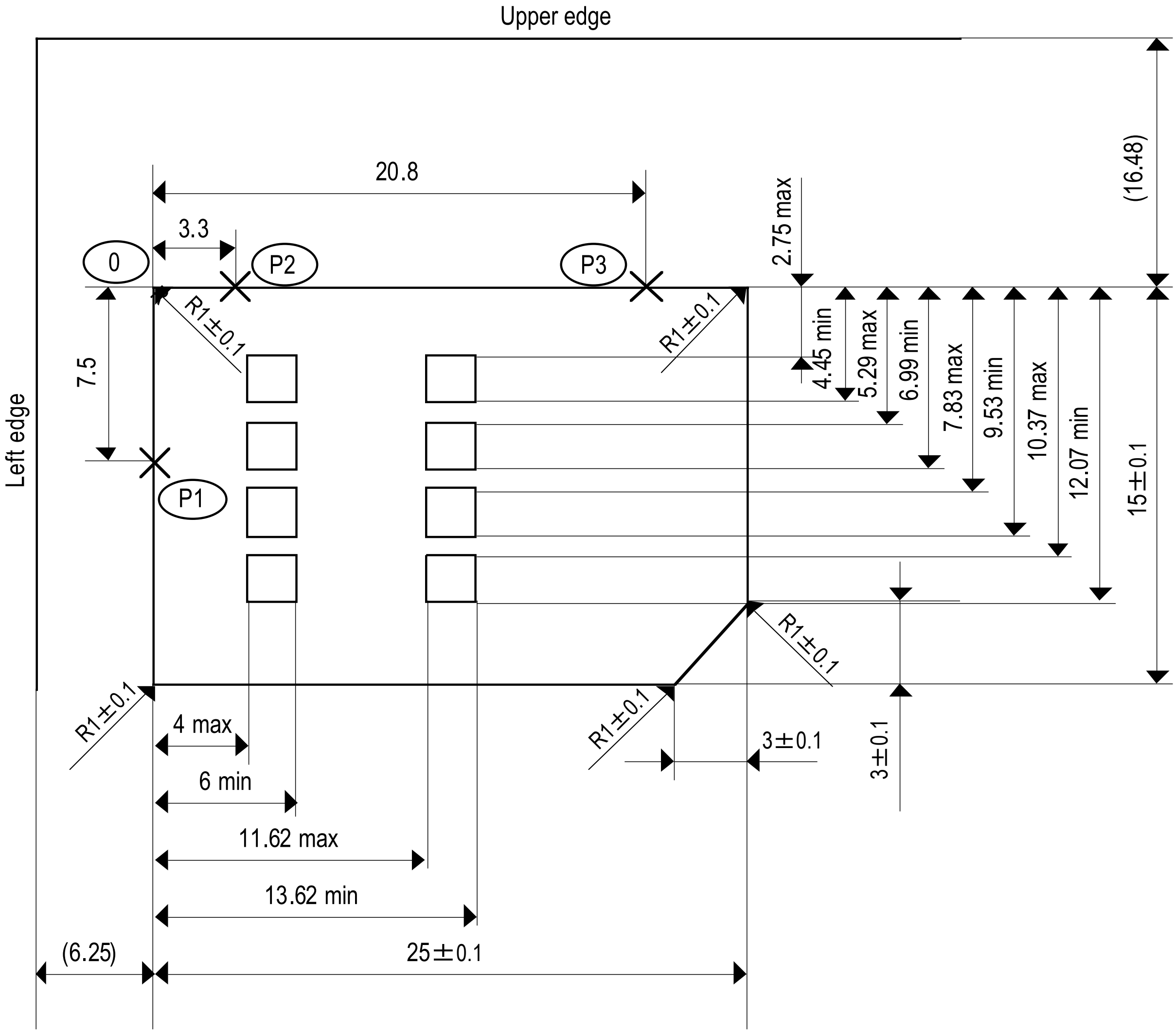


Fig. 5.1 : Plug-in IC card

Note : Figures within parentheses indicate the location in relation to the Full size IC card.

5.3 Temperature range for IC card operation

The temperature range for full operational use shall be between -25°C and +70°C with occasional peaks of up to +85°C. "Occasional" means less than 4 hours each time and not over 100 times during the life time of the card.

5.4 Contacts

5.4.1 Provision of contacts

Mobile station : Contact C4 and C8 shall be for optional use, and shall not be used for PDC applications.
Contact C6 need not be provided for Plug-in IC cards.

IC card : Contacts C4 and C8 need not be provided by the IC card. Contact C6 shall not be bonded in the IC card for any function other than supplying Vpp.

5.4.2 Activation and deactivation

The ME shall connect, activate and deactivate the IC card in accordance with the specification in ISO/IEC 7816-3.

For any voltage level, monitored during the activation sequence, or during the deactivation sequence following soft power-down, the order of the contact activation/deactivation shall be respected.

Note1 : It is necessary that the deactivation sequence defined in ISO/IEC 7816-3 be performed when the power is turned off or battery voltage alarm is on ME.

If the IC card clock provided for the IC card is already stopped and is not restarted, the ME is allowed to deactivate all the contacts in any order, provided that all signals reach low level before Vcc leaves high level. If the IC card clock is already stopped and is restarted before the deactivation sequence, then the deactivation sequence specified in ISO/IEC 7816-3 Subclause 5.4 shall be followed.

When Vpp is connected to Vcc, as allowed by this standard, then Vpp will be activated and deactivated with Vcc, at the time of the Vcc activation.

5.4.3 Inactive contacts

The voltages on contacts C1, C2, C3, C6 and C7 of the ME shall be between 0 and ± 0, 4 volts referenced to ground (C5) when the ME is switched off with the power source connected to the ME.

The measurement equipment shall have a resistance of 50 kohms when measuring the voltage on C2, C3, C6 and C7. The resistance shall be 10 kohms when measuring the voltage on C1.

5.4.4 Contact pressure

The contact pressure shall be large enough to ensure reliable and continuous contact

The radius of any curvature of the contacting elements shall be greater than or equal to 0.8 mm over the contact area.

Under no circumstances may a contact force be 0.5N or greater.

6. Electrical characteristics and transmission protocols

Electric signals and transmission protocols shall be in accordance with ISO/IEC 7816-3. Items not specified by ISO are specified below.

The choice of the transmission protocol(s), to be used to communicate between the ME and the IC card ME, shall at least support the T=0 protocol specified in ISO/IEC 7816-3.

The values given in the tables hereafter are derived from ISO/IEC 7816-3 Subclause 4.2 with the following considerations:

- V_{OH} and V_{OL} always refer to the device (ME or IC card) which is driving the interface.
  V_{IH} and V_{IL} always refer to the device (ME or IC card) which is operating as a receiver on the interface.
- This specification, especially the current specification defined for I_{CC}, is different from that used in ISO/IEC 7816-3.
- The following sections define the core requirements for the IC card.
  For each state (V_{OH}, V_{IH}, VIL and V_{OL}), a positive current is defined as flowing out of the entity (ME or IC card) in that state.
- The high current options of ISO/IEC 7816-3 for V_{IH} and V_{OH} are not defined in this Standard.

The IC card defined in this Standard must support both 5V and 3V operation. Therefore, ME that only use the IC card under this Standard do not need to support 5V operation.

For the IC card and the ME which comply with ETSI TS 102 221, refer also to ETSI TS 102 221(5. Electrical specification of the UICC – Terminal interface) and (6. Initial communication establishment procedures).

6.1 Supply voltage Vcc : contact C1

6.1.1 At 5V operation

The IC card shall be able to operable within the following limits:

Table 6.1 : Electrical characteristics of Vcc under normal operating conditions

Sign	Minimum	Maximum	Unit
Vcc	4.5	5.5	V
Icc	-	10	mA

The current consumption of the IC card shall not exceed the value given in table 6.1 at any operation frequency accepted by the IC card.

When the IC card is in the idle state, the current consumption of the card shall not exceed 200 µA at 1 MHz and 25°C.

The supply voltage shall be within the specified range given a current consumption of the card having a maximum amplitude of 200 mA and a maximum charge of 40 nAs during 400 ns.

6.1.2 At 3V operation

The IC card shall be operated within the following limits:

Table 6.2 : Electrical characteristics of Vcc under normal operating conditions

Sign	Minimum	Maximum	Unit
Vcc	2.7	3.3	V
Icc	-	6 (Note 1)	mA

Note1 : At a supply voltage of 3.3 V and a clock frequency of 4 MHz.

6.2 Reset (RST) : contact C2

6.2.1 At 5V operation

The ME shall operate the IC card within the following limits:

Table 6.3 : Electrical characteristics of RST under normal operating conditions

Sign	Condition	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = +20µA	Vcc-0.7	Vcc (Note 1)	V
V_{OL}	I_{OLmax}= -200µA	0 (Note 1)	0.6	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	400	µs

Note 1 : The voltage on RST shall remain between -0.3V and Vcc+0.3V.

6.2.2 At 3V operation

The ME shall operate the IC card within the following limits:

Table 6.4 : Electrical characteristics of RST under normal operating conditions

Sign	Condition	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = +20µA	0.8 x Vcc	Vcc (Note 1)	V
V_{OL}	I_{OLmax} = -200µA	0V (Note 1)	0.2 x Vcc	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	400	µs

Note 1 : The voltage on RST shall remain between -0.3V and Vcc+0.3V.

6.3 Programming voltage (Vpp) : contact C6

In the case of the Full-size IC card, if the ME supplies voltage to contact C6, the same voltage as on Vcc shall be supplied to Vpp.

In the case of Plug-in IC cards, it cannot receive any voltage from the Vpp contact. The Vpp contact must be supplied with the same voltage as for the Vcc from the ME.

6.4 Clock signal (CLK) : contact C3

6.4.1 At 5V operation

The IC card shall always operate with an external clock. The range of operation frequency (clock frequency) shall be from 1 to 5 MHz.

The duty cycle of the clock signal shall be between 40% and 60% of the cycle during stable operation.

Table 6.5.1 : Electrical characteristics of CLK under normal operating conditions

Sign	Condition	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = +20µA	0.7 x Vcc	Vcc (Note 1)	V
V_{OL}	I_{OLmax} = -200µA	0 (Note 1)	0.2 x Vcc (max. 0.5)	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	9% of clock cycle (max. 50)	ns

Note 1 : The voltage on CLK shall remain between -0.3V and Vcc+0.3V.

6.4.2 At 3V operation

The IC card shall always operate with an external clock. The range of operation frequency (clock frequency) shall be from 1 to 4 MHz.

The duty cycle of the clock signal shall be between 40% and 60% of the cycle during stable operation.

Table 6.5.2 : Electrical characteristics of CLK under normal operating conditions

Sign	Condition	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = +20µA	0.7 x Vcc	Vcc (Note 1)	V
V_{OL}	I_{OLmax} = -200µA	0 (Note 1)	0.2 x Vcc (max. 0.5)	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	50 (Note2)	ns

Note 1 : The voltage on CLK shall remain between -0.3V and Vcc+0.3V.
Note 2 : The duty cycle is measured at 50% of Vcc. One clock cycle is defined as either the interval from one rising edge to the next rising edge or from one falling edge to the next falling edge. The ratio 40/60% is then calculated using the clock cycle.

6.5 I/O contact : contact C7

6.5.1 At 5V operation

Table 6.6 defines the electrical characteristics of the I/O contact (contact C7). The values given in the table have the effect of defining the values of the pull-up resistor in the ME and the impedance of the drivers and receivers in the ME and IC card.

Table 6.6 : Electrical characteristics of I/O under normal operating conditions

Symbol	Conditions	Minimum	Maximum	Unit
V_{IH}	I_{IHmax} = ±20µA (Note 2)	0.7 x Vcc	Vcc + 0.3	V
V_{IL}	I_{ILmax} = +1µA	-0.3	0.8	V
V_{OH} (Note 1)	I_{OHmax} = +20µA	3.8	Vcc (Note 3)	V
V_{OL}	I_{OLmax} = -1µA	0 (Note 3)	0.4	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	1	µs

Note 1 : It is assumed that a pull-up resistor is used in the interface device (recommended value: 20kohms).
Note 2 : During the idle state, only positive voltage is supplied. Under dynamic operating conditions (during transmission), negative voltage spikes may appear on the I/O contact for short periods of time.
Note 3 : The voltage on I/O shall remain between -0.3V and Vcc+0.3V.

6.5.2 At 3V operation

Table 6.7 shows the electrical characteristics of the I/O contact (contact C7). The values given in the table affect the pull-up resistor in the ME and the output and input impedances of the ME and the IC card.

Table 6.7 : Electrical characteristics of I/O under normal operating conditions

Symbol	Conditions	Minimum	Maximum	Unit
V_{IH}	I_{IHmax} = ±20μA (Note 2)	0.7 x Vcc	Vcc + 0.3	V
V_{IL}	I_{ILmax} = +1mA	-0.3	0.2 x Vcc	V
V_{OH} (Note 1)	I_{OHmax} = +20μA	0.7 x Vcc	Vcc (Note 3)	V
V_{OL}	I_{OLmax} = -1μA	0 (Note 3)	0.4	V
t_R, t_F	C_{out} = C_{in} = 30pF	-	1	μs

Note 1 It is assumed that a pull-up resistor is used in the interface device (recommended value: 20kohms).

Note 2 During the idle state, only positive voltage is supplied. Under dynamic operating conditions (during transmission), negative voltage spikes may appear on the I/O contact for short periods of time.

Note 3 The voltage on I/O shall remain between -0.3V and Vcc+0.3V.

6.6 States

There are two states for the IC card while the power supply is on:

- The IC card is in the operating state when it executes a command. This state also includes transmission from and to the ME.
- The IC card is in the idle state at any other time.

The IC card may support a clock stop mode.

The clock shall be switched off only subject to conditions specified in the file characteristics of the MF (see Section 10).

An ME shall wait at least 1860 clock cycles after having received the last bit of the response before it switches off the clock (if the IC card allows clock stop). It shall wait for at least 744 clock cycles before it sends the first command after having started the clock.

An IC card shall always send the status information "normal terminations" after receiving the command SLEEP.

PDC mobile stations shall not send a SLEEP command.

6.7 Baudrate

The baudrate for signal transmission shall be: (clock frequency)/372.

6.8 Answer To Reset (ATR)

6.8.1 Structure and contents

The IC card returns a response at the reset operation. This response consists of the initial character TS and at most 32 subsequent characters.

The following table gives an explanation of the characters specified in ISO/IEC 7816-3 and the requirements for their use in this Standard.

Table 6.8 : ATR

Character	Content	Output from IC card	a) Valid/invalid at MS b) Treatment at MS
Initial character TS	Indicates bit synchronization sequence and meaning for coding the data bytes of all subsequent characters (backward or forward meaning).	Always output.	a) Always valid. b) Used according to appropriate rules.
Structure indication character TO	Indicates the existence of subsequent connection information characters and the number of management information characters.	Always output	a) Always valid. b) Used for identifying subsequent characters.
Common connection information character TA1	A parameter determining the work etu.	Optional	a) Valid when it exists. b) Protocol format selection procedure is used when TA is not '11'.
Common connection information character TB1	A parameter determining the programming voltage and current.	Optional	a) Valid when it exists. b) Rejects IC card when PI1 is not 0.
Common connection information character TC1	Gives the special character protection time N.	Optional	a) Valid when it exists. b) Rejects IC card when TC1 is not 0 or 255. See NOTE
Connection information character TD1	Indicates the existence of subsequent connection information characters.	Optional	a) Valid when it exists. b) Used for identifying subsequent characters.
Connection information character TA2	Not used when protocol T=0.	Optional	a) Optional b) ....
Connection information character TB2	A parameter determining the programming voltage.	Not transmitted.	
Connection information character TC2	Indicates the stand-by time for a work.	Optional	a) Valid when it exists. b) Determines the stand-by time for a work.
Connection information character TDi (i>1)	Indicates the existence of subsequent connection information characters.	Optional	a) Always valid. b) Used for identifying subsequent characters.
Connection information character TAi, TBi, TCi (i>2)	Connection information character used in other protocols.	Optional	a) Optional b) ....
Management information character T1, ... TK	Not specified in ISO.	Optional	a) Optional b) ....
Examination character TCK	Check byte (EX-OR)	Not transmitted when T=0 only, transmitted in other cases.	a) Optional b) ....

Note : According to ISO/IEC 7816-3 amendment 2, N=255 indicates that the minimum delay is 12 etu for the asynchronous half-duplex character transmission protocol.

6.8.2 Protocol Type Selection (PTS) procedure

The PTS procedure according to ISO/IEC 7816-3 [25], Section 7, is applied, only if TA1 is not '11'.

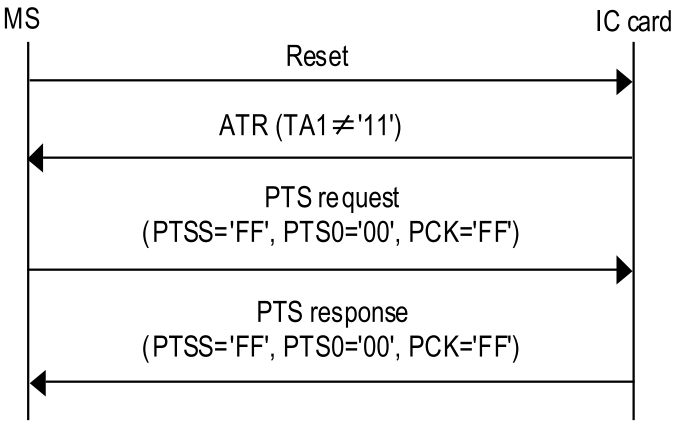


Fig. 6.1 : PTS procedure

6.9 Bit duration and character structure

The bit/character duration and sampling time shall be in accordance with ISO/IEC 7816-3 6.1.1 and 6.1.2.

6.10 Error handling

When receiving ATR characters not in accordance with this Standard, the ME shall perform a Reset. The ME shall not reject the IC card until at least three consecutive wrong ATRs have been received.

During the transmission of the ATR and the protocol type selection, the error detection and character repetition procedure specified in ISO/IEC 7816-3 6.1.3, is optional for the ME. For subsequent transmission, this procedure is mandatory.

For the IC card, the error detection and character repetition procedure are mandatory for all communications.

7. Logical Model

This section describes the logical structure of the IC card, the code associated with it, and the structure of files used.

7.1 General description

Figure 7.1 shows the general structural relationships which may exist between files.

The files are organised in a hierarchical structure and are of one of the three types defined below.

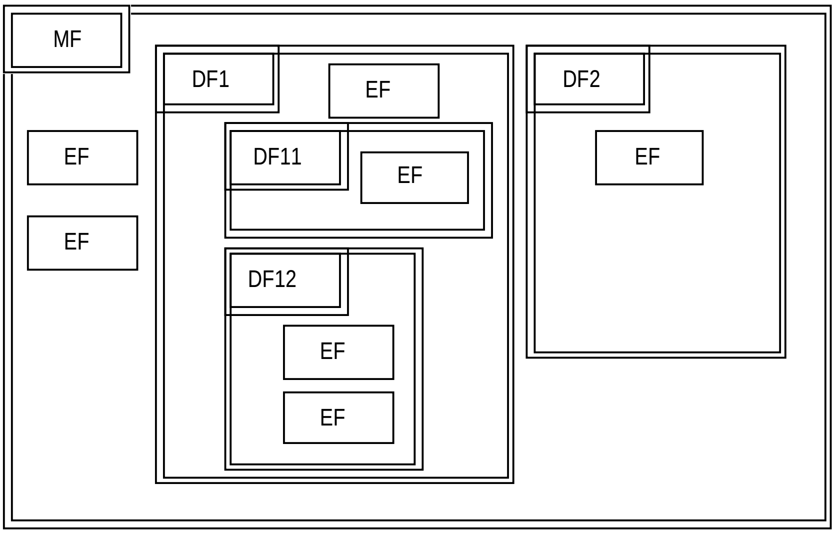


Fig. 7.1 : File structure

Files are composed of a header, which is internally managed by the IC card, and optionally a body part.

The information in the header is related to the structure and attributes of the file. The information is fixed during the administrative phase, and is not specified in this Standard.

The body part contains the data of the file.

7.2 File identifier (File ID)

A file ID is used to identify each specific file.

The file ID consists of two bytes and shall be coded in hexadecimal notation. They are specified in Section 11.

The first byte identifies the type of file in this Standard as follows :

- '3F': Master File (MF)
- '7F': 1st level Dedicated File (1st Dedicated File :DF)
- '5F': 2nd level Dedicated File (2nd Dedicated File : DF)
- '2F': Elementary File under the Master File (Elementary File : EF)
- '6F', '8F': Elementary File under a 1st level Dedicated File (Elementary File :EF)
- '4F' : Elementary File under a 2nd level DF (Elementary File : EF)

File IDs shall be subject the following conditions:

- the file ID shall be assigned at the time of creation of the file concerned;
- no two files under the same MF or DF shall have the same ID;
- files under the same hierarchy, shall never have the same file ID.

In this way, each file is uniquely identified.

7.3 Dedicated files (DF)

A Dedicated File (DF) is a functional grouping of files consisting of itself and all those files which contain this DF in their parental hierarchy (that is to say it consists of the DF and its complete subtree).

A DF consists only of a header part.

Two DFs are defined in this standard:

- DF_{PDC} which contains the applications used within this Standard.
- DF_{ADM} which contains the applications defined specifically by each operator (optional).

DF_{PDC} is placed immediately under the master file.

A DF_{ADM} is placed immediately under DF_{PDC}.

7.4 Elementary files (EF)

An Elementary File (EF) is composed of a header and a body part. The following three structures of an EF are used in this Standard.

7.4.1 Transparent EF

An EF with a transparent structure consists of a sequence of bytes. Once this EF is selected, access to the data is allowed through relative addressing.

The first byte of a transparent EF has the relative address '00 00'.

The total data length of the body part of the EF is indicated in the header part of the EF.

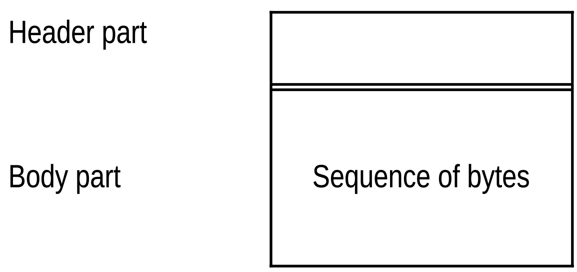


Fig. 7.2 : Structure of a transparent EF

7.4.2 Linear fixed EF

An EF with linear fixed structure consists of a sequence of records all having the same (fixed) length. The first record is record number 1.

The length of a record multiplied by the number of records is indicated in the body part of this EF.

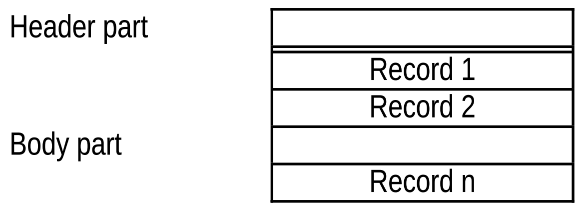


Fig. 7.3 : Structure of a linear fixed EF

There are several methods to access records within an EF of this type:

- absolutely using the record number;
- when the record pointer is not set it shall be possible to access the first or the last record;
- when the record pointer is set it shall be possible to access the record before or after a record.
- by identifying a record using pattern search.
- forwards from the beginning of the file;
- forwards from the record following the one at which the record pointer is set;
- backwards from the end of the file;
- backwards from the record preceding the one at which the record pointer is set.

If a record selection fails, the record pointer shall remain set at the record at which it was set prior to the action.

Note 1: The maximum number of records in each file shall be 255, and the maximum length of a record shall be 255 bytes.

7.4.3 Cyclic EF

An EF with a cyclic structure consists of a fixed number of records with the fixed length.*

In this file structure there is a link between the last record (n) and the first record. When the record pointer is set to the last record n, then the next record is record 1.

Similarly, when the record pointer is set to record 1, then the previous record is record n.

The last updated record becomes record number 1, and the oldest record becomes record number n.

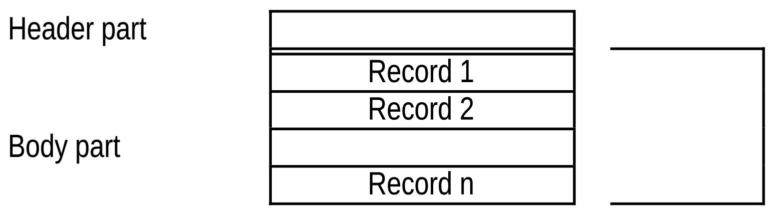


Fig. 7.4 : Structure of a cyclic EF

Updating shall only be performed for the records which have already been written.

For reading operations, the methods of addressing are Next, Previous, Current and Record Number.

After selection of a cyclic EF, the record pointer shall address the record updated or increased last. If a record selection fails, the record pointer shall remain set at the record at which it was set prior to the action.

Note 1: The maximum number of records in each file shall be 255, and the maximum length of a record shall be 255 bytes.

7.5 Methods of selecting a file

After the Answer To Reset (ATR), the Master File (MF) is automatically selected and becomes the initial Directory.

Each file becomes selectable by using the SELECT function in accordance with the following rules:

Selecting a DF or the MF sets the Current Directory. After such a selection there is no current EF.

Selecting an EF means to select the Current EF and the DF and MF directory to which the current EF belongs at the same time.

The following files may be selected from the last selected file:

- any file which is an immediate child of the Current Directory;
- any DF which is an immediate child of the parent MF or DF of the current DF;
- the parent MF or DF of the Current DF;
- the Current DF;
- the MF.

This means in particular that a DF shall be selected prior to the selection of any of its EFs.

All selections are made using the file ID.

Figure 7.5 gives the logical structure for this standard. This Standard defines nesting one level under the MF to be mandatory and two levels under the MF to be optional.

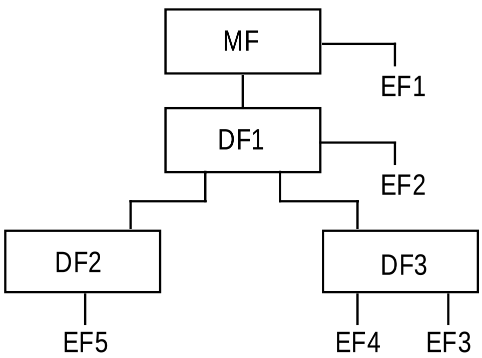


Fig. 7.5 : Logical structure

The following table gives the valid selections for the logical structure in figure 7.5.
Reselection of the last selected file is also allowed but not shown.

Table 7.1 : File selection

Last selected file	Valid selection
MF	DF1, EF1
DF1	MF, DF2, DF3, EF2
DF2	MF, DF1, DF3, EF5
DF3	MF, DF1, DF2, EF4, EF3
EF1	MF, DF1
EF2	MF, DF1, DF2, DF3
EF3	MF, DF1, DF2, DF3, EF4
EF4	MF, DF1, DF2, DF3, EF3
EF5	MF, DF1, DF2, DF3

7.6 Reservation of file IDs

In addition to the identifiers used for the files specified in this Standard, the following file IDs are reserved for future use.

Dedicated Files:

- administrative use:
  '7F4X'
- operational use:
  '7F80' (DF_{PDC}), '5F40' (DF_{ADM} under DF_{PDC}), '5F3X' (under DF_{PDC}),
  '5F4X' (under DF_{PDC})

Elementary files:

- administrative use:
  '8FXX' (under DF_{PDC}) '2F01' (under MF), '2FEX'(under MF)
- operational use:
  '2F1X'(under MF), '6F XX'(under DF_{PDC})
- administrative/operational use:
  '4FXX' (under 2nd level DF)

8. Security features

This section gives information related to the security features supported by the IC card to enable the following:

- authentication of subscriber information and ME information by the network;
- data confidentiality over the air interface;
- setting of file access conditions.

For the IC card and the ME which comply with ETSI TS 102 221, refer also to Section 8.4 in addition to Sections 8.1 through 8.3.

8.1 Authentication and cipher key generation procedure

This section describes the authentication mechanism and cipher key generation procedure which are invoked by the network.

For the specification of the corresponding procedures for the IC card/ME interface, see Section 12.

The network sends an authentication random number to the ME in an MM signal (Authentication Request). The ME passes the authentication random number to the IC card in the command PDC AUTHENTICATE (Mode = '00'). The IC card returns the result of the authentication calculation, specified in Annex 1 of this Standard, to the ME as a response.

The ME sends the value to the network in an MM signal (Authentication Response).

The ME passes the authentication random number in the MM signal (Authentication Request) from the network to the IC card in the command PDC AUTHENTICATE (Mode = '02') to obtain the cipher key.

The ME uses the result of the calculation obtained in the response for the PDC AUTHENTICATE from the IC card as the cipher key for the encryption specified in Annex 1 of this Standard.

The ME also passes the authentication random number used in the authentication procedure to the IC card in the command PDC AUTHENTICATE (mode = '01') upon receipt of an order to change the encryption mode from the network, and uses the response as the cipher key.

8.2 Algorithms and processes

The authentication algorithms for this Standard are specified in Annex 1.

The processes between the IC card and ME are specified by the PDC AUTHENTICATE command and the response described in Section 10.

8.3 File access conditions

Every file has its own specific access condition for each command.

The relevant access condition of the last selected file shall be fulfilled before the requested action can take place.

For each file:

- the access conditions for the commands READ and SEEK are identical;
- the access conditions for the commands SELECT and STATUS are ALWays.

No file access conditions are assigned to the MF and the DFs.

The access condition levels are defined in the following table:

Table 8.1 : Access condition level coding

Level	Access condition
0	Always allowed (ALW)
1	PIN 1
2	PIN 2
3	reserved
4-14	Issuer (ADM)
15	Access not allowed (NEV)

The meaning of the file access conditions is as follows:

Always allowed (ALW) : the access can be performed without any restriction.

PIN 1: access shall only be possible if one of the following three conditions is fulfilled:

- a correct PIN1 has already been presented to the IC card after the power has been turned on.
- the PIN1 enabled/disabled indicator is set to "disabled";
- UNBLOCK PIN1 has been successfully performed after the power has been turned on.

PIN2: access shall only be possible if one of the following two conditions is fulfilled:

- a correct PIN2 has already been presented to the IC card after the power has been turned on.
- UNBLOCK PIN2 has been successfully performed after the power has been turned on.

Issuer (ADM): allocation of these levels and the respective requirements for their fulfilment are the responsibility of the card issuer and are not specified in this Standard.

Access not allowed (NEV): access cannot be performed over the IC card/ME interface.

Condition levels are not hierarchical. For instance, correct presentation of PIN2 does not allow actions which require presentation of PIN1 to be performed.

A condition level which has been satisfied remains valid until the IC card becomes inactivated as long as the corresponding secret code remains unblocked, i.e. after three consecutive wrong attempts, not necessarily in the same card session, the access rights previously granted by this secret code are lost immediately.

Access by a password applies to DF_{PDC}.

The ME shall determine whether PIN2 is available by using the STATUS command and the response to it. If PIN2 is not set, PIN2 related commands shall not be executable.

PIN2-related commands are shown below as the case of PIN2 indication.

- VERIFY PIN
- CHANGE PIN
- UNBLOCK PIN

8.4 Security features in the operation mode specified in ETSI TS 102 221

8.4.1 Authentication and cipher key generation procedure

This section describes the authentication mechanism and the cipher key generation procedure which are invoked by the network.

For the specification of the corresponding procedures for the IC card/ ME interface, see Section 12.

The network sends an authentication random number to the ME in an MM signal (Authentication Request). The ME passes the authentication random number to the IC card in the command AUTHENTICATE (P2=‘80’).

The IC card returns the result of the authentication calculation, specified in Annex 1 of this Standard to the ME as a response.

The ME sends the value to the network in an MM signal (Authentication Response).

The ME passes the authentication random number in the MM signal (Authentication Request) from the network to the IC card in the command AUTHENTICATE (P2=‘82’) to obtain the cipher key.

The ME uses the result of the calculation obtained in the response for the AUTHENTICATE from the IC card as the cipher key for the encryption specified in Annex 1 of this Standard.

The ME also passes the authentication random number used in the authentication procedure to the IC card in the command AUTHENTICATE (P2=‘81’) upon receipt of an order to change the encryption mode from the network, and uses the response as the cipher key.

8.4.2 Algorithm and procedure

The authentication algorithms for this Standard is specified in Annex 1.
The processes between the IC card and ME are specified by the AUTHENTICATE command and the response described in Section 10.5.

8.4.3 Other security features

Refer to ETSI TS 102 221 (9. Security features).

9. Description of the functions

This section gives a functional description of the commands and their respective responses.

For the IC card and the ME which comply with ETSI TS 102 221, refer also to Section 9.18 in addition to Sections 9.1 through 9.17.

Associated status conditions, error codes and their corresponding coding are specified in Section 10.

It shall be mandatory for all cards complying with this Standard to support all commands described in this Standard. The command GET RESPONSE which is needed for the protocol T=0 is specified in Section 10.

The following table lists the file types and structures together with the commands which may be used during IC card operation. The applicable file types are indicated by asterisks (*).

Table 9.1 : Table of corresponding commands

	File				
Command	MF	DF	Transparent EF	Linear fixed EF	Cyclic EF
SELECT	*	*	*	*	*
STATUS	*	*	*	*	*
READ BINARY	-	-	*	-	-
UPDATE BINARY	-	-	*	-	-
READ RECORD	-	-	-	*	*
UPDATE RECORD	-	-	-	*	*
SEEK	-	-	-	*	-
INCREASE	-	-	-	-	*
INVALIDATE	-	-	*	*	*
REHABILITATE	-	-	*	*	*

9.1 SELECT

This function selects a file according to the methods described in Section 7.

The record pointer is unspecified when the selected file by this command is a linear fixed file. The record pointer in a cyclic file shall address the last record which has been updated or increased.

Input:

- file ID.

Output:

- if the selected file is the MF or a DF:
  file ID, total memory space available, PIN enabled/disabled indicator, PIN status etc.
- if the selected file is an EF:
  file ID, file size, access conditions, invalidated/validated indicator, structure of EF and length of the records in case of linear fixed structure or cyclic structure.

9.2 STATUS

This function returns information concerning the current directory. A current EF is not affected by the STATUS function.

Input:

- none.

Output:

- file ID, total memory space available, PIN enabled/disabled indicator, PIN status, etc.

9.3 READ BINARY

This function reads a string of bytes from the current transparent EF. This function shall only be performed if the READ access condition for this EF is satisfied.

Input:

- relative address and the length of the string.

Output:

- string of bytes.

9.4 UPDATE BINARY

This function updates the current transparent EF with a string of bytes. This function shall only be performed if the UPDATE access condition for this EF is satisfied. An update can be considered as a replacement of the string already present in the EF by the string given in the UPDATE command.

Input:

- relative address and the length of the string;
- string of bytes.

Output:

- none.

9.5 READ RECORD

This function reads one complete record in the current linear fixed or cyclic EF. The record to be read is described by the modes below. This function shall only be performed if the READ access condition for

this EF is satisfied. The record pointer shall not be changed by an unsuccessful READ RECORD function.
Four modes are defined:

CURRENT The current record is read. The record pointer is not affected.

ABSOLUTE The record given by the record number is read. The record pointer is not affected.

NEXT The record pointer is incremented before the READ RECORD function is performed and the pointed record is read. If the record pointer has not been previously set within the selected EF, then READ RECORD (next) shall read the first record and set the record pointer to this record.
If the record pointer addresses the last record in a linear fixed EF, READ RECORD (next) shall not cause the record pointer to be changed, no data shall be read, and error status shall be returned.

If the record pointer addresses the last record in a cyclic EF, READ RECORD (next) shall set the record pointer to the first record in this EF and this record shall be read.

PREVIOUS The record pointer is decremented before the READ RECORD function is performed and the pointed record is read. If the record pointer has not been previously set within the selected EF, then READ RECORD (previous) shall read the last record and set the record pointer to this record.

If the record pointer addresses the first record in a linear fixed EF, READ RECORD (previous) shall not cause the record pointer to be changed, no data shall be read, and error status shall be returned.

If the record pointer addresses the first record in a cyclic EF, READ RECORD (previous) shall set the record pointer to the last record in this EF and this record shall be read.

Input:

- mode, record number (absolute mode only) and the length of the record.

Output:

- the record.

9.6 UPDATE RECORD

This function updates one complete record in the current linear fixed or cyclic EF. The record to be updated is described by the modes below. This function shall only be performed if the UPDATE access condition for this EF is satisfied. The record pointer shall not be changed by an unsuccessful UPDATE RECORD function.

Four modes are defined of which only PREVIOUS is allowed for cyclic files:

CURRENT The current record is updated. The record pointer is not affected.

ABSOLUTE The record given by the record number is updated. The record pointer is not affected.

NEXT For a linear fixed EF, the record pointer is incremented before the UPDATE RECORD function is performed and the pointed record is updated. If the record pointer has not been previously set within the selected EF, then UPDATE RECORD (next) shall set the record pointer to the first record in this EF and this record shall be updated. If the record pointer addresses the last record in a linear fixed EF, UPDATE RECORD (next) shall not cause the record pointer to be changed, and no record shall be updated.

PREVIOUS The record pointer is decremented before the UPDATE RECORD function is performed and the pointed record is updated. If the record pointer has not been previously set within the selected EF, then UPDATE RECORD (previous) shall set the record pointer to the last record in this EF and this record shall be updated. If the record pointer addresses the first record in a linear fixed EF, UPDATE RECORD (previous) shall not cause the record pointer to be changed, and no record shall be updated.
For a cyclic EF, the record containing the oldest data is updated, the record pointer is set to this record and this record becomes record number 1.

Input:

- mode, record number (absolute mode only) and the length of the record;
- the data used for updating the record.

Output:

- none.

9.7 SEEK

This function searches through the current linear fixed EF to find a record starting with the given pattern. This function shall only be performed if the READ access condition for this EF is satisfied. Two types of SEEK are defined:

Type 1 The record pointer is set to the record containing the pattern, no output is available.

Type 2 The record pointer is set to the record containing the pattern, the output is the record number.

The IC card shall be able to accept any pattern length from 1 to 16 bytes inclusive. The length of the pattern shall not exceed the record length.

Four modes are defined:

- from the beginning forwards;
- from the end backwards;
- from the pointed location forwards;
- from the pointed location backwards.

If the record pointer has not been previously set (its status is undefined) within the selected linear fixed EF, then the search begins:

- with the first record in the case of SEEK in the forward direction or
- with the last record in the case of SEEK in the backward direction

After a successful SEEK, the record pointer is set to the record in which the pattern was found. The record pointer shall not be changed by an unsuccessful SEEK function.

Input:

- type and mode;
- pattern;
- length of the pattern.

Output:

- type 1: none;
- type 2: record number

9.8 INCREASE

This function adds the value given by the ME to the value of the last increased/updated record of the current cyclic EF, and stores the result into the oldest record. The record pointer is set to this record and this record becomes record number 1. This function shall be used only if this EF has an INCREASE access condition assigned and this condition is fulfilled. The IC card shall not perform the increase if the result would exceed the maximum value of the record.

Input:

- the value to be added.

Output:

- value of the increased record;
- value which has been added (same as the input value).

9.9 VERIFY PIN

This function verifies the PIN presented by the ME by comparing it with the relevant one stored in the IC card. The verification process is subject to the following conditions being fulfilled:

- PIN is not disabled;
- PIN is not blocked.

If the access condition for a function to be performed on the last selected file is PIN1 or PIN2, then a successful verification of the relevant PIN is required prior to the use of the function on this file unless the PIN is disabled.

If the PIN presented is correct, the number of remaining PIN verification attempts for that PIN shall be reset to its initial value 3.

If the PIN presented is false, the number of remaining PIN verification attempts for that PIN shall be decremented. After 3 consecutive false PIN presentations, not necessarily in the same card session, the respective PIN shall be blocked and the access condition can never be fulfilled until the UNBLOCK PIN function has been successfully performed on the respective PIN.

Input:

- indication PIN1/PIN2, PIN.

Output:

- none.

9.10 CHANGE PIN

This function assigns a new value to the relevant PIN subject to the following conditions being fulfilled:

- PIN is not disabled;
- PIN is not blocked.

The current and new PIN must be presented.

If the current PIN presented is correct, the number of remaining PIN verification attempts for that PIN shall be reset to its initial value 3 and the new value for the PIN becomes valid.

If the current PIN presented is false, the number of remaining PIN verification attempts for that PIN shall be decremented and the value of the PIN is unchanged. After 3 consecutive false PIN presentations, not necessarily in the same card session, the respective PIN shall be blocked and the access to files for which the PIN is the access condition can never be fulfilled allowed until the UNBLOCK PIN function has been performed successfully on the respective PIN.

Input:

- indication PIN1/PIN2, current PIN, new PIN.

Output:

- none.

9.11 DISABLE PIN

This function may only be applied to PIN1. A successful execution of this function changes the access condition PIN1 of each file to "always allowed". The function DISABLE PIN shall not be executed by the IC card when PIN is already disabled or blocked.

If the PIN1 presented is correct, the number of remaining PIN1 verification attempts shall be reset to its initial value 3 and PIN1 shall be disabled.

If the PIN1 presented is false, the number of remaining PIN1 verification attempts shall be decremented and PIN1 remains enabled. After 3 consecutive false PIN1 presentations, not necessarily in the same card session, PIN1 shall be blocked and the access condition can never be fulfilled until the UNBLOCK PIN function has been successfully performed on PIN1 .

Input:

- PIN1 .

Output:

- none.

9.12 ENABLE PIN

This function may only be applied to PIN1. It is the reverse function of DISABLE PIN. The function ENABLE PIN shall not be executed by the IC card when PIN1 is already enabled or blocked.

If the PIN1 presented is correct, the number of remaining PIN1 verification attempts shall be reset to its initial value 3 and PIN1 shall be enabled.

If the PIN1 presented is false, the number of remaining PIN1 verification attempts shall be decremented and PIN1 remains disabled. After 3 consecutive false PIN1 presentations, not necessarily in the same card session, PIN1 shall be blocked and the access condition can never be fulfilled until the UNBLOCK PIN function has been successfully performed on PIN1 .

Input:

- PIN1 .

Output:

- none.

9.13 UNBLOCK PIN

This function unblocks a PIN which has been blocked by 3 consecutive wrong PIN presentations. This function may be performed whether or not the relevant PIN is blocked.

If the UNBLOCK PIN presented is correct, the value of the PIN, presented together with the UNBLOCK PIN, is assigned to that PIN, the number of remaining UNBLOCK PIN verification attempts for that UNBLOCK PIN is reset to its initial value 10 and the number of remaining PIN verification attempts for that PIN is reset to its initial value 3.

If the presented UNBLOCK PIN is false, the number of remaining UNBLOCK PIN verification attempts for that UNBLOCK PIN shall be decremented. After 10 consecutive false UNBLOCK PIN presentations, not necessarily in the same card session, the respective UNBLOCK PIN shall be blocked. A false UNBLOCK PIN shall have no effect on the status of the respective PIN itself.

Input:

- indication PIN1/PIN2, the UNBLOCK PIN number and the new PIN.

Output:

- none.

9.14 INVALIDATE

This function invalidates the current EF. After an INVALIDATE function the respective flag in the file status shall be changed accordingly. This function shall only be performed if the INVALIDATE access condition for the current EF is satisfied.

An invalidated file shall no longer be available within the application for any function except for the SELECT and the REHABILITATE functions.

Input:

- none.

Output:

- none.

9.15 REHABILITATE

This function rehabilitates the invalidated current EF. After a REHABILITATE function the respective flag in the file status shall be changed accordingly. This function shall only be performed if the REHABILITATE access condition for the current EF is satisfied.

Input:

- none.

Output:

- none.

9.16 PDC AUTHENTICATE

This function is used during the procedure for authenticating the IC card to a PDC network and to calculate a cipher key. The specific calculation algorithms are specified in Appendix 1 of this standard. An EF file immediately under a DF must be selected to perform this function.

Input:

- random number, operation mode.

Output:

- calculation result

9.17 SLEEP

This command shall not be used in the ME specified in this standard.

9.18 Operation mode specified by ETSI TS 102 221

Refer to ETSI TS 102 221(10. Structure of commands and responses), (11. Commands) and (12. Transmission Oriented Command).

From among the commands specified by ETSI TS 102 221, the following commands are mandatory.

SELECT FILE	VERIFY
STATUS	CHANGE PIN
	DISABLE PIN
READ BINARY	ENABLE PIN
UPDATE BINARY	UNBLOCK PIN
READ RECORD	
UPDATE RECORD	DEACTIVATE FILE
	ACTIVATE FILE
SEARCH RECORD	
INCREASE	AUTHENTICATE
	GET RESPONSE (When T=0)

10. Description of the commands

This section states the general coding principles of the functions described in Section 9 on the transmission protocol.

For the IC card and ME which comply with ETSI TS 102 221, refer also to ETSI TS 102 221(10. Structure of commands and responses) and (11. Commands) in addition to Sections 10.1 through 10.4. For the mapping of the APDU on the TPDU, refer to ETSI TS 102 221(7. Transmission protocols). Refer to Section 10.5 for the AUTHENTICATE command.

10.1 Coding principles

The application protocol data unit (APDU) shall be a command APDU or a response APDU.

The command APDU has the following general format:

CLS	INS	P1	P2	P3	DATA

Fig. 10.1 : Format of command APDU

The response APDU has the following general format:

DATA	SW1	SW2

Fig. 10.2 : Format of response APDU

An APDU is transported by the T=0 transmission protocol without any change. Other protocols might embed an APDU into their own transport structure.

Each byte has the following meaning:

- CLA is the class of instruction. 'A0' is used in this standard.
- INS is the instruction code as defined in this section for each command.
- P1, P2, P3 are parameters for the instruction. They are specified in table 10.1. 'FF' is a valid value for P1, P2 and P3.
  P3 gives the length of the data element. P3='00' introduces a 256 byte data transfer from the IC card in an outgoing data transfer command. In an incoming data transfer command, P3='00' introduces no transfer of data.
- SW1 and SW2 are the status bytes indicating the successful or unsuccessful outcome of the command.

For some of the functions described in Section 9, it is necessary to use a supplementary transport service command (GET RESPONSE) to obtain the output data.

For example, the SELECT function needs the following two commands:

- the first command (SELECT) has both parameters and data serving as input for the function;
- the second command (GET RESPONSE) has a parameter indicating the length of the data to be returned.

If the length of the response data is not known beforehand, then its correct length may be obtained by applying the first command and interpreting the status bytes. If SW1 is '9F', SW2 shall give the total length of the data. Other cases indicate error codes. The various cases are:

Case 1: No input / No output

CLA	INS	P1	P2	P3
				lgth '00'

	SW1	SW2
	'90'	'00'

Case 2: No input / Output of known length

CLA	INS	P1	P2	P3
				lgth

lgth length data	SW1	SW2
	'90'	'00'

NOTE: lgth='00' causes a data transfer of 256 bytes.

Case 3: No Input / Output of unknown length

CLA	INS	P1	P2	P3
				lgth '00'

SW1	SW2
'9F'	lgth 1

GET RESPONSE

CLA	INS	P1	P2	P3
				lgth 2

lgth2 (≤lgth1) length data	SW1	SW2
	'90'	'00'

Case 4: Input / No output

CLA	INS	P1	P2	P3	lgth length data
				lgth	

SW1	SW2
'90'	'00'

Case 5: Input / Output of known or unknown length

CLA	INS	P1	P2	P3	lgth length data
				lgth	

SW1	SW2
'9f'	lgth 1

GET RESPONSE

CLA	INS	P1	P2	P3
				lgth 2

lgth2 (≤lgth1) length data	SW1	SW2
	'90'	'00'

10.2 Coding of the commands

Table 10.1 gives the coding of the commands.

The direction of the data is indicated by (S) and (R), where (S) stands for data sent by the ME while (R) stands for data received by the ME.

Offset is coded on 2 bytes where offset high gives the high order byte and offset low the low order byte. '00 00' means no offset and reading/updating starts with the first byte while an offset of '00 01' means that reading/updating starts with the second byte.

Table 10.1 : Coding of the commands

Command name	INS	P1	P2	P3	S/R
SELECT	'A4'	'00'	'00'	'02'	S/R
STATUS	'F2'	'00'	'00'	lgth	R
READ BINARY	'B0'	offset high	offset low	lgth	R
UPDATE BINARY	'D6'	offset high	offset low	lgth	S
READ RECORD	'B2'	rec No.	mode	lgth	R
UPDATE RECORD	'DC'	rec No.	mode	lgth	S
SEEK	'A2'	'00'	type/mode	lgth	S/R
INCREASE	'32'	'00'	'00'	'03'	S/R
VERIFY PIN	'20'	'00'	PIN No.	'08'	S
CHANGE PIN	'24'	'00'	PIN No.	'10'	S
DISABLE PIN	'26'	'00'	'01'	'08'	S
ENABLE PIN	'28'	'00'	'01'	'08'	S
UNBLOCK PIN	'2C'	'00'	NOTE	'10'	S
INVALIDATE	'04'	'00'	'00'	'00'	-
REHABILITATE	'44'	'00'	'00'	'00'	-
PDC AUTHENTICATE	'88'	'00'	Mode	'08'	S/R
SLEEP	'FA'	'00'	'00'	'00'	-
GET RESPONSE	'C0'	'00'	'00'	lgth	R

Note : If the UNBLOCK PIN command applies to PIN1, then P2 is coded '00'; if it applies to PIN2, then P2 is coded '02'.

10.2.1 SELECT

Table 10.2 : Coding of SELECT command

COMMAND	CLASS	INS	P1	P2	P3
SELECT	'A0'	'A4'	'00'	'00'	'02'

Command parameters/data:

Table 10.3 : SELECT command parameter

Byte	Description	Data length
1-2	File ID	2

Response parameters/data in case of an MF or DF:

Table 10.4 : Response parameters/data for SELECT command (in MF/DF)

Byte	Description	Data length
1-2	RFU	2
3-4	Current DF available capacity	2
5-6	File ID	2
7	File type (see 10.3)	1
8-12	Reserved	5
13	PDC data length (byte 14 and onward)	1
14-34	PDC data	21

Detailed data

Table 10.5 : Details of PDC data

Byte	Description	Data length
14	File characteristics byte (see Detail 1)	1
15	No. of DFs immediately under the current DF	1
16	No. of EFs immediately under the current DF	1
17	No. of PIN, UNBLOCK PIN and management code	1
18	RFU	1
19	PIN1 status (see Detail 2)	1
20	UNBLOCK PIN1 status (see Detail 2)	1
21	PIN2 status (see Detail 2)	1
22	UNBLOCK PIN2 status (see Detail 2)	1
23	RFU	1
24-34	Reserved for issuer management (optional)	$0 \leq$lgth ≤ 11

Note 1 : Byte 35 and following are RFU.

Note 2 : The MF and DF provide identical status information (e.g. PIN status). On a multi-application card the MF shall Several Pieces of not contain any specific data. Such data is obtained by terminals from the specific application directories.
The ME manufacturers should take this into account and therefore not use application specific data which may exist in the MF of a mono-application IC card.
Similarly, the Verify PIN command should not be executed in other than the relevant application directory.

Detail 1: File characteristics

Table 10.6 : Details of file characteristics bytes

b8	PIN enabled/disabled indication 0: PIN1 enabled, 1: PIN1 disabled
b7	RFU
b6	
b5	3V operation indication 0: 5V operation IC card, 1: 3V operable IC card (sent when DF_{PDC} is selected) (See Detail 3)
b4	Clock stop condition
b3	Clock stop condition
b2	Required frequency for authentication processing 0: 13/8 MHz, 1: 13/4 MHz
b1	Clock stop condition

The coding of the conditions for stopping the clock is as follows:

Table 10.7 : Clock stop conditions

b1	b3	b4	Condition
1	0	0	Clock stop allowed: no preferred level
1	1	0	Clock stop allowed: high level preferred
1	0	1	Clock stop allowed: low level preferred
0	0	0	Clock stop not allowed
0	1	0	Clock stop not allowed, unless at high level
0	0	1	Clock stop not allowed, unless at low level

Detail 2: PIN status byte

Table 10.8 : PIN status

b8	0: PIN not initialized, 1: PIN initialized
b7	Reserved
b6	
b5	
b4	Number of allowed PIN verification attempts (0 indicates blocked condition.)
b3	
b2	
b1	

Response parameters/data in case of an EF:

Table 10.9 : Response parameter/data for SELECT command (in EF)

Byte	Description	Data length
1-2	RFU	2
3-4	File size (For a transparent EF: the byte length of the body part of the EF; for a linear fixed or cyclic EF: the record length x number of records)	2
5-6	File ID	2
7	File type (see 10.3)	1
8	See Detail 4	1
9-11	Access condition (see 10.3)	3
12	File status (see 10.3)	1
13	Length of the following data (byte 14 to the end)	1
14	EF structure (see 10.3)	1
15	Record length (see Detail 5)	1

Note : Byte 16 and following are RFU.

Detail 3: 3V operation indication

3V operation indication can be obtained by executing the SELECT PDC, STATUS/GET RESPONSE commands after ATR but before any other commands.

Detail 4: Byte 8

For transparent and linear fixed EFs this byte is RFU.
For a cyclic EF all bits except bit 7 are RFU; b7=1 indicates that the INCREASE command is allowed on the selected cyclic file.

Detail 5: Byte 15

For cyclic and linear fixed EFs this byte denotes the length of a record. For a transparent EF, this byte shall be coded '00', if this byte is sent by the IC card.

10.2.2 STATUS

Table 10.10 : Coding of STATUS command

COMMAND	CLASS	INS	P1	P2	P3
STATUS	'A0'	'F2'	'00'	'00'	lgth

The response parameters/data are identical to the response parameters/data of the SELECT command in case of an MF or DF.

10.2.3 READ BINARY

Table 10.11 : Coding of READ BINARY command

COMMAND	CLASS	INS	P1	P2	P3
READ BINARY	'A0'	'B0'	offset high	offset low	lgth

Response parameters/data:

Table 10.12 : Response data for READ BINARY command

Byte	Description	Data length
1-lgth	Data	lgth

10.2.4 UPDATE BINARY

Table 10.13 : Coding of UPDATE BINARY command

COMMAND	CLASS	INS	P1	P2	P3
UPDATE BINARY	'A0'	'D6'	offset high	offset low	lgth

Command parameters/data:

Table 10.14 :

Byte	Description	Data length
1-lgth	Data	lgth

10.2.5 READ RECORD

Table 10.15 : Coding of READ RECORD command

COMMAND	CLASS	INS	P1	P2	P3
READ RECORD	'A0'	'B2'	Record no.	Mode	lgth

Parameter P2 specifies the mode:

- '02' = next record;
- '03' = previous record;
- '04' = absolute mode/current mode, the record number is given in P1 with P1='00' denoting the current record.

For the modes "next" and "previous" P1 has no significance and shall be set to '00' by the ME.

When a value other than '00' is given by the ME, the IC card must ignore it.

Response parameters/data:

Table 10.16 : Response data for READ RECORD command

Byte	Description	Data length
1-lgth	Data	lgth

10.2.6 UPDATE RECORD

Table 10.17 : Coding of UPDATE RECORD command

COMMAND	CLASS	INS	P1	P2	P3
UPDATE RECORD	'A0'	'DC'	Record no.	Mode	lgth

Parameter P2 specifies the mode:

- '02' = next record;
- '03' = previous record;
- '04' = absolute mode/current mode; the record number is given in P1 with P1='00' denoting the current record.

For the modes "next" and "previous" P1 has no significance and shall be set to '00' by the ME.

When a value other than '00' is given by the ME, the IC card must ignore it.

Command parameters/data:

Table 10.16 : Command data of UPDATE RECORD command

Byte	Description	Data length
1-lgth	Data	lgth

10.2.7 SEEK

Table 10.19 : Coding of SEEK command

COMMAND	CLASS	INS	P1	P2	P3
SEEK	'A0'	'A2'	'00'	Type/mode	lgth

Parameter P2 specifies type and mode:

- 'x0' = from the beginning forward;
- 'x1' = from the end backward;
- 'x2' = from the location after the record pointer forward;
- 'x3' = from the location before the record pointer backward
  with x='0' specifies type 1 and x='1' specifies type 2 of the SEEK command.

Command parameters/data:

Table 10.20 : Command data of SEEK command

Byte	Description	Data length
1-lgth	Pattern	

There are no response parameters/data for a type 1 SEEK. A type 2 SEEK returns the following response parameters/data:

Response parameter/data:

Table 10.21 : Response parameter for SEEK command

Byte	Description	Data length
1	Record number	1

10.2.8 INCREASE

Table 10.22 : Coding of INCREASE command

COMMAND	CLASS	INS	P1	P2	P3
INCREASE	'A0'	'32'	'00'	'00'	'03'

Command parameters/data:

Table 10.23 : Command data of INCREASE command

Byte	Description	Data length
1-3	Value to be added	3

Response parameters/data:

Table 10.24 : Response data for INCREASE command

Byte	Description	Data length
1 to X	Value of the increased record	X
X + 1 to X + 3	Value that has been added	3

Note :   X denotes the length of the record.

10.2.9 VERIFY PIN

Table 10.25 : Coding of VERIFY PIN command

COMMAND	CLASS	INS	P1	P2	P3
VERIFY PIN	'A0'	'20'	'00'	PIN No.	'08'

Parameter P2 specifies the PIN number:

- '01' = PIN1;
- '02' = PIN2.

Command parameters/data:

Table 10.26 : Command data of VERIFY PIN command

Byte	Description	Data length
1-8	Value of PIN	8

10.2.10 CHANGE PIN

Table 10.27 : Coding of CHANGE PIN command

COMMAND	CLASS	INS	P1	P2	P3
CHANGE PIN	'A0'	'24'	'00'	PIN No.	'10'

Parameter P2 specifies the PIN number.

- '01' = PIN1;
- '02' = PIN2.

Command parameters/data:

Table 10.28 : Command data of CHANGE PIN command

Byte	Description	Data length
1-8	Value of old PIN	8
9-16	Value of new PIN	8

10.2.11 DISABLE PIN

Table 10.29 : Coding of DISABLE PIN command

COMMAND	CLASS	INS	P1	P2	P3
DISABLE PIN	'A0'	'26'	'00'	'01'	'08'

Command parameters/data:

Table 10.30 : Command data of DISABLE PIN command

Byte	Description	Data length
1-8	Value of PIN1	8

10.2.12 ENABLE PIN

Table 10.31 : Coding of ENABLE PIN command

COMMAND	CLASS	INS	P1	P2	P3
ENABLE PIN	'A0'	'28'	'00'	'01'	'08'

Command parameters/data:

Table 10.32 : Command data of ENABLE PIN command

Byte	Description	Data length
1-8	Value of PIN1	8

10.2.13 UNBLOCK

Table 10.33 : Coding of UNBLOCK PIN command

COMMAND	CLASS	INS	P1	P2	P3
UNBLOCK PIN	'A0'	'2C'	'00'	PIN No.	'10'

Parameter P2 specifies the PIN number:

- '00' = PIN1;
- '02' = PIN2.

Note: The coding of the PIN1 '00' for differs from the coding used for other commands.
Command parameters/data:

Table 10.34 : Command parameters/data of UNBLOCK PIN command

Byte	Description	Data length
1-8	Value of UNBLOCK PIN	8
9-16	Value of new PIN	8

10.2.14 INVALIDATE

Table 10.35 : Coding of INVALIDATE command

COMMAND	CLASS	INS	P1	P2	P3
INVALIDATE	'A0'	'04'	'00'	'00'	'00'

10.2.15 REHABILITATE

Table 10.36 : Coding of REHABILITATE command

COMMAND	CLASS	INS	P1	P2	P3
REHABILITATE	'A0'	'44'	'00'	'00'	'00'

10.2.16 PDC AUTHENTICATE

Table 10.37 : Coding of PDC AUTHENTICATE command

COMMAND	CLASS	INS	P1	P2	P3
PDC AUTHENTICATE	'A0'	'88'	'00'	Mode	'08'

The mode indicates the calculation result that it requires.

'00' : return authentication response.
'01' : return calculation result by KeyP.
'02' : return calculation result by KeyS.

Command parameters/data:

Table 10.38 : Command data of PDC AUTHENTICATE command

Byte	Description	Data length
1-8	Random number	8

Response parameters/data:

Table 10.39 : Response to PDC AUTHENTICATE command

Byte	Description	Data length
1-8	Calculation result	8

10.2.17 SLEEP

Table 10.40 : Coding of SLEEP command

COMMAND	CLASS	INS	P1	P2	P3
SLEEP	'A0'	'FA'	'00'	'00'	'00'

10.2.18 GET RESPONSE

Table 10.41 : Coding of GET RESPONSE command

COMMAND	CLASS	INS	P1	P2	P3
GET RESPONSE	'A0'	'C0'	'00'	'00'	lgth

The response data depends on the preceding command. Response data is available after the commands PDC AUTHENTICATE, SEEK (type 2), SELECT, and INCREASE.

If the command GET RESPONSE is executed, it is required that it is executed immediately after the command it is related to (no other command shall come between the command/response pair and the command GET RESPONSE). If the sequence is not respected, the IC card shall send the status information "technical problem with no diagnostic given" as a reaction to the GET RESPONSE.

Since the MF is implicitly selected after activation of the IC card, GET RESPONSE is also allowed as the first command after the IC card activation.

The response data to GET RESPONSE is defined in the Section for the corresponding command.

10.3 Definitions and coding

The following definitions and coding are used in the response parameters/data of the commands.

Coding

Each byte is represented by bits b8 to b1, where b8 is the most significant bit (MSB) and b1 is the least significant bit (LSB).
In each representation the leftmost bit is the MSB.

RFU

In IC cards specified in this standard, all bytes which are RFU shall be set to '0'. The ME must ignore the RFU bits even if a value other than '0' is set.

File status

B8-B2: RFU
B1=0: Invalidated, =1: Not invalidated

Structure of file

- '00' transparent;
- '01' linear fixed;
- '03' cyclic.

Type of File

- '00' RFU;
- '01' MF;
- '02' DF;
- '04' EF.

Coding of PIN and UNBLOCK PIN

A PIN is coded on 8 bytes. Only (decimal) digits (0-9) shall be used, coded in CCITT T.50 with bit 8 set to zero.
The minimum number of digits is 4.
If the number of digits presented by the user is less than 8, then the ME shall pad the presented PIN with 'FF' before sending it to the IC card.
The coding of the UNBLOCK PIN is identical to the coding of the PIN. However, the number of (decimal) digits is always 8.

Coding of Access Conditions

The access conditions for the commands are coded on bytes 9, 10 and 11 of the response data of the SELECT command.
Each condition is coded on 4 bits as shown in table 10.42.

Table 10.42 : Access conditions

ALW	'0'
PIN1	'1'
PIN2	'2'
Reserved	'3'
ADM	'4'
....	...
ADM	'E'
NEV	'F'

Byte 9: b8-b5: READ, SEEK
Byte 9: b4-b1: UPDATE
Byte 10: b8-b5: INCREASE
Byte 10: b4-b1: Reserved
Byte 11: b8-b5: REHABILITATE
Byte 11: b4-b1: INVALIDATE

10.4 Status conditions returned by the IC card

This Section specifies the coding of the status bytes SW1 and SW2.

10.4.1 Responses to commands which are correctly executed

Table 10.43 : Response at normal completion

SW1	SW2	Description
'90'	'00'	- Normal completion
'9F'	'XX'	- Normal completion (Length 'XX' of the response data)

10.4.2 Memory management

Table 10.44 : Response at memory-related error

SW1	SW2	Description
'92'	'0X'	- Update successful but after X attempts
'92'	'40'	- Memory problem

10.4.3 Referencing management

Table 10.45 : Response at reference condition error

SW1	SW2	Description
'94'	'00'	- NO EF Selected
'94'	'02'	- Out of reference range (invalid address)
'94'	'04'	- File ID not found - Search pattern not found
'94'	'08'	- File inconsistent with command

10.4.4 Security management

Table 10.46 : Response at security-related error

SW1	SW2	Description
'98'	'02'	- PIN not initialized (PIN not written).
'98'	'04'	- Access condition not fulfilled. - Unsuccessful PIN verification, at least one attempt left - Unsuccessful UNBLOCK PIN verification, as least one attempt left - Authentication failed (see note.)
'98'	'08'	- In contradiction with PIN status.
'98'	'10'	- In contradiction with invalidation status.
'98'	'40'	- Unsuccessful PIN verification, no attempt left - Unsuccessful UNBLOCK PIN verification failed, no attempt left - PIN blocked. - UNBLOCK PIN blocked.
'98'	'50'	- Increase cannot be performed, maximum value reached

Note : The ME must respect that this error code is sent after the third consecutive unsuccessful PIN verification attempt or the tenth consecutive unsuccessful UNBLOCK PIN attempt.

10.4.5 Application independent errors

Table 10.47 : Responses for application-independent errors

SW1	SW2	Description
'67'	'XX'	- P3 invalid. (See Note 1.)
'6B'	'XX'	- P1 or P2 invalid. (See Notes 2 and 3.)
'6D'	'XX'	- Unknown instruction code given in the command (See Note 3.)
'6E'	'XX'	- Wrong instruction class given in the command. (See Note 3.)
'6F'	'XX'	- Technical problem with no diagnostic given (See Note 3.)

Note 1 : 'XX' indicates that there is no correct number of bytes or supplementary information ('00').

Note 2 : When the error in P1 or P2 is caused by the addressed record being out of range, then the status bytes '94 02' shall be used.

Note 3 : 'XX' is defined by ISO/EC. Currently only '00' is defined.

10.4.6 Commands versus possible status responses

The following table shows for each command the possible status conditions returned.

Table 10.48 : Commands and response

	Normal		Memory management		Reference management				Security management						Application - independent error				
	9000-	9FXX	920X	9240	9400	9402	9404	9408	9802	9804	9808	9810	9840	9850	6EXX	6DXX	6FXX	6BXX	67XX
SELECT		*		*			*								*		*	*	*
STATUS	*			*											*		*	*	*
UPDATE BINARY	*		*	*	*			*		*		*			*		*	*	*
UPDATE RECORD	*		*	*	*	*		*		*		*			*		*	*	*
READ BINARY	*			*	*			*		*		*			*		*	*	*
READ RECORD	*			*	*	*		*		*		*			*		*	*	*
SEEK	*	*		*	*		*	*		*		*			*		*	*	*
INCREASE		*	*	*	*			*		*		*		*	*		*	*	*
VERIFY PIN	*		*	*					*	*	*		*		*		*	*	*
CHANGE PIN	*		*	*					*	*	*		*		*		*	*	*
DISABLE PIN	*		*	*					*	*	*		*		*		*	*	*
ENABLE PIN	*		*	*					*	*	*		*		*		*	*	*
UNBLOCK PIN	*		*	*					*	*	*		*		*		*	*	*
INVALIDATE	*		*	*	*					*		*			*		*	*	*
REHABILITATE	*		*	*	*					*		*			*		*	*	*
PDC AUTHENTICATE		*		*				*		*					*		*	*	*
SLEEP	*														*		*	*	*
GET RESPONSE	*			*											*		*	*	*

10.5 AUTHENTICATE command in the operation mode specified in ETSI TS 102 221

Of the description in ETSI TS 102 221 (11.1.16 AUTHENTICATE), P2 coding shall be set as shown below.

P2=‘80’: Returns an Authentication Response
P2=‘81’: Returns the calculation result by Key P.
P2=‘82’: Returns the calculation result by Key S.

Both Lc and Le are ‘08’. The command input data is 8-byte random number and the response data is 8-byte calculation result.

11 Contents of the Elementary Files (EF)

11.1 Card identification information

This EF indicates the information about the card type.

Table 11.1 : Structure and access conditions of the card identification information EF

Structure		Access condition	
File ID	6F 1F	READ	ALWAYS
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	1 byte	REHABILITATE	ADM

Table 11.2 : Contents of the card identification information EF

Byte	Contents	M/O	Byte length
1	General/test mode information	M	1

General mode (=00h) : The ME uses appropriate perch channels according to the network identity and the roaming state.
Test mode (=01h) : The ME must use test perch channels independently of network identity or the roaming state. However, the ME shall roaming the network identity during standby.

11.2 Mobile Subscriber Number (MSN)

This EF indicates the mobile subscriber number.

Table 11.3 : Structure and access conditions of the mobile subscriber number EF

<table>
<tr><th colspan="2">Structure</th><th colspan="2">Access condition</th></tr>
<tr><td>File ID</td><td>6F 30</td><td>READ</td><td>PIN1</td></tr>
<tr><td>Structure</td><td>Linear fixed EF</td><td>UPDATE</td><td>ADM</td></tr>
<tr><td>Mandatory/optional</td><td>Mandatory</td><td rowspan="2">INVALIDATE</td><td rowspan="2">PIN1</td></tr>
<tr><td>Record length</td><td>14 bytes</td></tr>
<tr><td>No. of records</td><td>1</td><td>REHABILITATE</td><td>PIN1</td></tr>
</table>

Table 11.4 : Contents of Mobile Subscriber Number EF

Byte	Contents			M/O	Byte length
1	Mobile Subscriber Number content length			M	1
2	1 *	Number type	Numbering plan identifier	M	1
3	2nd number		1st number	M	1
4	4th number		3rd number	M	1
...	...		...	...	...
12	22nd number		21st number	M	1
14	24th number		23rd number	M	1

Note : The numbering digits "*1 (odd/even indication)", "number type" and "numbering plan identifier" are defined in Section 4.3.7.3.5.4 "Called Party Number" of this Standard.

11.3 Mobile station number (MSI)

This EF indicates the MSI length and MSI.

Table 11.5 : Structure and access conditions of the MSI EF

Structure		Access condition	
File ID	6F 50	READ	PIN1
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	9 bytes	REHABILITATE	PIN1

Table 11.6 Contents of the MSI EF

Byte	Contents	M/O	Byte length
1	MSI length	M	1
2	MSI (MSB)	M	1
...	...	...	...
9	MSI (LSB)	M	1

When the MSI is less than 64 bits, it is stored from the upper byte.

11.4 Mobile station category

This EF indicates the ME type.

Table 11.7 : Structure and access conditions of the ME category EF

Structure		Access condition	
File ID	6F 31	READ	PIN1
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	1 byte	REHABILITATE	ADM

Table 11.8 : Contents of the ME category EF

Byte	Contents		M/O	Byte length
1	Mobile station category	Operator specific definition area	M	1

Table 11.9 : Details of the ME category

Details of ME category		
b7	b6	Meaning
0	0	Normal MS
0	1	Priority MS
1	0	Spare
1	1	MS for maintenance

Operator specific definition area

- An area that can be freely defined by each operator.
- The ME must map the information in this domain bit by bit to the operator specific definition area in the ME type information element in the RT signal.

11.5 Home network identification

This EF indicates the information to identify the home network.

Table 11.10 : Structure and access conditions of the home network identification EF

Structure		Access condition	
File ID	6F 51	READ	PIN1
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	4 bytes	REHABILITATE	ADM

Table 11.11 : Contents of the home network identification EF

Byte	Contents	M/O	Byte length
1-2	Home operator network identity (intra-group network identity is '0000')	M	2
3-4	Intra-group network code	M	2

The home operator network identity included in this EF is of the same format as the network identity in Section 4.3.5.3.3.25 and the part in which the intra-group network identity is included shall be '0000'.

The intra-group network identity included in this EF shall be as follows:

Table 11.12 : Details of intra-group network identity

Intra-group network identity								
Byte	b7	b6	b5	b4	b3	b2	b1	b0
1	a15	a14	a13	a12	a11	a10	a9	a8
2	a7	a6	a5	a4	a3	a2	a1	a0

(ai, i = 0 to 15): indicates if a network in an operator group is the home network or not.
'i' indicates the intra-group network identity.

ai = 1: home network
ai = 0: not home network

11.6 Roaming priority

This EF indicates the priority for roaming.

The priority shall be set by operator group.

Table 11.13 : Structure and access conditions of the roaming priority EF

Structure		Access condition	
File ID	6F 52	READ	PIN1
Structure	Transparent EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	ADM
File size	1-15 bytes	REHABILITATE	ADM

Table 11.14 : Contents of the roaming priority EF

Byte	Contents	M/O	Byte length
1	Number of registered priority network identities (0 to 7)	M	1
2-3	Priority 1 network identity	O	2
4-5	Priority 2 network identity	O	2
...	...	...	...
12-13	Priority 6 network identity	O	2
14-15	Priority 7 network identity	O	2

The network identities of priority 1 to 7 included in this EF are of the same format as the network identity in Section 4.3.5.3.3.25 and the part in which the intra-group network identity is included shall be '0000'.

The ME must access the operator groups specified in this EF in order of priority.

The access priority shall not be defined for operators that are not specified in this EF.

Only network identities with priorities between 1 and up to the number of registered priority network identities shall be valid; the following data shall be invalid.

The contents of this EF may be updated by the user.

11.7 Roaming not allowed network information

This EF contains the network identities whose reception has been rejected (roaming not allowed).

Location registration will automatically be prohibited for the networks with the network identities included in this EF.

Table 11.15 : Structure and access conditions of the roaming not allowed network information EF

Structure		Access condition	
File ID	6F 53	READ	PIN1
Structure	Transparent EF	UPDATE	PIN1
Mandatory/optional	Mandatory (Note)	INVALIDATE	ADM
File size	61 byte	REHABILITATE	ADM

Table 11.16 : Contents of the roaming not allowed network information EF

Byte	Contents	M/O	Byte length
1	Registered number of rejected network identities (0 to 30)	M	1
2 to 3	Rejected network identity (last)	M	2
4 to 5	Rejected network identity (second last)	M	2
...	...	...	...
60-61	Rejected network identity (oldest)	M	2

The rejected network identities included in this EF are of the same format as the network identity in Section 4.3.5.3.3.25.

The procedure in which the ME refers to the contents of this EF and the method of storing this EF shall be as follows:

The most recently not allowed network identity shall be placed in the highest location and the oldest one in the lowest location. When the number of information items exceeds 30, due to additional network identities whose reception has been rejected, network identities shall be deleted, starting from the oldest one.

Location registration shall be allowed for the networks with the network identities stored in this information EF only through user operation.

In this case, when a network identity whose reception has already been rejected in the past is rejected once more, the previous information shall be deleted and the network identity shall be saved as the most recently rejected network identity.

When "Location Registration Acknowledgment" is received, the previous information (network identity) shall be deleted. At this time, the network identities shall be moved up to fill the area of the deleted rejected network identity and the number of registered rejected network identities shall be updated.

When the registered number of rejected network identities is less than 30, only the most recently rejected network identities, their number being equal to the registered number of rejected network identities, shall be valid; the following data shall be invalid.

Note : This EF shall be unnecessary only when the roaming operation control information is '00' Hex or '01' Hex but shall otherwise be mandatory.

11.8 Roaming operation control information

This EF indicates the information that controls the roaming operation of the ME.

Table 11.17 : Structure and access condition of roaming operation control information EF

Structure		Access condition	
File ID	6F 54	READ	PIN1
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	1 byte	REHABILITATE	ADM

Table 11.18 : Contents of the roaming operation control information EF

Byte	Contents	M/O	Byte length
1	Roaming operation control information	M	1

Table 11.19 : Details of roaming operation control information

Details of roaming operation control information				
b7 b6 b5 b4 b3	b2	b1	b0	Meaning
Reserved	International roaming 0=not allowed 1=allowed	Domestic roaming 0=not allowed 1=allowed	Home group intra-network roaming 0=not allowed 1=allowed	
00000	0	0	0	Home NW access only.
00000	0	0	1	Home group NW access only.
00000	0	1	0	Home NW access and domestic (other than home group NW) roaming only.
00000	0	1	1	Domestic roaming only.
00000	1	0	0	Home NW access and international roaming only.
00000	1	0	1	Home operator group NW and international roaming only.
00000	1	1	0	Home NW access , international and domestic (other than home group NW) roaming only.
00000	1	1	1	Access allowed to all NW incl. international roaming.

The ME is prohibited from accessing the networks with access restriction in this EF even in the case of user manipulation.

When the network identity of a network to which access is allowed in this information is included in the roaming not allowed network information, the ME cannot access the network without user manipulation.

11.9 Location registration information

This EF contains the network identity of the network that completed location registration most recently.

Table 11.20 : Structure and access conditions of the location registration information EF

Structure		Access condition	
File ID	6F 55	READ	PIN1
Structure	Transparent EF	UPDATE	PIN1
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	5 bytes	REHABILITATE	PIN1

Table 11.21 : Contents of the location registration information EF

Byte	Contents	M/O	Byte length
1-2	Network code	M	2
3	Location number	M	1
4	Band identification	M	1
5	Location registration condition	M	1

The Network code included in this EF is of the same format as the Network identity in Section 4.3.5.3.3.25 and the Location number is of the same format as the Location identity in Section 4.3.5.3.3.4.

The Band identification shall be of the same format as the Frequency band identifier in Frequency code in 4.3.5.3.3.8 and the upper 4 bits shall be '0000'.

When the cards are issued, the location registration condition is 'not completed (=0)'.

After an ME performs the location registration, the location registration condition shall be set to 'completed (=1)'.

When the location registration condition is 'not completed (=0)', the ME performs location registration regardless of the Network identity, Location identity, and Band identification.

11.10 Calling party number indication identifier

This EF contains the indication identifier that is set to the calling party number information element of the call setup signal in the CC signal.

Table 11.22 : Structure and access conditions of the calling party number indication identifier EF

Structure		Access condition	
File ID	6F 32	READ	PIN1
Structure	Transparent EF	UPDATE	PIN1
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	1 byte	REHABILITATE	ADM

Table 11.23 : Contents of the calling party number indication identifier EF

Byte	Contents	M/O	Byte length
1	Calling party number indication identifier	M	1

The calling party number indication identifier included in this EF is of the same format as the indication identifier in Section 4.3.7.3.5.6 and b7 to b2 shall be '000000'.

The ME must set the contents of this EF in the indication identifier that is set in the calling party number information element of the call setup signal in the CC signal.

The contents of this EF can be modified by user operation.

11.11 Card version

This EF contains the version of the IC card.

Table 11.24 : Structure and access conditions of the card version EF

Structure		Access condition	
File ID	6F 10	READ	ALWAYS
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	1 byte	REHABILITATE	ADM

Table 11.25 : Contents of card version EF

Byte	Contents	M/O	Byte length
1	Card version	M	1

The card version shall be '00000001'.
Other bytes shall be RFU.

11.12 Memory dial

This EF contains the memory dial information.

Table 11.26 : Structure and access conditions of the memory dial EF

Structure		Access condition	
File ID	6F 33	READ	PIN1
Structure	Linear fixed EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	PIN1/PIN2
Record length	8 + X +Y+Z bytes		
Number of records	Not specified	REHABILITATE	PIN2

Table 11.27 : Contents of the memory dial EF

Byte	Contents	M/O	Byte length
1	Secret data information	M	1
2	Index registration code	M	1
3	Index length ($X \leq 24$)	M	1
4 to 3 + X	Index	O	X
4 + X	Number content length($Y \leq 13$)	M	1
5 + X	*1 / Number type / Numbering plan identifier	M	1
6+X to 4+X+Y	Telephone Number (Max. 24 digits)	O	Y-1
5 + X+Y	Group Number	M	1
6+X+Y	Kanji Data Code	M	1
7+X+Y	Kanji Data Length ($Z \leq 24$)	M	1
8+X+Y to 7+X +Y+Z	Kanji Data	O	Z
8+X+Y+Z	Extension record number	M	1

Secret data information

'00' Hex = normal memory dial information
'01' Hex = secret data information set by user

Kanji data code and Index registration code

b7 to b3 : RFU (0)
b2 : IA5 (no='0', yes = '1')
b1 : Shift JIS (no='0', yes = '1')
b0 : JIS8 (no='0', yes = '1')
Note: b7 to b0 = '0x00' means no code

Kanji data length and Index length

0 to 24 in Hex.

Kanji data

Stores Kanji data if it registered. (In this case, pronunciation is stored in Index data.)
Stores Kanji data code 'Undefined' and Kanji data length '0 (0x00)', in case of no Kanji registration.

The number content length contains the number length of the "dialing for origination" (at most 13 bytes).

The bytes from (4 + X) to (4 + X + Y) shall be of the same format as in the MSN in 11.2.

For the number digit, '1101' is additionally defined as the 'pause indication' and '1110' as the 'hyphen indication' are defined in addition to the definition in "Called party number" in Section 4.3.7.3.5.4 of this Standard.

The 'pause indication' is a signal that does not appear in the air interface and identifies the "dialing for origination" and "DTMF" that is transmitted during communication. It is coded as "dialing for origination", "pause indication", "DTMF 1", "pause indication", "DTMF 2", and so on.

Group number

The group number is used when the memory dial information is divided into information for companies, for individuals and so on. The group number shall be set to "0" for the memory dial information that is not divided into groups.

When the memory dial number is divided by group number (1 to 99), the contents of the group index information EF shall be referred to for the index data for each group (companies, individuals, etc.).

Extension record number

It indicates the record number of the extension indication EF in Section 11.23. When this byte is 'FF', it indicates that there is no extension.

Note: When the memory dial information is not registered, '0's are set for all the data in the record

11.13 Latest call duration

This EF contains the latest call duration.

Table 11.28 : Structure and access conditions of the latest call duration EF

Structure		Access condition	
File ID	6F 34	READ	PIN1
Structure	Linear fixed EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	ADM
Record length	2 bytes		
Number of records	1	REHABILITATE	ADM

Table 11.29 : Contents of the latest call duration EF

Byte	Contents	M/O	Byte length
1-2	Call duration	O	2

The call duration is stored as two-byte data in the unit of second.

Table 11.30 : Storing method of call duration

Call duration								
Byte	b7	b6	b5	b4	b3	b2	b1	b0
1	a15	a14	a13	a12	a11	a10	a9	a8
2	a7	a6	a5	a4	a3	a2	a1	a0

11.14 Accumulated call duration

This EF contains the accumulated call duration.

Table 11.31 : Structure and access conditions of the accumulated call duration EF

Structure		Access condition	
File ID	6F 35	READ	PIN1
Structure	Cyclic EF	UPDATE	PIN1/PIN2/ADM
Mandatory/optional	Optional	INCREASE	PIN1
Record length	4 bytes	INVALIDATE	PIN1/PIN2/ADM
Number of records	Not specified	REHABILITATE	PIN1/PIN2/ADM

Table 11.32 : Contents of the accumulated call duration EF

Byte	Contents	M/O	Byte length
1-4	Accumulated call duration	O	4

The accumulated call duration is stored as four-byte data in units of 1 second.

Table 11.33 : Storing method of accumulated call duration

Accumulated call duration								
Byte	b7	b6	b5	b4	b3	b2	b1	b0
1	a31	a30	a29	a28	a27	a26	a25	a24
2	a23	a22	a21	a20	a19	a18	a17	a16
3	a15	a14	a13	a12	a11	a10	a9	a8
4	a7	a6	a5	a4	a3	a2	a1	a0

11.15 Latest call charge

This EF contains the latest call charge.

Table 11.34 : Structure and access conditions of the latest call charge EF

Structure		Access condition	
File ID	6F 36	READ	PIN1
Structure	Linear fixed EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	ADM
Record length	2 bytes		
Number of records	Not specified	REHABILITATE	ADM

Table 11.35 : Contents of the latest call charge EF

Byte	Contents	M/O	Byte length
1-2	Call charge	O	2

The call charge is stored as two-byte data in units of 1 yen.

Table 11.36 : Method of storing call charge

Call charge								
Byte	b7	b6	b5	b4	b3	b2	b1	b0
1	a15	a14	a13	a12	a11	a10	a9	a8
2	a7	a6	a5	a4	a3	a2	a1	a0

11.16 Accumulated call charge

This EF contains the accumulated call charge.

Table 11.37 : Structure and access conditions of the accumulated call charge EF

Structure		Access condition	
File ID	6F 37	READ	PIN1
Structure	Cyclic EF	UPDATE	PIN1/PIN2/ADM
Mandatory/optional	Optional	INCREASE	PIN1
Record length	4 bytes	INVALIDATE	PIN1/PIN2/ADM
Number of records	Not specified	REHABILITATE	PIN1/PIN2/ADM

Table 11.38 : Contents of the accumulated call charge EF

Byte	Contents	M/O	Byte length
1-4	Accumulated call duration	O	4

The accumulated call charge is stored as 4-byte data in units of 1 yen.

Table 11.39 : Method of storing accumulated call charge

Accumulated call charge								
Byte	b7	b6	b5	b4	b3	b2	b1	b0
1	a31	a30	a29	a28	a27	a26	a25	a24
2	a23	a22	a21	a20	a19	a18	a17	a16
3	a15	a14	a13	a12	a11	a10	a9	a8
4	a7	a6	a5	a4	a3	a2	a1	a0

11.17 Origination history

This EF contains the origination dialing, index data and origination time.

Table 11.40 : Structure and access conditions of the origination history EF

Structure		Access condition	
File ID	6F 38	READ	PIN1
Structure	Cyclic EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	PIN1/PIN2
Record length	7+X+Y+Z+A bytes		
Number of records	Max. 10	REHABILITATE	PIN2

Table 11.41 : Contents of the origination history EF

Byte	Contents			M/O	Byte length
1	Time length (X≤4)			M	1
2 to 1+X	Time information			O	X
2+X	Index registration code			M	1
3+X	Index length (Y≤24)			M	1
4+X to 3+X+Y	Index			O	Y
4+X+Y	Number content length(Z≤13)			M	1
5+X+Y	*1	Number type	Numbering plan identifier	O	1
6+X+Y to 4+X+Y+Z	Telephone number (Max. 24 digits)			O	Z-1
5+X+Y+Z	Kanji data code			M	1
6+X+Y+Z	Kanji data length (A≤24)			M	1
7+X+Y+Z to 6+X+Y+Z+A	Kanji data			O	A
7+X+Y+Z+A	Extension record number			M	1

Table 11.42 : Time length

Byte	Time, index length
1	Time information length (0,2,4)

Table 11.43 : Time information

Byte	Time information
1	Month (1-12, Hex)
2	Day (1-31, Hex)
3	Hour (0-24, Hex)
4	Minute (0-59, Hex)

No time information shall be included when the time information length is 0, and only the hour and minute information is included when the time information length is 2.

The bytes from (2+X) to (7+X+Y+Z+A) shall be of the same format as the memory dial in Section 11.12.

Extension record number

They shall be of the same format as in Memory dial. (Section 11.12)

Note : When Origination history information is not registered, all '0' s are set for all data in the record.

11.18 Termination history

This EF stores the calling party number and the time of termination.

Table 11.44 : Structure and access conditions of the termination history EF

Structure		Access condition	
File ID	6F 39	READ	PIN1
Structure	Cyclic EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	PIN1/PIN2
Record length	7+X+Y+Z+A bytes		
Number of records	Max. 10	REHABILITATE	PIN2

Table 11.45 : Contents of the termination history EF

Byte	Contents			M/O	Byte length
1	Time length (X≤4)			M	1
2 to 1+X	Time information			O	X
2+X	Index registration code			M	1
3+X	Index length (Y≤24)			M	1
4+X to 3+X+Y	Index			O	Y
4+X+Y	Number content length(Z≤13)			M	1
5+X+Y	*1	Number type	Numbering plan identifier	O	1
6+X+Y to 4+X+Y+Z	Telephone number (Max. 24 digits)			O	Z-1
5+X+Y+Z	Kanji data code			M	1
6+X+Y+Z	Kanji data length (A≤24)			M	1
7+X+Y+Z to 6+X+Y+Z+A	Kanji data			O	A
7+X+Y+Z+A	Extension record number			M	1

Time length, time information

They shall be of the same format as origination history in Section 11.17.

The bytes from (2+X) to (7+X+Y+Z+A) shall be of the same format as in the memory dial in Section 11.2.

Extension record number

They shall be of the same format as Memory dial. (Section 11.12)

Note : When Termination history information is not registered, all '0' s are set for all data in the record.

11.19 Card serial number

This EF contains the serial number of the IC card.

Table 11.46 : Structure and access conditions of the card serial number EF

Structure		Access condition	
File ID	6F 11	READ	ALWAYS
Structure	Transparent EF	UPDATE	NEVER
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	Not specified	REHABILITATE	ADM

Table 11.47 : Contents of the card serial number EF

Byte	Contents	M/O	Byte length
	Not specified	M	Not specified

11.20 Language preference

This EF indicates the language preference.

It is used in the man-machine interface etc.

Table 11.48 : Structure and access conditions of the language preference EF

Structure		Access condition	
File ID	6F 12	READ	ALWAYS
Structure	Transparent EF	UPDATE	PIN1
Mandatory/optional	Mandatory	INVALIDATE	ADM
File size	2-1+N bytes	REHABILITATE	ADM

Table 11.49 : Contents of the language preference EF

Byte	Contents	M/O	Byte length
1	No. of registered preferred languages (N)	M	1
2	Most preferred language	M	1
3	Second preferred language	O	1
...	...	...	...
X	Nth preferred language	O	1

Preferred language

'51' Hex = Japanese
'01' Hex = English
Others = reserved

Only the preferred languages with priority numbers up to the registered number of preferred languages (starting from the most preferred language) shall be valid and data after that shall be invalid.

11.21 Operator specific area

This EF shall be an area that operators can define at their will.

Table 11.50 : Structure and access conditions of the operator specific area EF

Structure		Access condition	
File ID	6F 13	READ	Not specified
Structure	Not specified	UPDATE	Not specified
Mandatory/optional	Optional	INCREASE	Not specified
Record length	Not specified	INVALIDATE	Not specified
Number of records	Not specified	REHABILITATE	Not specified

Contents of EF

Not specified.

11.22 Subscriber personal information

This EF contains the subscriber information.

Table 11.51 : Structure and access conditions of the subscriber personal information EF

Structure		Access condition	
File ID	6F 14	READ	ALWAYS
Structure	Transparent EF	UPDATE	ADM
Mandatory/optional	Optional	INVALIDATE	ADM
File size	1 to X bytes	REHABILITATE	ADM

Table 11.52 : Contents of the subscriber personal information EF

Byte	Contents	M/O	Byte length
1	To be decided	O	1
2	To be decided	O	1
...	...	...	...
X	To be decided	O	1

11.23 Extension indication

This EF contains the numbering digits, subaddresses, etc. which cannot be stored in the numbering digit area of the memory dial EF, the origination history EF, or the termination history EF.

Table 11.53 : Structure and access conditions of the extension indication EF

Structure		Access condition	
File ID	6F 38	READ	PIN1
Structure	Linear fixed EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	ADM
Record length	2+N bytes		
Number of records	Not specified	REHABILITATE	ADM

Table 11.54 : Contents of the extension indication EF

Byte	Contents	M/O	Byte length
1	Record type	M	1
2 to 1+N	Extension information	M	N
2+N	Extension record number	M	1

Record type

'01' Hex = subaddress
'02' Hex = number digit
Other bytes = RFU

Extension information

The coding of the extension information varies depending on the record type.

When the record is a subaddress:
It is of the same format as the called party subaddress content length and onward defined in the called party subaddress in Section 4.3.7.3.5.5 of this Standard.

When the record is a number digit:
It is of the same format as the number digit of the memory dial.
In this case, the first byte contains the content length of number digits in this record.

Extension record number

It is of the same format as the extension indication of the memory dial.

Method of using extension indication

When there are more than 24 numbering digits of the memory dial etc. The record number of the "extension indication EF" containing the subsequent numbering digits shall be included in the "extension record number" of the concerned record.

When the number digits cannot be stored in one record of the "extension indication EF", it shall be extended to additional extension indication records to store the digits.

Example

When N=23 bytes and there are 100 numbering digits

- The first 24 digits shall be stored in the memory dial EF with "extension record number" = '03'.
- The digits from 25 to 68 shall be stored in the record of the extension indication EF '03' with "extension record number" = '01'.
- The digits from 69 to 100 shall be stored in the record of the extension indication EF '01' with "extension record number" = 'FF'.

When there are subaddresses attached to the memory dial etc., the subaddresses shall be stored in the "extension indication EF" even when the numbering digits are fewer than 24.
The subaddresses and numbering digits shall be stored in separate records even when there are more than 24 numbering digits.

11.24 Supplementary service identifier

This EF contains information as to whether there are any options provided by the IC card.

Table 11.55 : Structure and access conditions of the supplementary service identifier EF

Structure		Access condition	
File ID	6F 15	READ	PIN1
Structure	Linear fixed EF	UPDATE	ADM
Mandatory/optional	Mandatory	INVALIDATE	ADM
Record length	3 bytes		
Number of records	1	REHABILITATE	ADM

Table 11.56 : Contents of the supplementary service identifier EF

Byte	Contents	M/O	Byte length
1	IC card service condition	M	1
2 to 3	Existence of information on options	M	2

IC card service condition

'00' Hex = both Mobile Subscriber Number and Mobile station number exist
'01' Hex = Mobile Subscriber Number exists but Mobile station number does not (for future service)
Other bytes = RFU

Table 11.57 : Details on whether there is information on options

Byte	Details on whether there is information on options							
2	a15	a14	a13	a12	a11	a10	a9	a8
3	a7	a6	a5	a4	a3	a2	a1	a0

a15: existence of operator specific information EF (0=no, 1=yes)
a14: existence of subscriber personal information EF (0=no, 1=yes)
a13: existence of roaming priority EF (0=no, 1=yes)
a12: existence of roaming not allowed network information EF (0=no, 1=yes)
a11: existence of group index information (0=no, 1=yes)
a10: existence of memory dial EF (0=no, 1=yes)
a9: existence of extension indication EF (0=no, 1=yes)
a8: RFU
a7: existence of latest call duration EF (0=no, 1=yes)
a6: existence of accumulated call duration EF(0=no, 1=yes)
a5: existence of latest call charge (0=no, 1=yes)
a4: existence of accumulated call charge (0=no, 1=yes)
a3: existence of origination history EF (0=no, 1=yes)
a2: existence of termination history EF (0=no, 1=yes)
a1: RFU
a0: RFU

11.25 Group index information

This EF contains the index information of each group (for companies, individuals, etc.) in the case the memory dial information is divided by group number.

Table 11.58 : Structure and access conditions of the group index EF

Structure		Access condition	
File ID	6F 3A	READ	PIN1
Structure	Linear fixed EF	UPDATE	PIN1
Mandatory/optional	Optional	INVALIDATE	PIN1/PIN2
Record length	5+X+Y bytes		
Number of records	Max. 99	REHABILITATE	PIN2

Table 11.59 : Contents of the group index EF

Byte	Contents	M/O	Byte length
1	Group number 1 to 99 (0x01 to 0x63)	M	1
2	Index registration code	M	1
3	Index length ($X \le 24$)	M	1
4 to 3+X	Index	O	X
4+X	Kanji data code	M	1
5+X	Kanji data length ($Y \le 24$)	M	1
6+X to 5+X+Y	Kanji data	O	Y

Kanji data code and Index registration code

b7 to b3: RFU (0)
b2 : IA5 (= 0 : no / = 1 : yes)
b1 : shift JIS (= 0 : no / = 1 : yes)
b0 : JIS8 (= 0 : no / = 1 : yes)
Note: b7 to b0 = '0x00' means no code.

Index length

0 to 30 in Hex.

Note : The memory dial information divided by group number 1 to 99 (0x01 to 0x63) can be searched and categorized for indication by the above group index information.
If the group index information is not registered, all '0's are set for all data in this record.

12. Application protocol

This section describes the application protocols in DF_{PDC} between the ME and the IC card.

For the IC card and the ME which comply with ETSI TS 102 221, refer also to ETSI TS 102 221(14. Application independent protocol) in addition to Sections 12.1 through 12.5.

12.1 General procedures

12.1.1 Reading an EF

The ME selects the EF and sends a READ command.

This contains the record number or address of the data to be read. The concerned record number can be confirmed by using the SEEK command.

If the access condition for READ is fulfilled, the IC card sends a response including the requested data contained in the EF to the ME. If the access condition is not fulfilled, no data will be sent and an error code will be returned.

12.1.2 Updating an EF

The ME selects the EF and sends an UPDATE command.

This contains the record number or address of the data to be updated and the new data to be stored.

The concerned record number can be confirmed by using the SEEK command.

If the access conditions for UPDATE and READ are fulfilled simultaneously, the IC card replaces the existing data in the EF by the data contained in the UPDATE command and saves the result. If the access conditions are not fulfilled, the data existing in the EF will be unchanged, and an error code will be returned.

12.1.3 Increasing an EF

The ME selects the EF and sends an INCREASE command.

This contains the value which has to be added to the contents of the last updated/increased record.

If the access conditions for INCREASE are fulfilled, the IC card increases the existing value of the EF by the data contained in the command, and stores the result. If the access conditions are not fulfilled, the data existing in the EF will be unchanged and an error code will be returned.

12.2 IC card management procedures

12.2.1 IC card initialization

After IC card activation, the ME selects the DF_{PDC} and acquires the Language Preference EF.

The ME should operate in a language according to the language preference EF. If this EF is not available or the languages in the EF are not supported, then the ME selects a default language. It then runs the PIN1 verification procedure.
If the PIN1 verification procedure is performed successfully, the ME then performs the card version EF acquisition procedure.

Operation of the PDC application shall start only if either of the two following conditions is fulfilled:

- Mobile station number (MSI) EF and location registration information EF are valid.

- Mobile station number (MSI) EF and location registration information EF are invalidated and the ME validates the two EFs.

If the above conditions are fulfilled, the ME runs the following procedures:

- Card identification information EF acquisition
- Mobile Subscriber Number EF acquisition
- Mobile station number (MSI) EF acquisition
- ME category EF acquisition
- Supplementary service identifier acquisition
- Home network identification EF acquisition
- Roaming priority EF acquisition (if any)
- Roaming not allowed network information EF acquisition (if any)
- Roaming operation control information EF acquisition
- Location registration information EF acquisition
- Calling party number indication identifier EF acquisition

After all of the above information has been acquired, the ME can access the PDC network.

In the case of ME which complies with ETSI TS 102 221, the following procedure is also performed in addition to the procedure above.

After the IC card has been activated, the ME issues a command using the CLA code specified in ETSI TS 102 221. If the response to this command is normal, the IC card and the ME shall operate in the operation mode specified in ETSI TS 102 221. If the response is other than normal, the ME re-issues a command using the CLA code specified in this Standard. In case when the response to the pertinent command is normal, the IC card and the ME shall operate in the operation mode specified in this Standard. If a response other than the normal response is received, the card will be assumed as an incompatible card.

12.2.2 PDC application termination

This is the procedure to terminate the PDC application. It is carried out before and is distinct from the IC card deactivation procedure in Section 5.4.2.
The PDC application is terminated after the following procedures are completed.

- Update of roaming not allowed network information EF
- Update of location registration information EF

Connection between the ME and IC card shall be released after a response that completion of the update of the above information has been sent from the IC card.
Finally, the ME deletes at least the Mobile station identifier and the Location registration information.

NOTE: If the ME has already updated any of the above information during access to the PDC network, and the value has not changed since then, the ME may omit the respective updating procedure at termination of the PDC application.

12.2.3 Language preference EF

Acquisition procedure: The ME performs the reading procedure of the language preference EF.

Updating procedure: The ME performs the updating procedure of the language preference EF.

12.2.4 Mobile station category EF acquisition procedure

The ME performs the reading procedure of the ME category EF.

12.2.5 Supplementary service identifier EF acquisition procedure

The ME performs the reading procedure of the supplementary service identifier EF.

12.2.6 Card version EF acquisition procedure

The ME performs the reading procedure of the card version EF.

12.2.7 Card serial number EF acquisition procedure

The ME performs the reading procedure of the card serial number EF.

12.2.8 IC card presence detection

To detect that the IC card is installed during a card session, the ME must send a STATUS command at certain intervals. (This interval shall not be longer than 30 seconds.)

If there is no response data or the response data is not that of the current DF, the call shall be terminated immediately.

12.2.9 5V operation ME

The 5 V operation ME shall activate the IC card at the voltage specified in Section 6.1.1.

12.2.10 3V/5V operation ME

The 3V/5V operation ME shall activate the IC card at the voltage specified in Section 6.1.2. If the 3V operation indication specified in Section 10.2.1 is '0', the IC card shall be activated at the voltage specified in Section 6.1.1. If switching of operation voltage from 3V to 5V is performed, it shall be carried out before execution of any other commands than SELECT STATUS/GET RESPONSE.

When an incorrect ATR is received at 3V, ME shall start the error handling procedures specified in Section 6.10 by keeping a 3V supply.

When the IC card dose not return a correct ATR in the error handling procedure, the ME shall activate the IC card at the voltage specified in Section 6.1.1.

When an ATR with 3V cannot be received, the ME shall deactivate the IC card, and shall conduct activation at the voltage specified in Section 6.1.1.

12.2.11 3V operation ME

The 3V operation ME shall activate the IC card at the voltage specified in Section 6.1.2.

If the 3V operation ME is able to detect a 5V operation IC card according to the procedure in Section 12.2.11, or if the 3V activation is unsuccessful, the ME shall deactivate and reject the IC card immediately (within at most 5s) before issuing any other commands than SELECT STATUS/GET RESPONSE.

12.3 PIN related procedures

A successful completion of one of the following procedures grants the access right of the corresponding PIN.

This right is valid for all files within the PDC application protected by this PIN.

After three consecutive unsuccessful presentation attempts, not necessarily in the same session, the PIN status becomes "blocked" and the access right previously granted by this PIN is lost immediately.

An access right is not granted if any of the following procedures are terminated unsuccessfully or aborted.

12.3.1 PIN verification

The ME checks the PIN status. If the PIN status is "blocked", the procedure is terminated unsuccessfully.

If the PIN status is not "blocked", the ME reads the PIN enabled/disabled indicator. If this is "disabled", the procedure is terminated successfully.

If the PIN status is not "blocked" and the enabled/disabled indicator is "enabled", the ME uses the VERIFY PIN command.

If the PIN provided by the ME with the VERIFY PIN command is equal to the corresponding PIN stored in the IC card, the procedure is terminated successfully. If the PIN provided by the ME is not identical to the corresponding PIN stored in the IC card, the procedure is terminated unsuccessfully.

12.3.2 PIN value substitution

The ME checks the PIN status. If the PIN status is "blocked" or "disabled", the procedure is terminated unsuccessfully.

If the PIN status is not "blocked" and the enabled/disabled indicator is set "enabled", the ME uses the CHANGE PIN command.

If the old PIN provided by the ME with the CHANGE PIN command is identical to the corresponding PIN stored in the IC card, the new PIN provided by the ME is stored in the IC card and the procedure is terminated successfully.

If the old PIN provided by the ME with the CHANGE PIN command is not identical to the PIN stored in the IC card, the procedure is terminated unsuccessfully.

12.3.3 PIN disabling

The ME checks the PIN1 status. If the PIN1 status is "blocked", the procedure is terminated unsuccessfully.

If the PIN1 status is not "blocked", the ME reads the PIN1 enabled/disabled indicator. If it is "disabled", the procedure is terminated unsuccessfully.

If the PIN1 status is not "blocked" and the enabled/disabled indicator is "enabled", the ME uses the DISABLE PIN command.

If the PIN1 provided by the ME with the DISABLE PIN command is identical to the PIN1 stored in the IC card, the status of PIN1 is "disabled" and the procedure is terminated successfully. If the PIN1 provided by the ME is not identical to the PIN1 stored in the IC card, the procedure is terminated unsuccessfully.

12.3.4 PIN enabling

The ME checks the PIN1 status. If the PIN1 status is "blocked", the procedure is terminated unsuccessfully.

If the PIN1 status is not "blocked", the ME reads the PIN1 enabled/disabled indicator. If this is "enabled", the procedure is terminated unsuccessfully.
If the PIN1 status is not "blocked" and the enabled/disabled indicator is "disabled", the ME uses the ENABLE PIN command.

If the PIN1 provided by the ME with the ENABLE PIN command is identical to the PIN1 stored in the IC card, the status of PIN1 is "enabled" and the procedure is terminated successfully.

If the PIN1 provided by the ME is not identical to the PIN1 stored in the IC card, the procedure is terminated unsuccessfully.

12.3.5 PIN unblocking

The execution of the PIN unblocking procedure is independent of the corresponding PIN status.

The ME checks the UNBLOCK PIN status. If the UNBLOCK PIN status is "blocked", the procedure is terminated unsuccessfully.

If the UNBLOCK PIN status is not "blocked", the ME uses the UNBLOCK PIN command.

If the UNBLOCK PIN provided by the ME with the UNBLOCK PIN command is identical to the corresponding UNBLOCK PIN stored in the IC card, the relevant PIN status changes to "unblocked" and the procedure is terminated successfully. If the UNBLOCK PIN provided by the ME is not identical to the corresponding UNBLOCK PIN stored in the IC card, the procedure is terminated unsuccessfully.

12.4 Security related procedures

The security related procedures shall be mandatory operations when the relevant EF exists.

12.4.1 PDC authentication algorithm

The ME selects the EF immediately under DF_{PDC} and sends the PDC AUTHENTICATE command.

The PDC AUTHENTICATE command contains the random numbers given by the air interface to the ME and the parameters that indicate the required calculation results.

The IC card shall send a response including the data when the calculation is completed correctly. When the calculation is not completed correctly, data shall not be sent and an error code shall be returned.

However, in the case of the operation mode specified in ETSI TS 102 221, the PDC AUTHENTICATION command above shall be assumed as the AUTHENTICATION command.

12.4.2 Card identification information EF acquisition

The ME performs the reading procedure of the card identification information EF.

12.4.3 Mobile station number (MSI) EF acquisition

The ME performs the reading procedure of the Mobile station number (MSI) EF.

12.4.4 Mobile station number (MSI) EF acquisition

The ME performs the reading procedure of the Mobile Subscriber Number EF.

12.4.5 Home network identification EF acquisition

The ME performs the reading procedure of the home network identification EF.

12.4.6 Roaming priority EF

Acquisition procedure : The ME performs the reading procedure of the roaming priority EF.

Updating procedure : The ME performs the updating procedure of the roaming priority EF.

The updating procedure has to be performed by the user, using the man-machine interface.

12.4.7 Roaming not allowed network information EF

Acquisition procedure : The ME performs the reading procedure of the roaming not allowed network information EF.

Updating procedure : The ME performs the updating procedure of the roaming not allowed network information EF.

12.4.8 Roaming operation control information EF acquisition

The ME performs the reading procedure of the roaming operation control information EF.

12.4.9 Location registration information EF

Acquisition procedure : The ME performs the reading procedure of the location registration information EF.

Updating procedure : The ME performs the updating procedure of the location registration information EF.

12.4.10 Calling party number indication identifier EF

Acquisition procedure : The ME performs the reading procedure of calling party number indication identifier EF.

Updating procedure : The ME performs the updating procedure of calling party number indication identifier EF.

The updating procedure has to be performed by the user, using the man-machine interface.

12.5 Supplementary service related procedures

These procedures are performed only when the concerned EFs exist in the IC card and the ME has the functions to acquire and update those EFs.

The ME must have the functions of both acquiring and updating the concerned EFs.

12.5.1 Memory dial EF

The ME may select either of the following as a memory dial related function:

(1) The ME does not have any memory dial related function.
(2) The ME has the memory dial EF acquisition, updating, validating and invalidating functions.

In the case of (2), the ME may select among the following functions:

- an optional index use function (including the case when there is no such function)
- existence of a function to use the extension indication EF

Acquisition procedure : The ME must perform the memory dial EF acquisition procedure immediately after the initialization of the IC card if the ME has the memory dial acquisition and updating functions.

If the memory dial EF is 'disabled', the ME with the memory dial EF acquisition and updating function must notify the 'disabled status' to the user through the man-machine interface.

Updating procedure : The ME performs the update procedure of the memory dial EF.

The ME must perform the update of the extension indication EF as well at the memory dial EF update.

12.5.2 Latest call duration EF

Acquisition procedure : The ME performs the reading procedure of the latest call duration EF.

Updating procedure : The ME performs the updating procedure of the latest call duration EF.

12.5.3 Accumulated call duration EF

Acquisition procedure : The ME performs the reading procedure of the accumulated call duration EF.

Updating procedure : The ME performs the updating procedure of the accumulated call duration EF.

Addition procedure : The ME performs the addition procedure of the accumulated call duration EF.

12.5.4 Latest call charge EF

Acquisition procedure : The ME performs the reading procedure of the latest call charge EF.

Updating procedure : The ME performs the updating procedure of latest call charge EF.

12.5.5 Accumulated call charge EF

Acquisition procedure : The ME performs the reading procedure of the accumulated call charge EF.

Updating procedure : The ME performs the updating procedure of the accumulated call charge EF.

Addition procedure : The ME performs the addition procedure of the accumulated call charge EF.

12.5.6 Origination history EF

The acquisition and updating procedures are the same as those in the memory dial EF.

12.5.7 Termination history EF

The acquisition and updating procedures are the same as those in the memory dial EF.

12.5.8 Group index EF

The acquisition and updating procedures are the same as those in the memory dial EF.

Annex 5 Half-duplex packet communications standard for the Personal Digital Cellular Telecommunication System

CONTENTS

1. General

This annex specifies the air interface of a Half-duplex (high-speed) packet communication method (Half-duplex mode), which is an alternative method of the high-speed packet communication method (Full-duplex mode) specified in the main text of this standard. The Half-duplex mode is intended to utilize the multiple-slot structure present for the packet physical channel in layer 1 and is valid for SAPI=1,6, only in layer 2.The Packet physical channel structure (Section 4.1.10.2.2.1 of the main text) indicates that up to 3 time slots per subframe can be assigned for the packet physical channel, and each channel comprises a UPCH functional channel. Section 4.1.10.2.2.2.2 of the main text describes a high-speed transmission, where it is assumed that the mobile station is full-duplex, i.e. capable of transmission of units over the number of slots comprising the packet physical channel, whilst simultaneously receiving units over these slots.

For mobile stations without full-duplex capability, a low-speed transmission method is described (Section 4.1.10.2.2.2.1), where transmission and reception of units is limited to one slot per subframe on both uplink and downlink, even if 3 slots are assigned to the packet physical channel in one subframe. This annex describes a Half-duplex mode of operation in which a MS without full-duplex capability can utilize the packet physical channel consisting of up to three slots in the downlink direction. In such a mode, the MS performs high-speed continuous or intermittent reception only when the MS is not transmitting units. When the MS is transmitting units, the MS performs continuous or intermittent reception according to the low-speed mode of reception. With this method,

- Downlink data throughput goes close to Full-duplex mode even for mobile stations without full-duplex capability.
- Full and half-duplex MS will be able to share the same packet physical channels.
- The network can transmit to other mobile stations (full or half-duplex) whilst receiving units from half-duplex MS.

The number of slots used by the Half-duplex packet is 2 or 3 per subframe. It is mandatory for a mobile station which supports the Half-duplex mode to support the low-speed transmission as described in the main text of this standard in order to keep compatibility for packet communication in a network.

In this annex unless otherwise mentioned, the terms 'Low-speed' and 'High-speed' correspond to “Low-speed ”(single-slot) and “High-speed ” (multi-slot), respectively, specifically for this Half-duplex packet communication only rather than the Low-speed mode and High-speed mode, respectively, in Full-duplex mode.

2. Operation at the MS side

2.1 Layer 1

2.1.1 L1 modes for Half-duplex packet communication

Layer 1 on the MS side operates in two different modes:

- High-speed mode: The MS keeps the receiver active on all slots comprising the physical channel in the downlink direction(up to three slots) . The MS will not transmit itself in this mode.
- Low-speed mode: The MS uses only the dedicated slot for transmission/reception.

2.1.2 Transmission method

When there are units to be transmitted, the MS performs random access and subsequent transmission of units on the uplink channel according to the low-speed transmission operation as described in Section 4.1.10.2.2.2.1(1) of the main text.

2.1.3 Reception method

When there are no units to be transmitted by the MS, the MS performs high-speed reception according to one of the following reception types as described in Section 4.1.10.2.2.2.2(2) of the main text.

- Continuous Reception
- Intermittent Reception

When there are units to be transmitted, the MS performs low-speed reception in the dedicated slot as described in Section 4.1.10.2.2.2.1(2) of the main text.

The switching between low-speed and high-speed reception is controlled by a signal which is received from layer 2.

The Half-duplex packet communication method is illustrated in Figure 1 for the case where the MS is performing high-speed continuous reception prior to transmitting units.

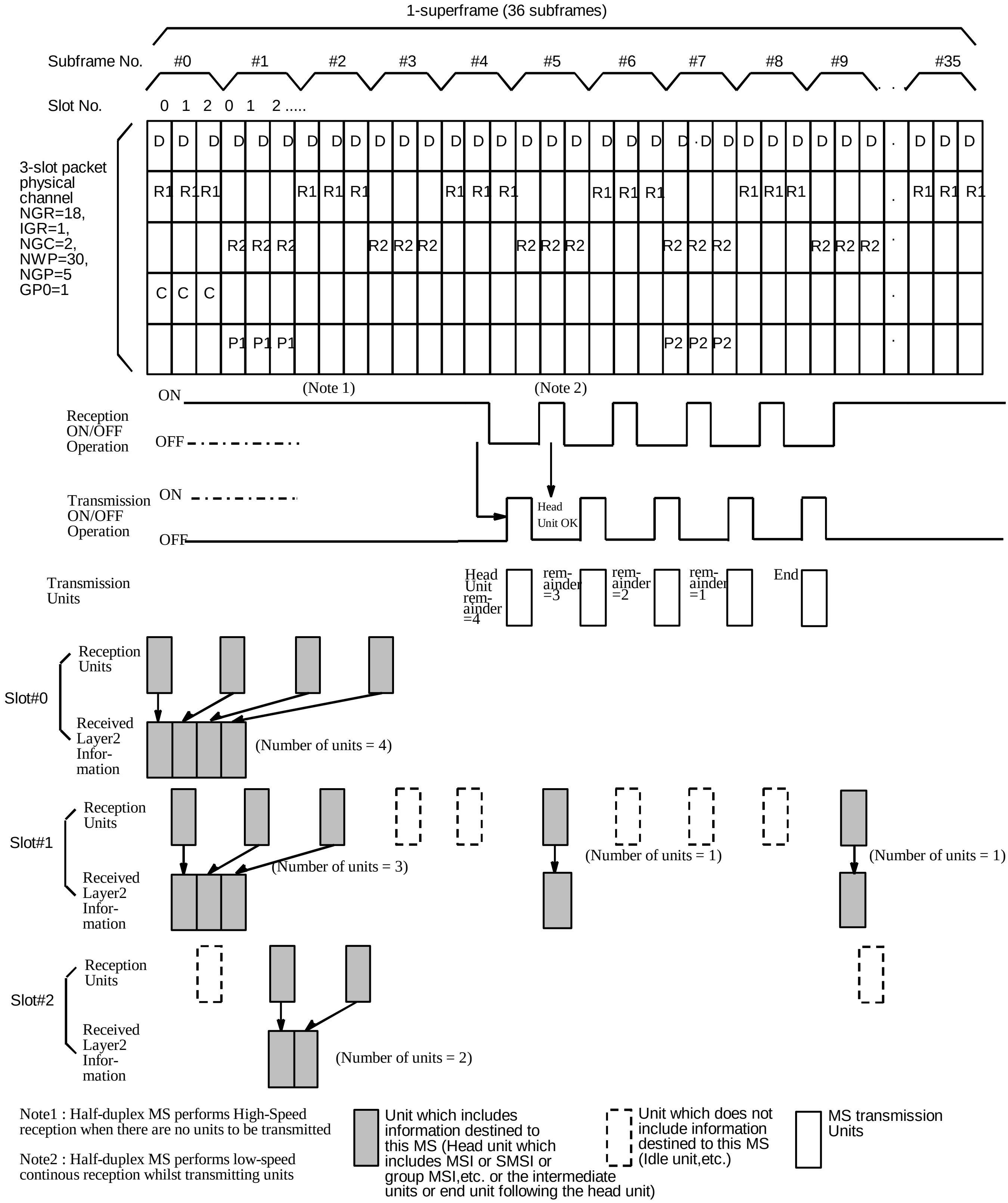


Figure 1. Example of Half-duplex packet communication

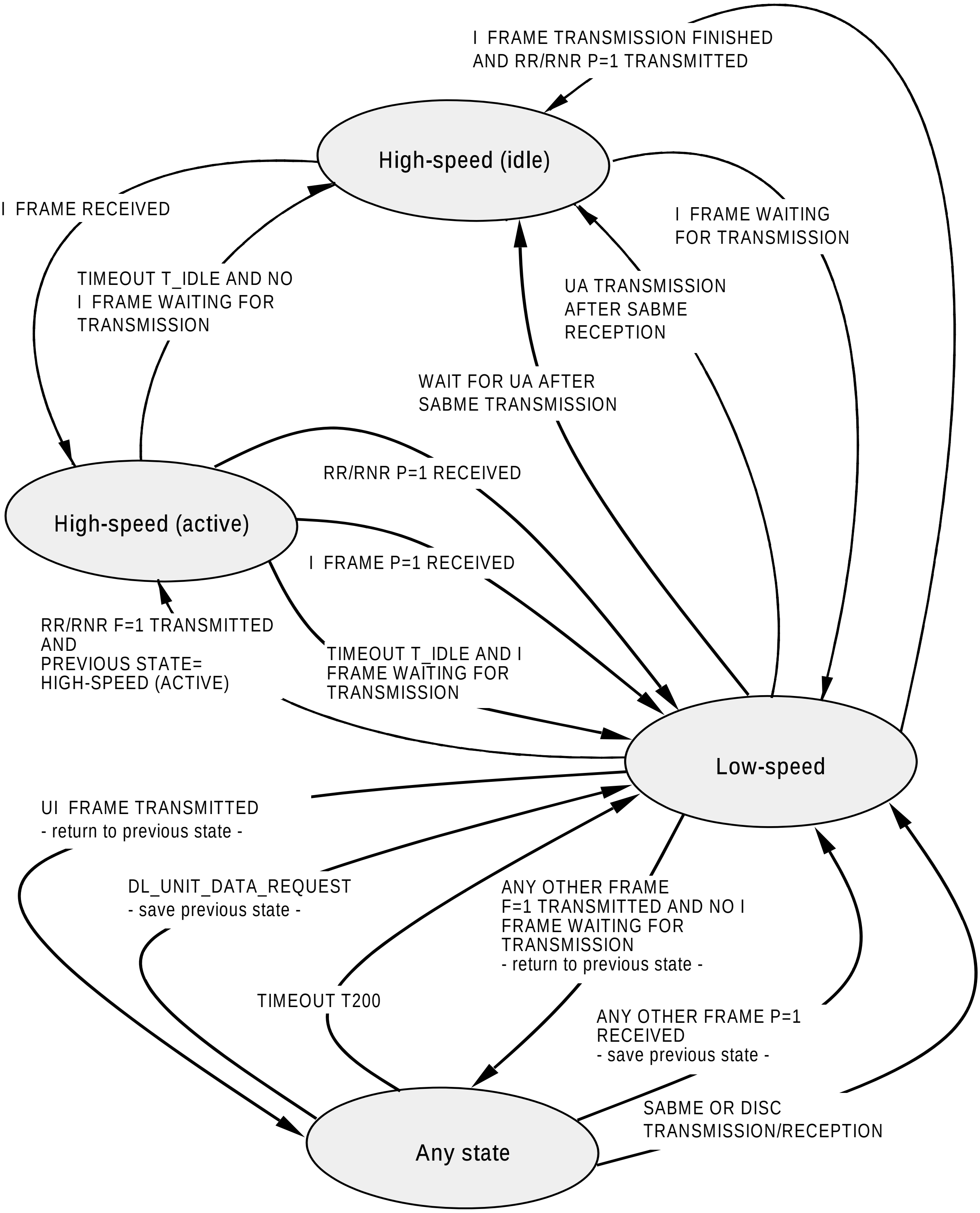
2.2 Layer 2

2.2.1 L2 states for Half-duplex packet communication

The Half-duplex packet communication modes are controlled by a state machine on the user side. This state machine is controlled by the user layer 2 protocol in the similar way as described in Appendix A, A.4.
This state machine contains the states:

- High-speed (idle) state
- High-speed (active) state
- Low-speed state

The state machine is shown in Figure 2.



Note: Events not affecting the half-duplex state are not shown in this diagram.

Figure 2. Half-duplex states on the user side

2.2.1.1 High-speed (idle) state

The High-speed (idle) state is the initial (stable) state which is entered after the link establish procedure (Figure 3).

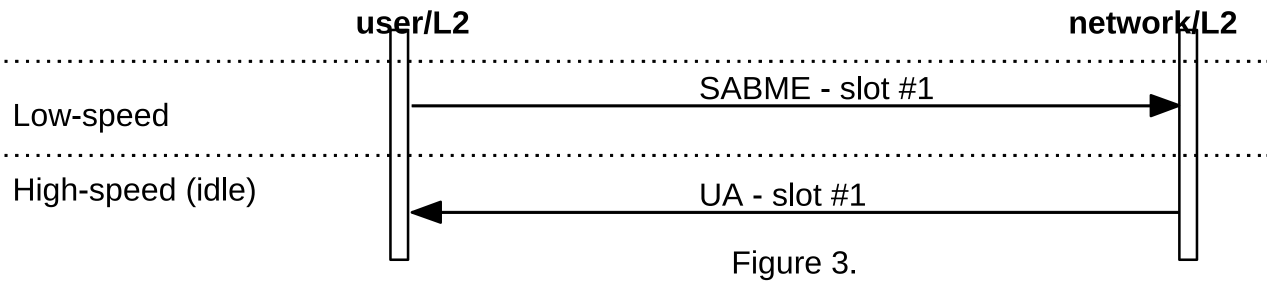


Figure 3.

In High-speed (idle) state, the network can initiate the I frame transmission. Therefore, the user listens in all three slots. Hence, the user cannot transmit any frames (Figure 4).

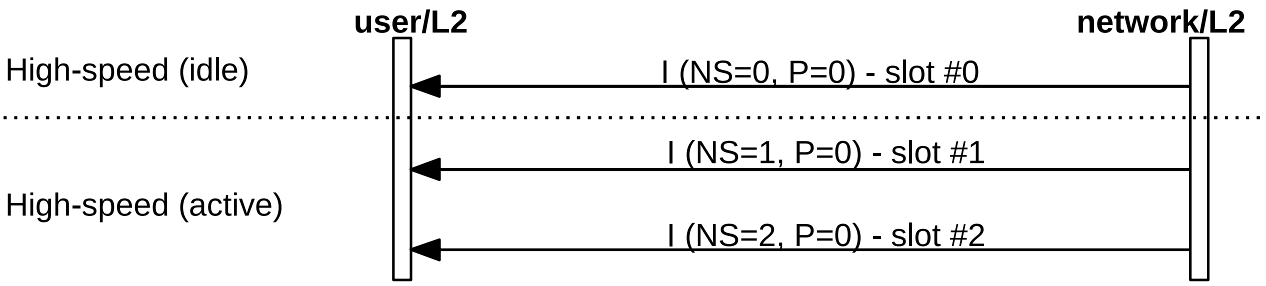


Figure 4.

If the user has to transmit a layer 2 frame it enters the Low-speed state before it starts transmission Therefore, it transmits a RR1 frame to inform the network about its intention to move to Low-speed state and its readiness to receive on the dedicated slot. (Figure 5).

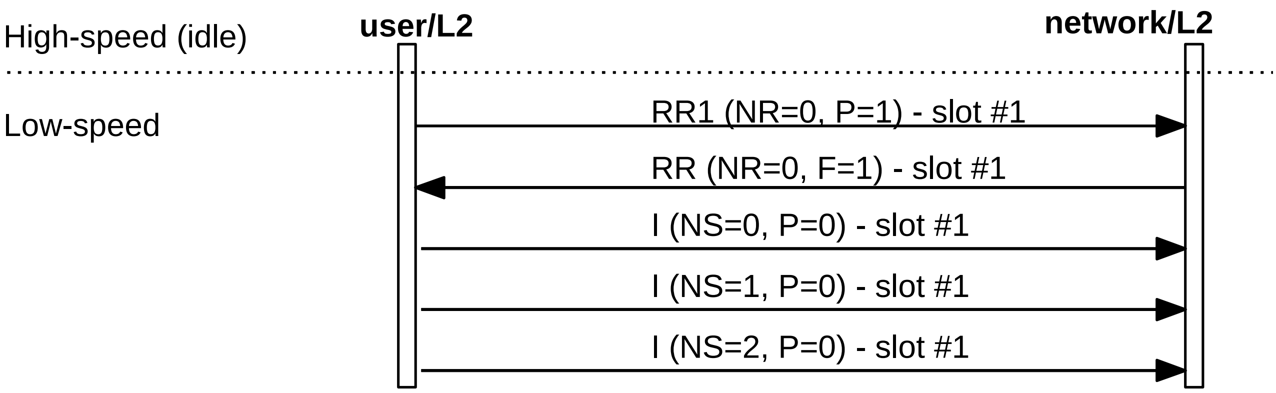


Figure 5.

2.2.1.2 High-speed (active) state

This state is dedicated to the transmission of I frames from the network to the user. The user is receiving in all three slots in this state (Figure 6).
Like in High-speed (idle) state, the user cannot transmit in this state, but
unlike High-speed(idle) state, the user cannot leave this state spontaneously.

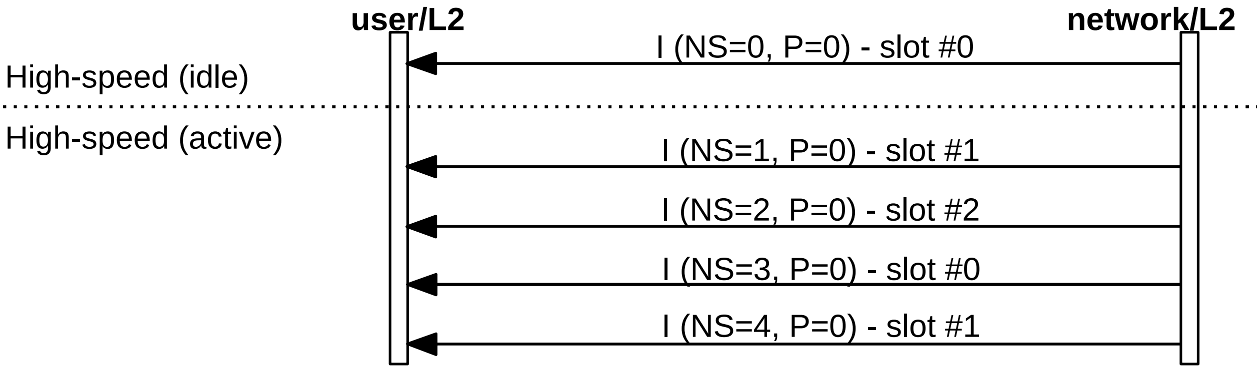


Figure 6.

2.2.1.3 Low-speed state

The Low-speed state is the only state where the user is able to transmit and receive.
This state is used for the following purposes:

- I frame transmission from the user to layer 2 on the network side (Figure 7). The network is also allowed to transmit I frames on dedicated slot at the same time (Figure 8).
- acknowledgement of I frames which have been received from network side in High-speed(active) state (Figure 9). The network is also allowed to transmit I frames on one slot at the same time (Figure 10).

In Low-speed state the user receives and transmits only in the dedicated slot.
The user transmits unnumbered and supervisory frames also in the Low-speed state.

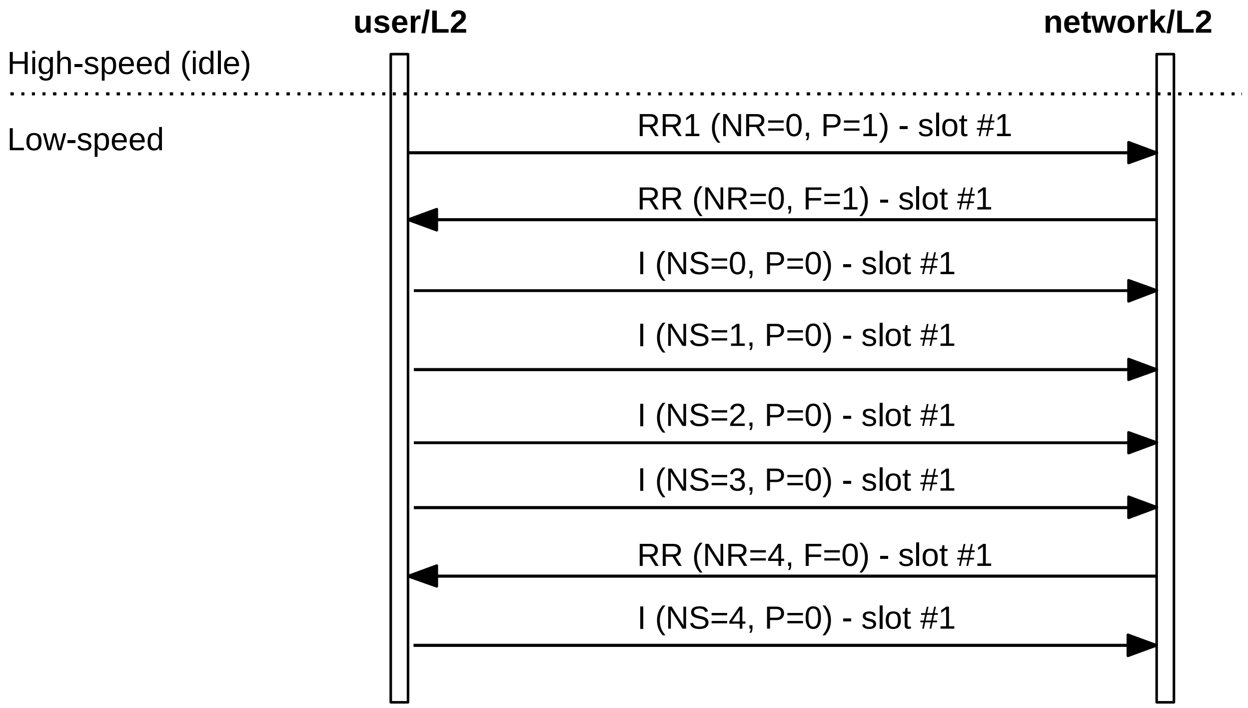


Figure 7.

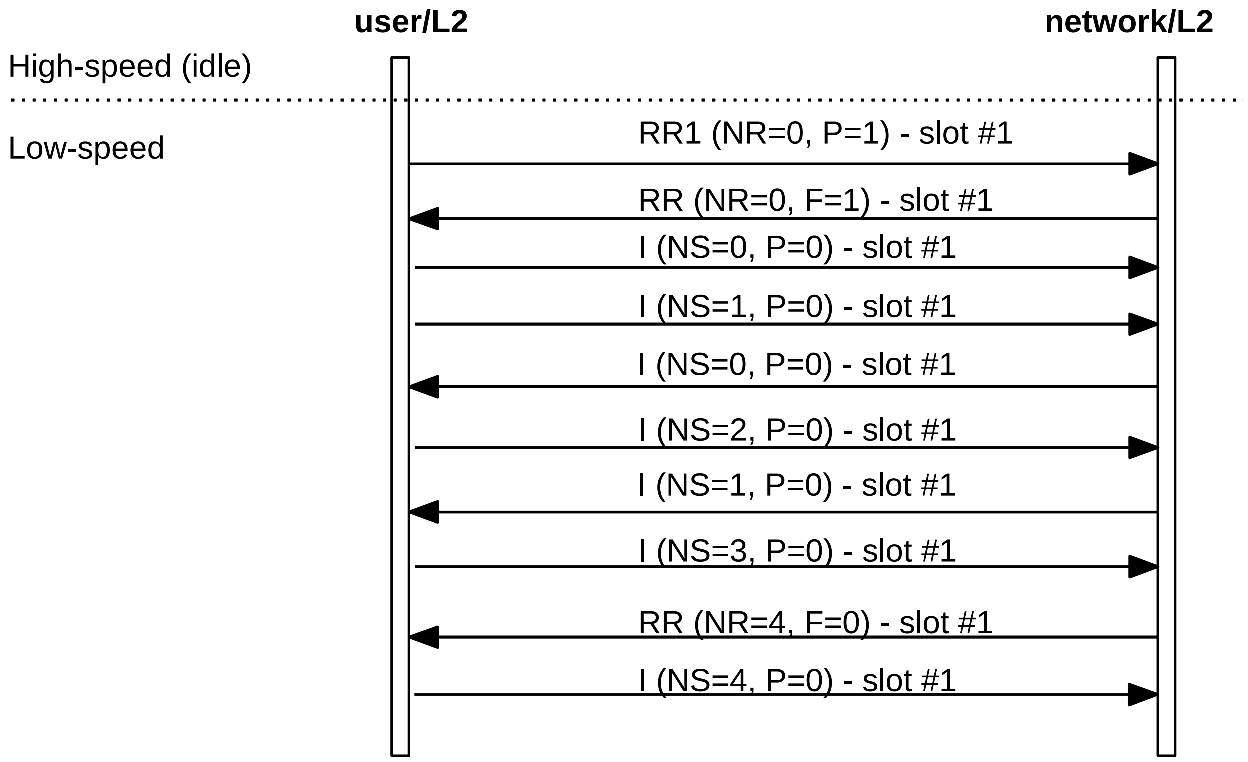


Figure 8.

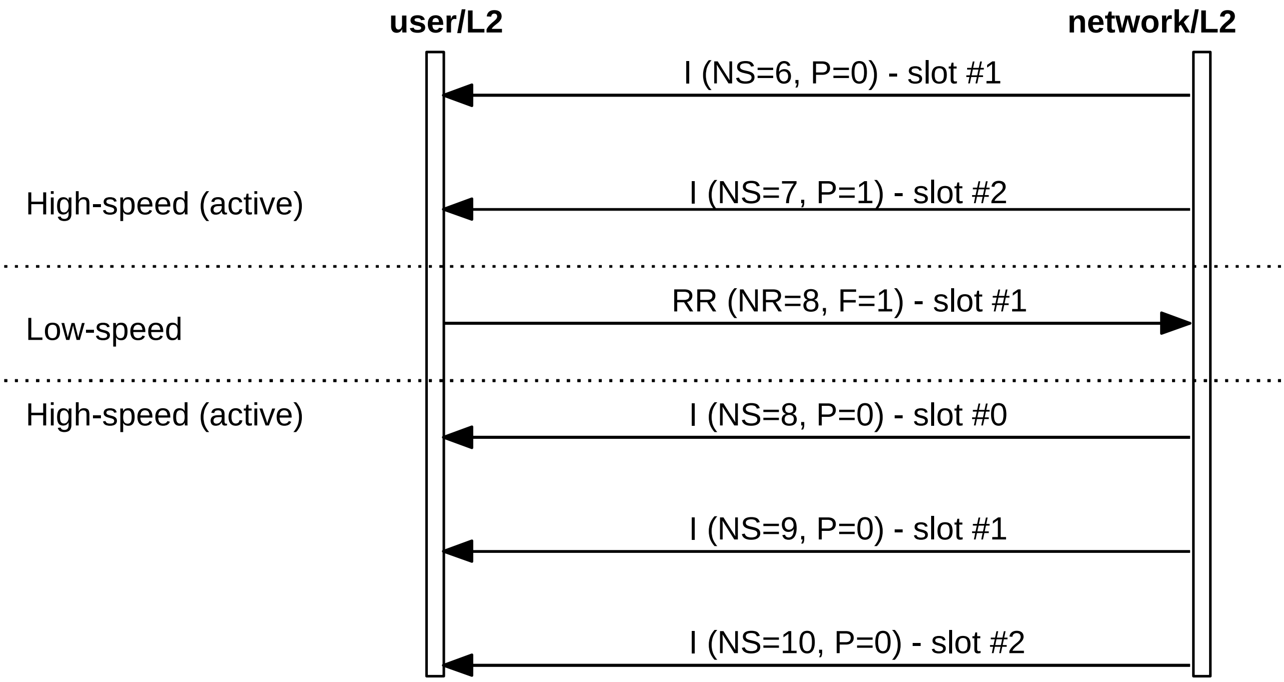


Figure 9.

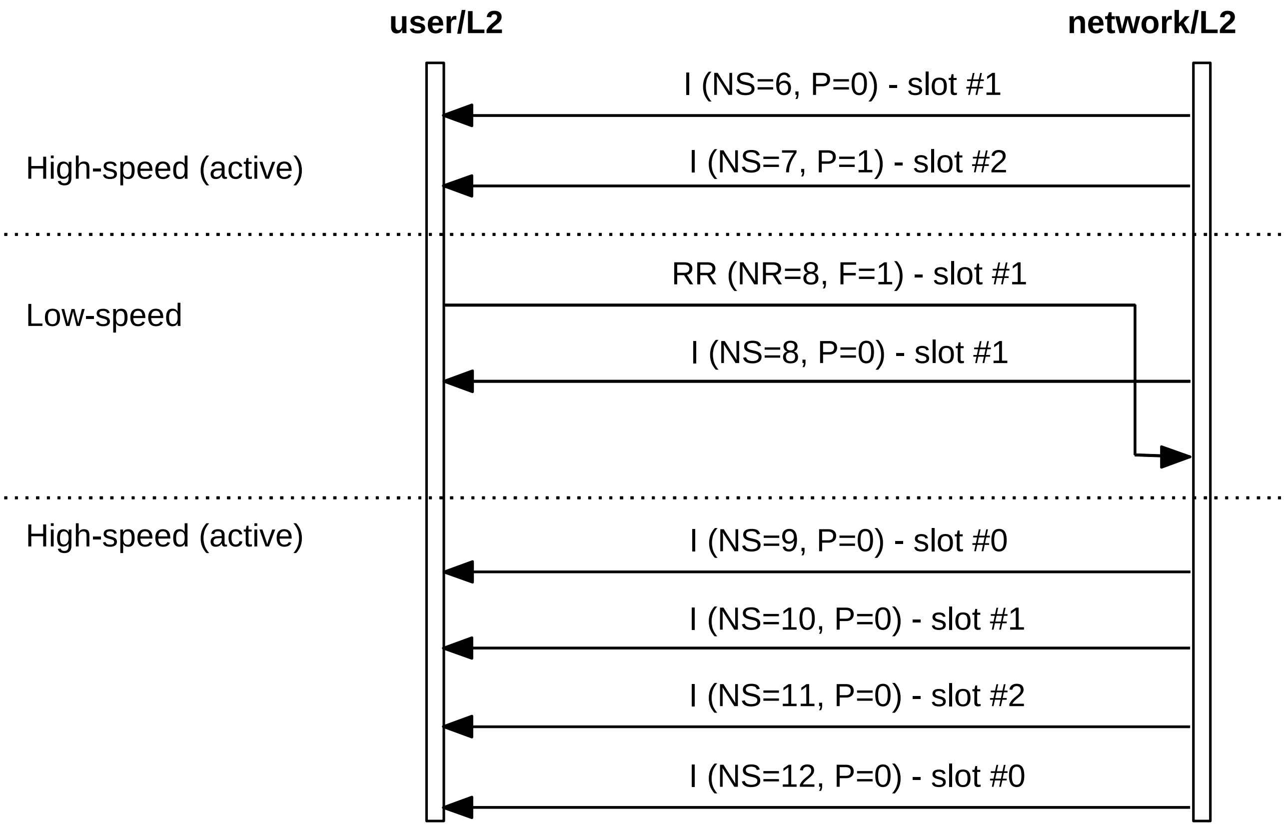


Figure 10.

2.2.2 Transmission method

The user side transmits in the Low-Speed state, only.

2.2.2.1 Transmission of I frames

2.2.2.1.1 Start of transmission

Depending on the state of the half-duplex communication state machine the user starts its transmission using two different methods:

Figure 11: If the Half-duplex communication state machine is in High-speed(idle) state it moves to Low-speed state and transmits an RR1 P=1 in order to prevent layer 2 on the network side from sending I frames in High-speed mode. When the user receives the RR F=1 from layer 2 on the network side it starts to transmit I frames. The RR1 P=1/RR F=1 sequence is monitored by the timer T200 on the user side.

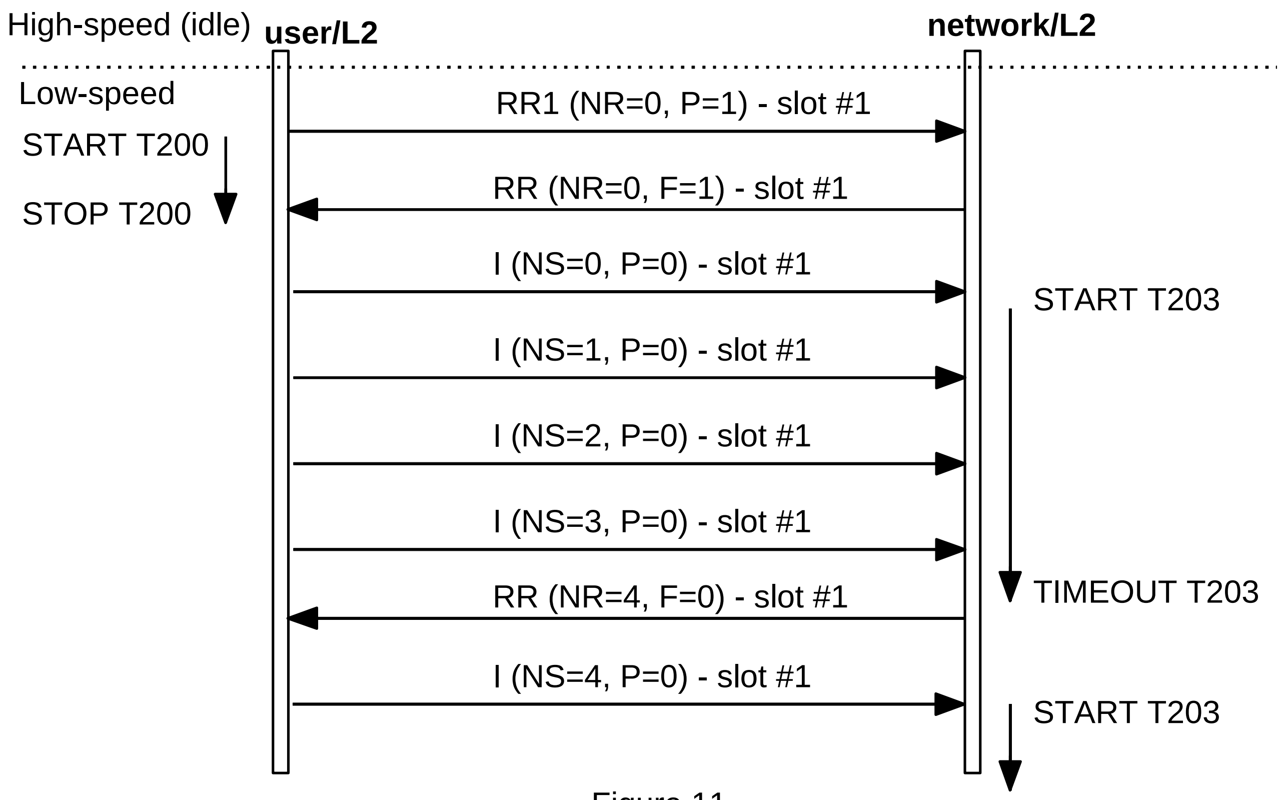


Figure 11.

Figure 12: If the Half-duplex communication state machine is in High-speed(active) state, layer 2 on the network side will request an acknowledgement from the user for the previously transmitted up to j I frames by transmitting the j-th I frame with P=1. In this case, the user may acknowledge the received I frames with an RR1 F=1 and can immediately start sending I frames.
However, the network may continue sending I frames in Low-speed mode, i.e. on the dedicated slot, until its maximum number of outstanding frames is reached.

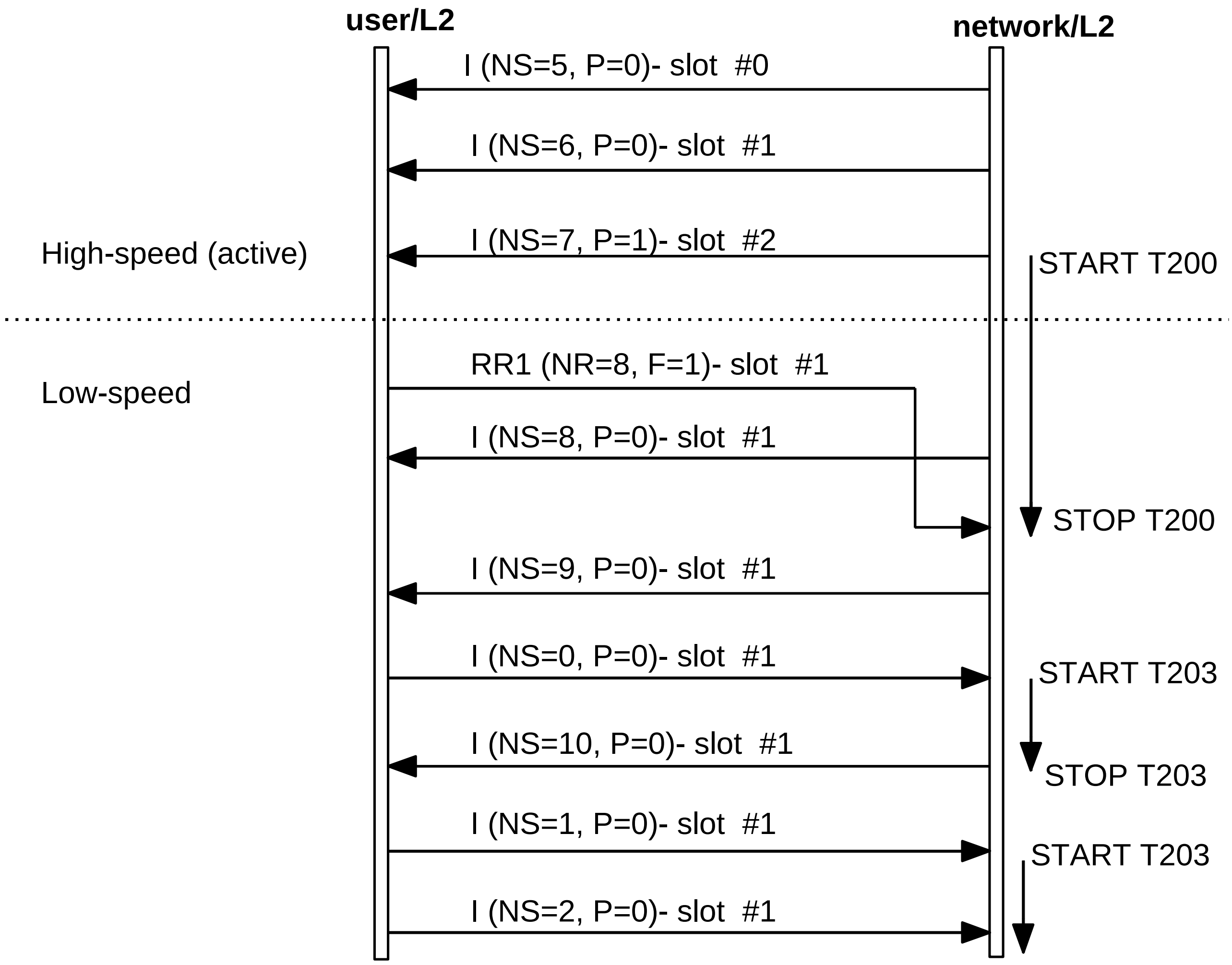


Figure 12.

2.2.2.1.2 Acknowledgement/retransmission mechanism

User layer 2 uses a sliding window when transmitting I frames (Section 4.2.2.5.6.1). For acknowledgement and retransmission control RR and SREJ/SREJ' frames are used as defined in Section 4.2.2.5.6.3.2 and Section 4.2.2.5.6.8.

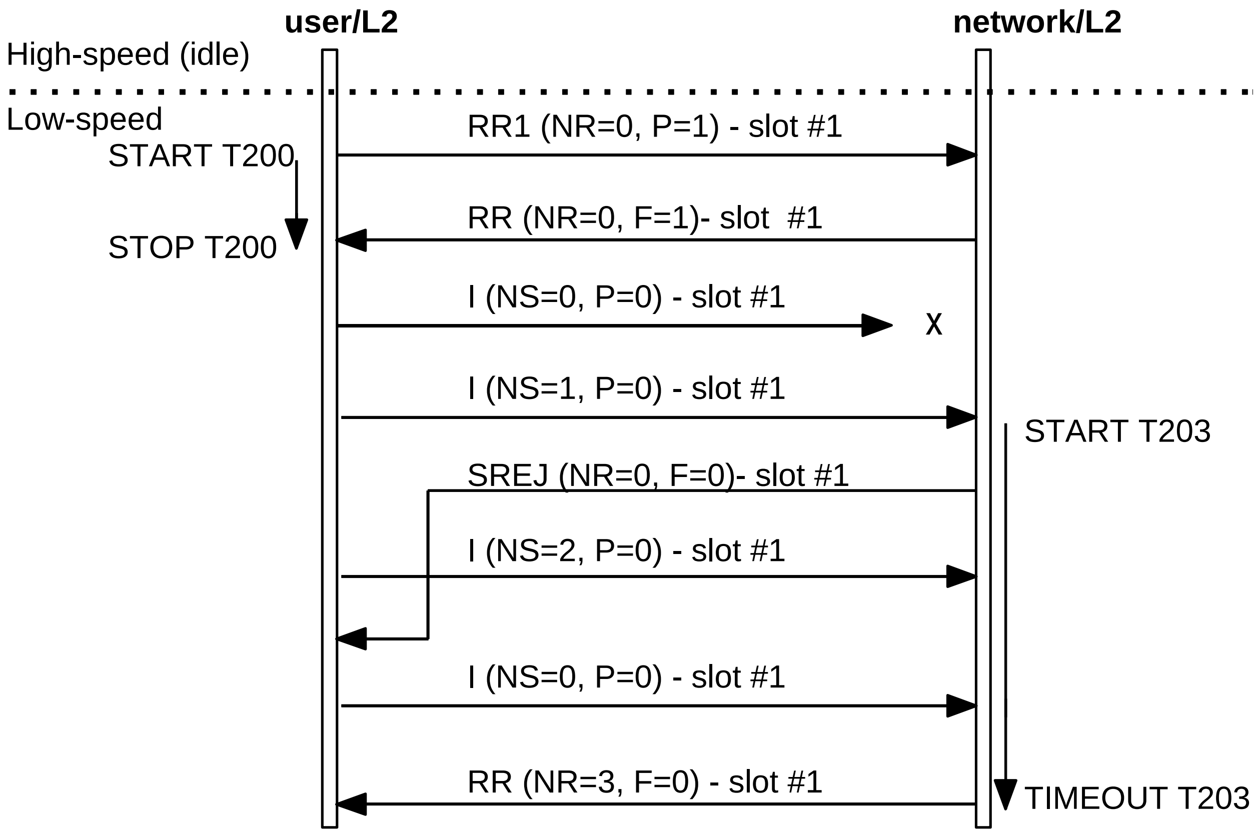


Figure 13.

2.2.2.1.3 Timer operation during transmission

The user operates T200 and layer 2 on the network side operates T203, (Figure 14).
T200 is not started at the transmission of the first I frame with a P = 0 rather than at the transmission of the I frame with P=1. The condition for sending an I frame with P=1 are:

- The maximum number of outstanding frames - windowsize k has been reached.
- The user has reached the last I frame in its current transmission. (The user has no more I frames waiting in its transmission queue.)

This transmission of the P=1 does not mean that the user gives away the initiative to send I frames.

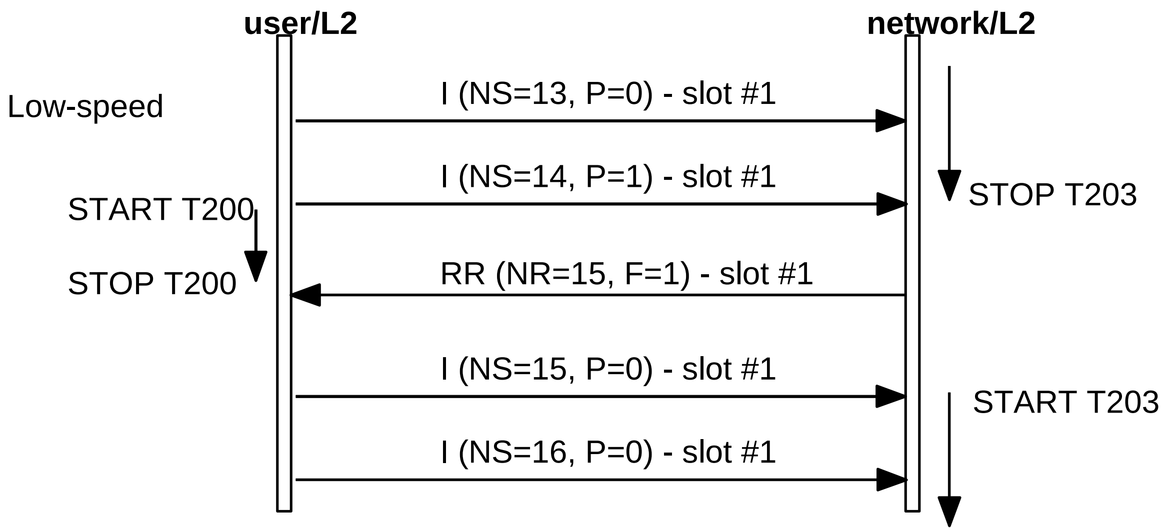


Figure 14.

2.2.2.1.4 End of transmission

The user stops its I frame transmission if the following event occurs:

- The user has no more I frames waiting for transmission.

The user will send an RR P=1 to the network and moves to the High-speed(idle) state (Figure 15).

The transmission of RR P=1 is monitored by the timer T200 on the user side.

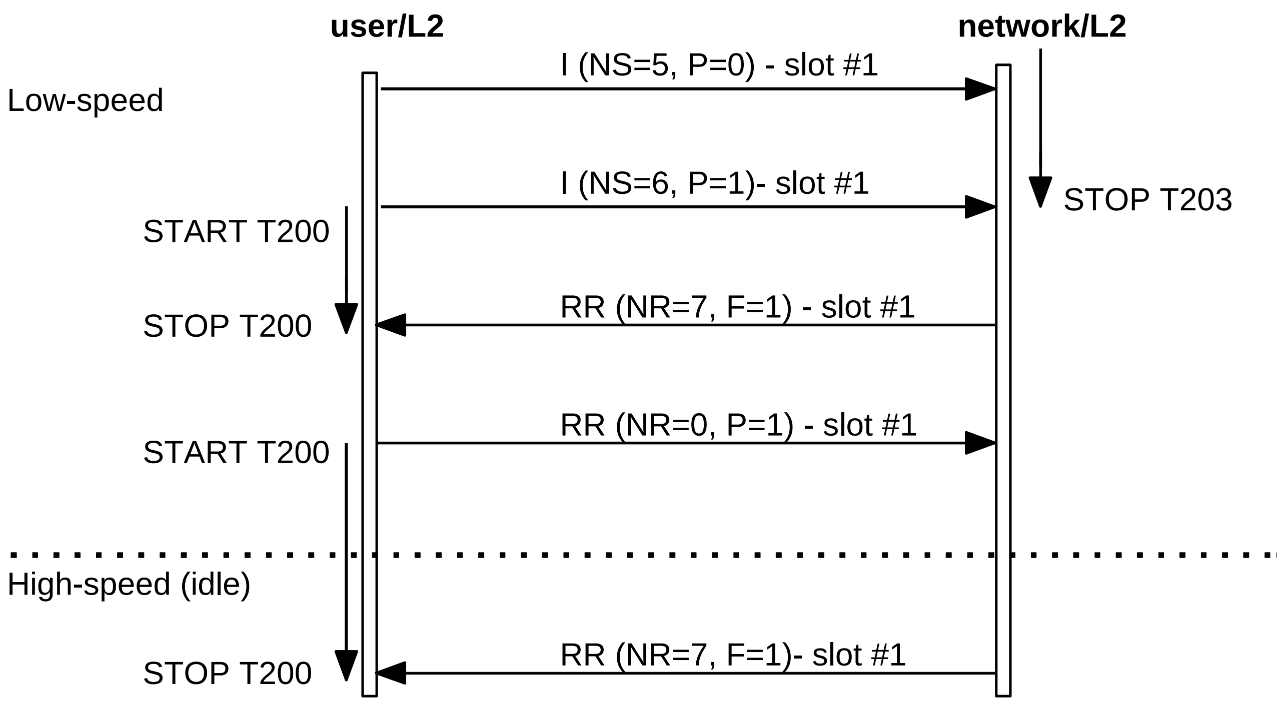


Figure 15.

2.2.2.2 Transmission of other frames

The user moves to Low-speed state from any state and transmits the frame required by the layer 2 protocol if one of the following events occurs:

- If the user receives a frame with P=1. In this case, the user has to answer immediately with F=1. Therefore it moves to Low-speed state and transmits the requested frame (Figure 16).
- If timer T200 times out. This may happen when the user is waiting for UA F=1 in High-speed(idle) state during link setup or if the user tries to resolve the 'ready-to-receive-in-Low-speed-mode' condition on the network side by sending RR P =1 (Figure 17).
- If, for some reason, the user transmits unnumbered frames (SABME, DISC, UI, FRMR). These frames are considered to have a high priority, hence they can interrupt an ongoing I frame transmission (Figure 18).
- If the user receives an SABME from layer 2 on the network side.

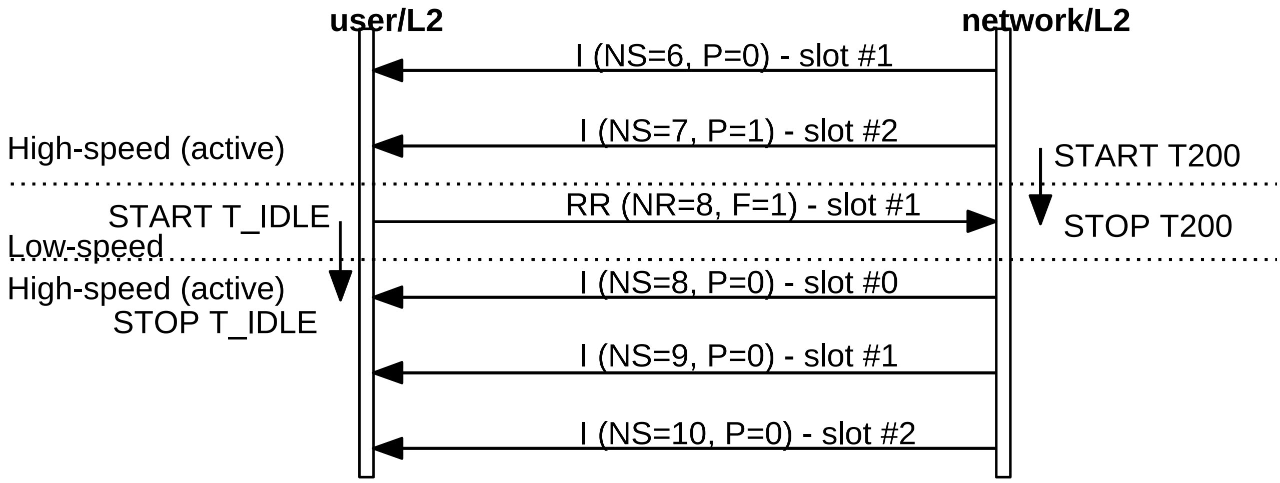


Figure 16.

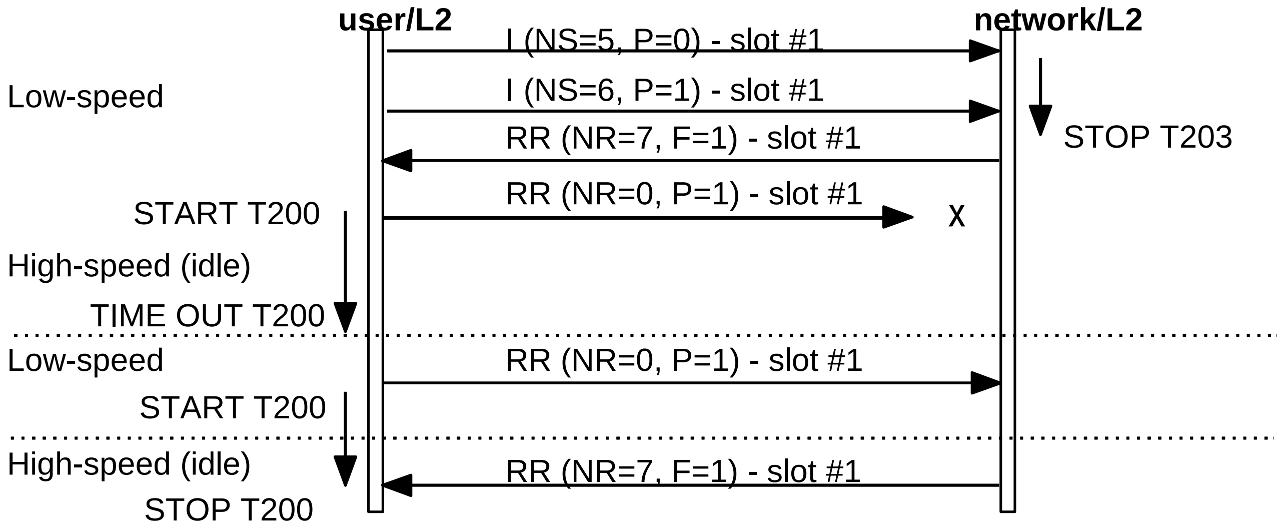


Figure 17.

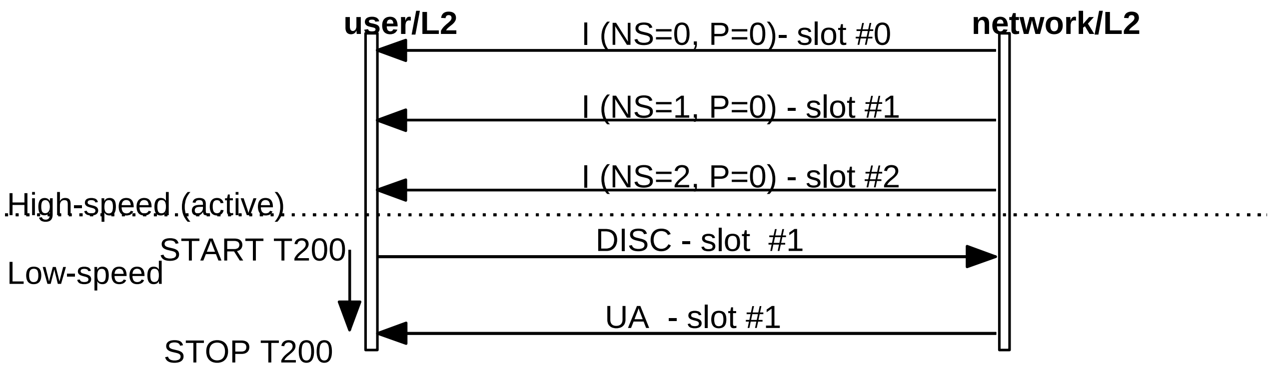


Figure 18.

2.2.3 Reception method

2.2.3.1 Reception of I frames

I frames shall be received in the High-speed mode which utilizes up to three slots. However, I frames received in the Low-speed mode shall not be discarded but shall be processed according to the LAPDM operation.

2.2.3.1.1 Start of reception

If the user receives an I frame in High-speed(idle) state, user layer 2 moves to High-speed(active) state (Figure 19).

If user layer 2 is already in High-speed(active) state it stays there and stops the timer T_IDLE if the timer is running (Figure 20).

If user layer 2 is already in Low-speed state it does not change its state (Figure 21).

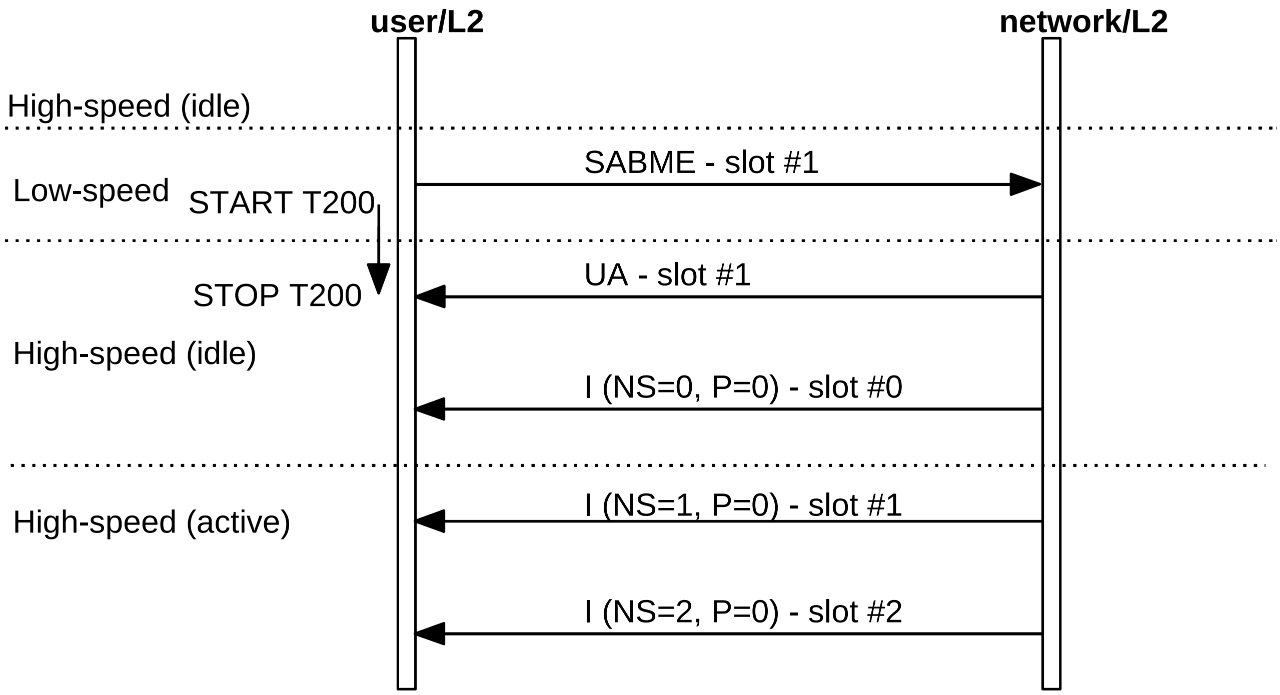


Figure 19.

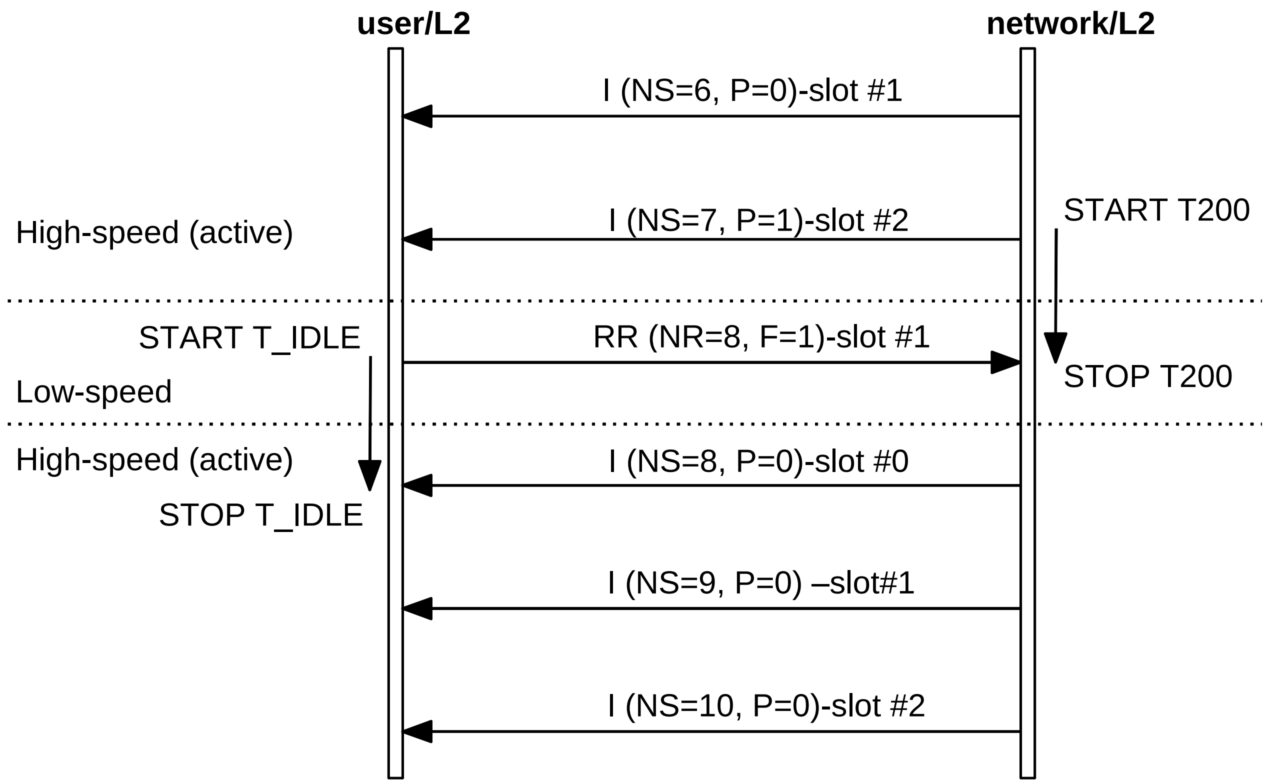


Figure 20.

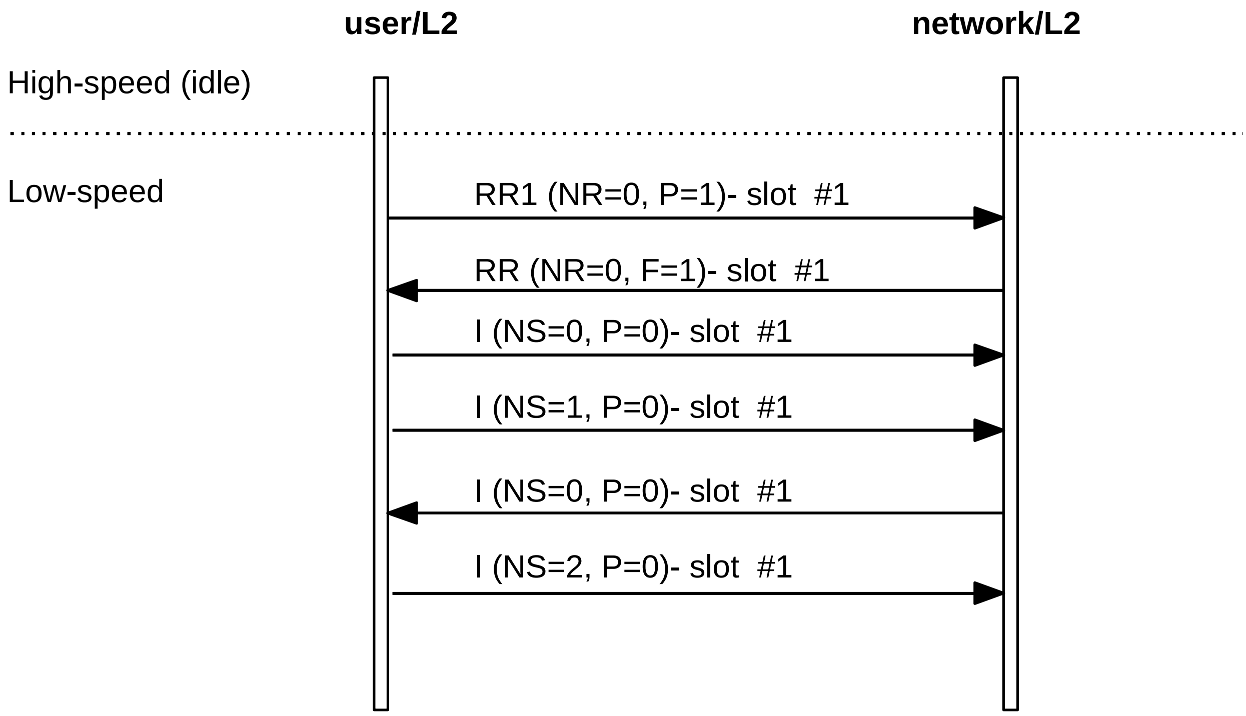


Figure 21.

2.2.3.1.2 Acknowledgement/retransmission mechanism

The user does not acknowledge received I frames without being explicitly asked to acknowledge by receiving a frame containing a P bit set to one, i.e. timer T203 is not used on the user side. Each unsynchronized (to the network) acknowledgement, i.e. transmission of a frame in Low-speed mode, results in a potential loss of I frames.

Even if the user detects that one or more I frames are missing in an I frame sequence in High-speed (active) state it does not send immediately the request for re-transmission to layer 2 on the network side. The SREJ frames are sent only after having received an I frame with P = 1. After the SREJ frames have been sent the RR/RR1 F =1 is transmitted to answer the outstanding P =1 to layer 2 on the network side. The retransmissions of the I frames from layer 2 on the network side are performed in High-speed(active) state (Figure 22, Figure 23, Figure 24) unless the user acknowledges the P=1 with an RR1 F=1 (Figure 25).

The handling of the receive queue after having received an I frame with P=1 in Half-duplex mode is as follows:

- I frame with P=1 does not reset the receive queue.

Note: The acknowledgement/retransmission mechanism described above shall be used even for I frames which are transmitted in Low-speed state by the network.

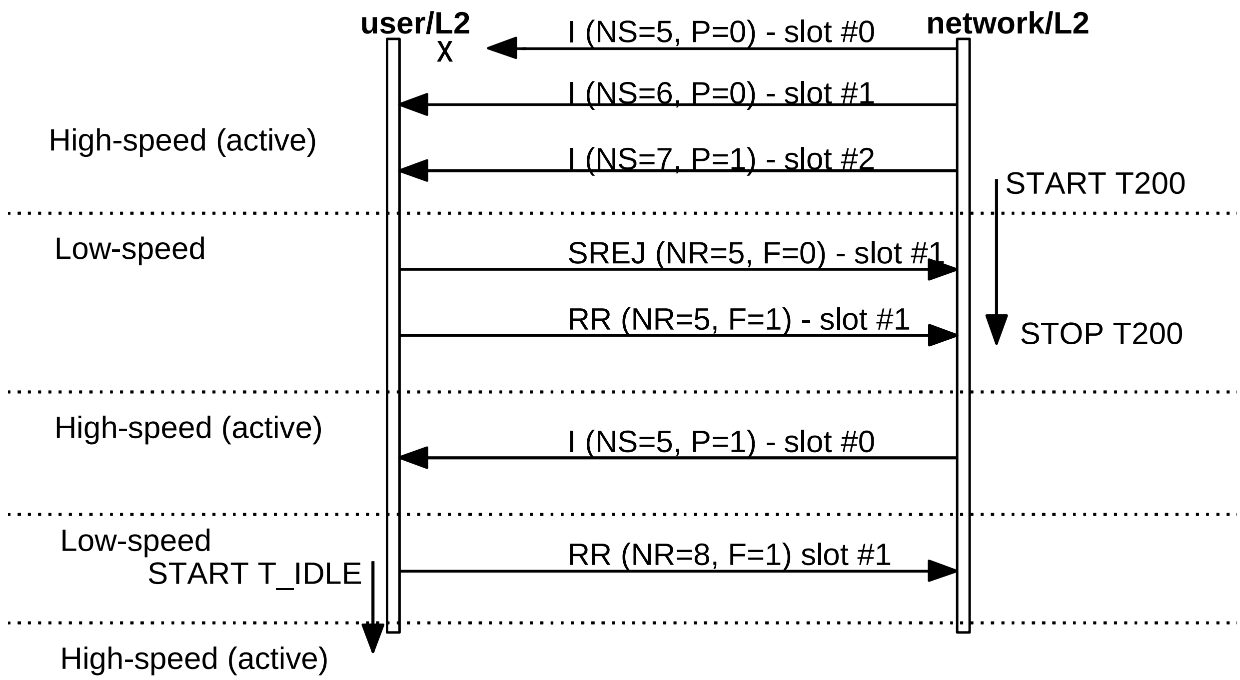


Figure 22.

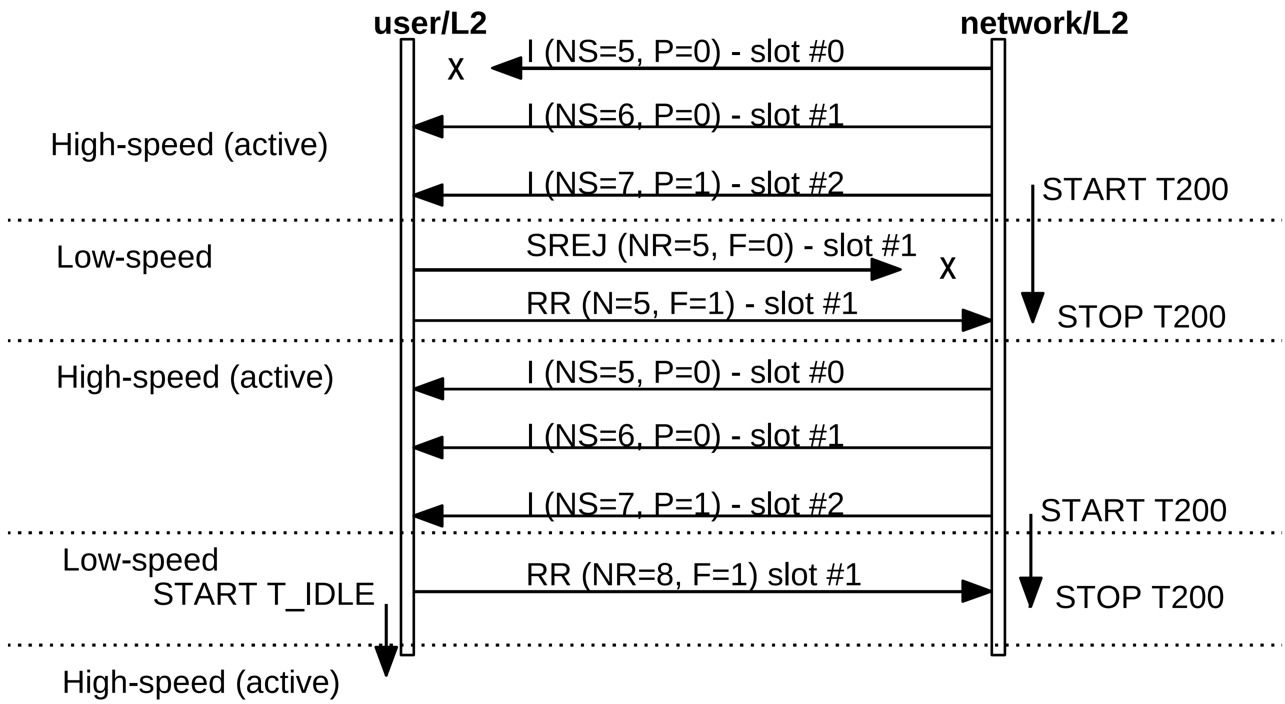


Figure 23.

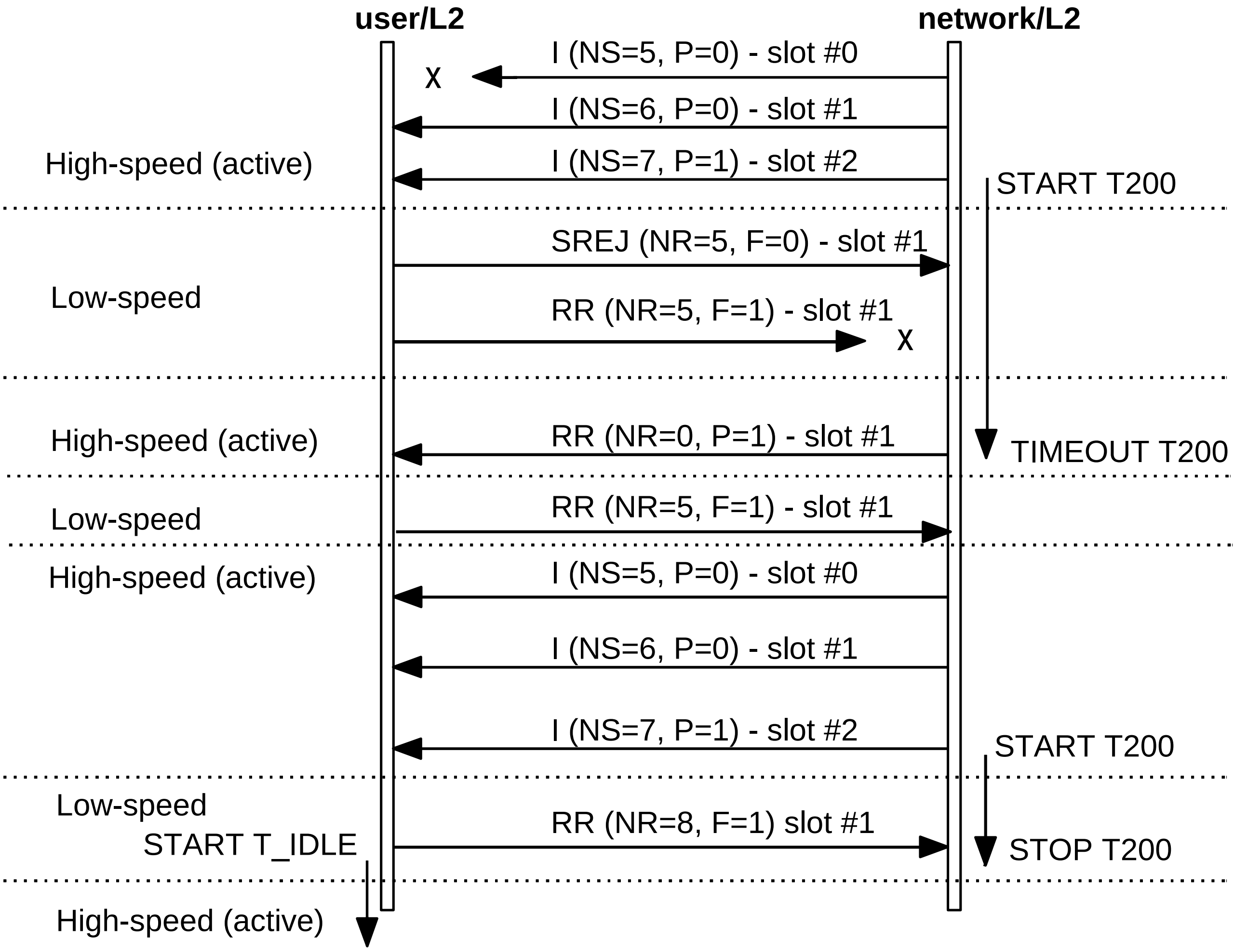

user/L2
network/L2
I (NS=5, P=0) - slot #0
X
I (NS=6, P=0) - slot #1
I (NS=7, P=1) - slot #2
High-speed (active)
START T200
SREJ (NR=5, F=0) - slot #1
Low-speed
RR (NR=5, F=1) - slot #1
X
High-speed (active)
RR (NR=0, P=1) - slot #1
TIMEOUT T200
Low-speed
RR (NR=5, F=1) - slot #1
High-speed (active)
I (NS=5, P=0) - slot #0
I (NS=6, P=0) - slot #1
I (NS=7, P=1) - slot #2
START T200
Low-speed
START T_IDLE
RR (NR=8, F=1) slot #1
STOP T200
High-speed (active)

Figure 24.

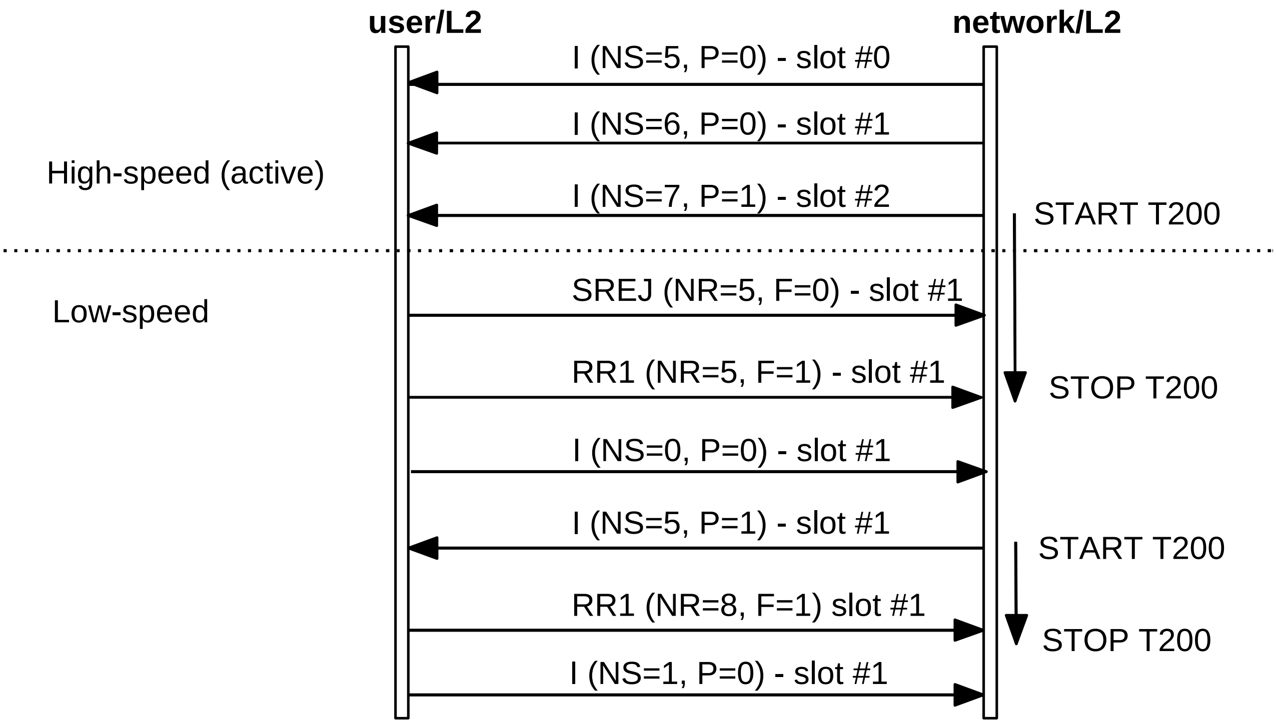


Figure 25.

2.2.3.1.3 End of reception

The transmission of I frames from the network to the user can be ended in two different ways:

(1)User layer 2 receives a DL_DATA_REQ from a higher layer during the ongoing I frame reception. As soon as it receives the frame which contains the P=1 the user moves to Low-speed state where it acknowledges the received I frames with an RR1 F=1 and starts to transmit I frames by itself (Figure 26).

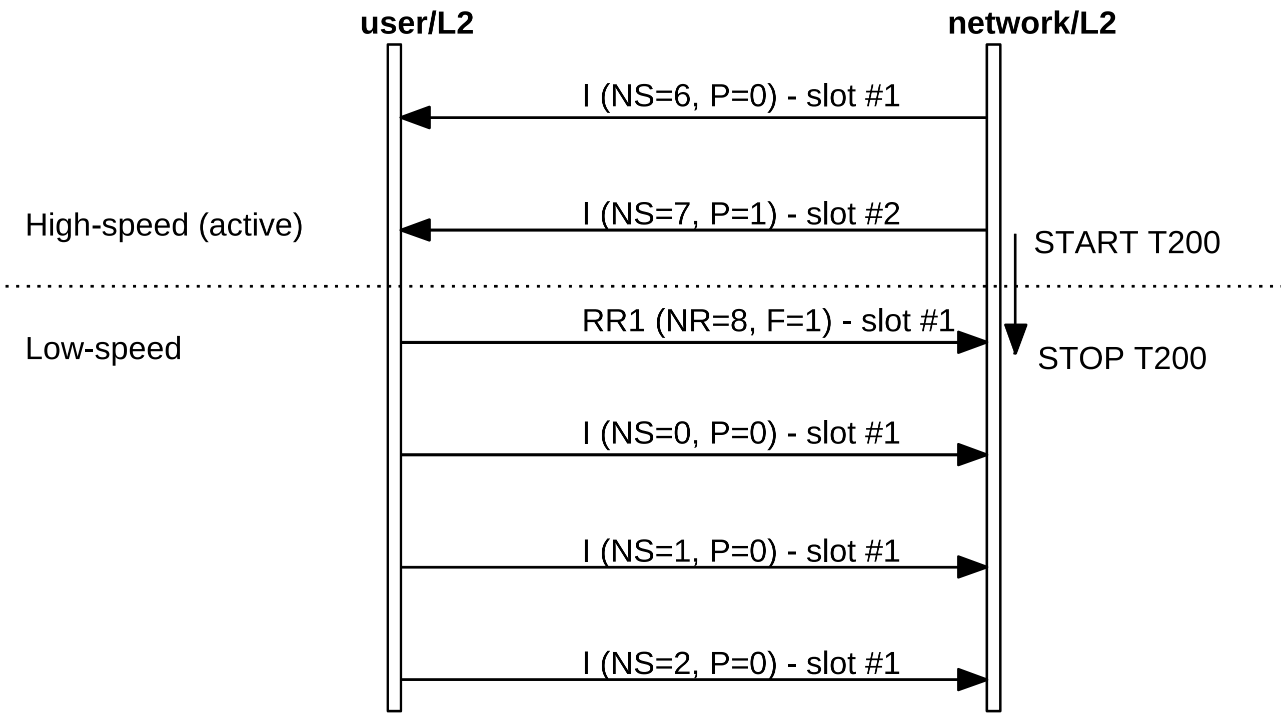


Figure 26.

(2)The user has received the last I frame from layer 2 on the network side containing P=1 and therefore it moves to Low-speed state where it transmits the RR F=1. Then, it returns to High-speed(active) state where it starts the timer T_IDLE. Because layer 2 on the network side will not transmit more I frames this timer will not be stopped. Upon expiry of T_IDLE user layer 2 will move to High-speed(idle) state (Figure 27).

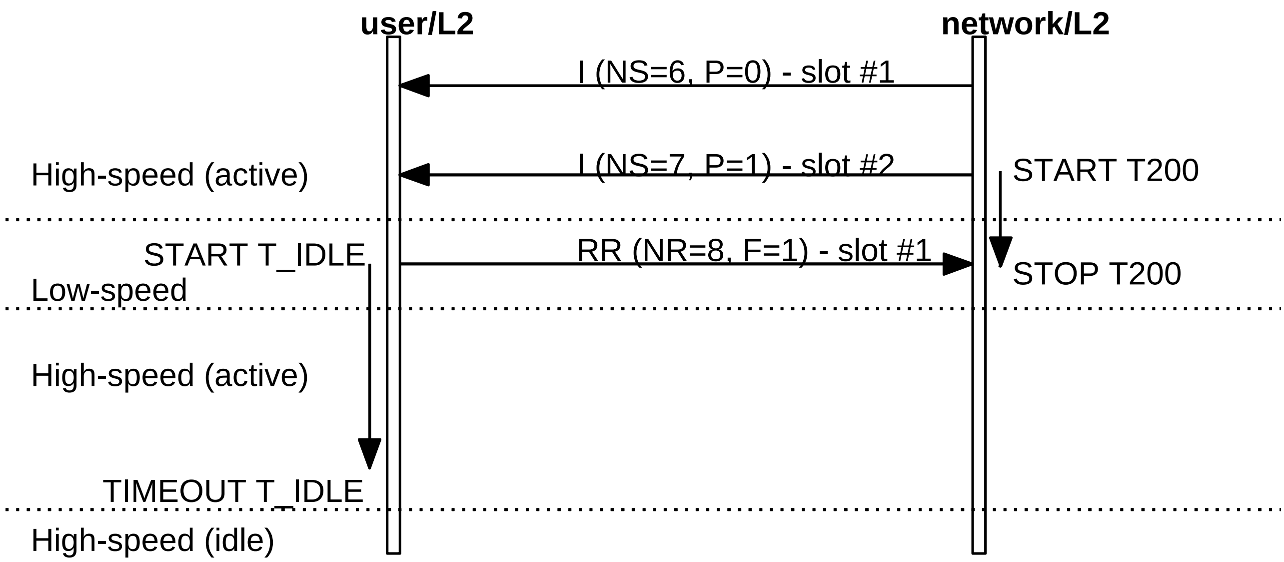


Figure 27.

2.2.3.2 Reception of other frames

Other frames than I frames shall be received by the user in single slot mode and in the dedicated slot.

2.2.3.2.1 Timer operation

Timer operation in High-speed (active) state is as follows: The user does not operate an acknowledgement hold timer (T203).
In addition to other layer 2 timers described in the main text, the timer T_IDLE is used. This timer is described in Section 2.2.4.3.

2.2.4 Layer 2 parameters for Half-duplex communication

2.2.4.1 Timer T200

Timer T200 started at the transmission of a frame with a P bit set to one. It is stopped at the reception of a frame with F bit set to one, accordingly. T200 is not started at the transmission of an I frames with P=0. Only I frames with P=1 are monitored.
The default value is the same as defined in Table 4.2.2.5.-3.

2.2.4.2 Timer T203

Timer T203 is not used on the user side in Half-duplex mode.

2.2.4.3 Timer T_IDLE

The timer T_IDLE is operated on the user side, only, in Half-duplex mode. T_IDLE defines the time for which the user is not allowed to transmit I frames, i.e. it defines the maximum time for which the user can stay in High-speed(active) state without receiving an I frame.

The timer T_IDLE is started when the user enters the High-speed(active) state. This happens:

- after it has transmitted the acknowledgement(RR F=1) for a number of I frames previously transmitted by the network.

The timer T_IDLE is stopped:

- when the user leaves the High-speed (active) state in order to transmit a frame (T200 timeout, received frame with P =1) or,
- when the user receives an I frame in High-speed(active) state.

Upon the timeout of T_IDLE the user move to High-speed(idle) state.

The value for T_IDLE will be specified by the network.

2.2.4.4 Other parameters

The other layer 2 parameters, i.e. N200, N201, k and T202, operate and have the same default values as defined in Table 4.2.2.5.-3.

2.2.5 Layer 2 control of Half-duplex communication states

The states of the layer 2 protocol state machine on the user side may be considered as belonging to two groups:

- Group 1: The Half-duplex state is unchanged as long as the layer 2 protocol state machine on the user side does not change its state. The relevant states in both state machines are:

Table 1.

layer 2 state	**Half-duplex communication state**
1 Multiple frame unestablished state	Low-speed state
2 Standby for link release	Low-speed state
3 Standby for link establish	High-speed(idle)
4 Link stop	depends on the state in which layer 2 has been stopped

The signals issued by layer 2 in order to switch layer 1 into the mode according to Table 1 are not explicitly shown in the SDL diagrams on the user side. Whenever the layer 2 protocol state machine enters one of the states mentioned above it shall issue the appropriate signals to layer 1 according to Table 1.

- Group 2: The Half-duplex state is changed depending on the operation of the layer 2 protocol state machine on the user side. The states which belong to this group are: Multiple frame established and Timer recovery. When the layer 2 protocol state machine is in either of these two states the Half-duplex communication can be in one of the state: Low-speed state, High-speed(active) state or High-speed(idle) state. In these cases, the signals issued by layer 2 in order to switch layer 1 to the relevant mode are shown in the SDL diagrams for the user side.

2.3 Layer 3

The layer 3 operation of the Half-duplex packet communication method is the same as specified in the main text of this standard.

3 Operation at the network side

3.1 Layer 1

3.1.1 L1 modes for Half-duplex packet communication

Layer 1 on the network side operates in two different modes:

- High-speed mode: The network is allowed to transmit on all slots comprising the packet physical channel (up to three slots) in the downlink direction. Which slot is used is specified by each particular PH_DATA_REQ.
- Low-speed mode: The network uses only the pertinent slot for transmission.

For the reception, the network uses only the dedicated slot during Half-duplex packet communication.

3.1.2 Transmission method

Layer 1 on the network side transmits either on the dedicated slot or on all slots comprising the packet physical channel.
Therefore, the PH_DATA_REQ received from layer 2 on the network side contains the information on whether this layer 2 frame must be transmitted on the dedicated slot in Low-speed mode or in High-speed mode.

3.1.3 Reception method

Layer 1 on the network side receives on all slots comprising the packet physical channel all the time.

3.2 Layer 2

3.2.1 Overview

The layer 2 state machine described in the main text of this standard has to be modified in order to be able to follow the operation of the Half-duplex state machine on the user side. Layer 2 on the network side must retrieve the information about the Half-duplex state on the user side to determine the way a particular I frame shall be sent (either on the dedicated slot or on any of all slots comprising the packet channel).
In order to ensure that supervisory and unnumbered frames are transmitted only on the dedicated slot and I frames are transmitted either on all slots comprising the packet physical channel or on the dedicated slot, only, layer 2 on the network side has to be modified in its interface towards layer 1 so as to be able to specify on which slot a particular frame will be transmitted.

3.2.2 L2 states for Half-duplex packet communication

Layer 2 on the network side operates in two different states:

- High-speed state: The network is allowed to transmit I frames on all slots comprising the packet physical channel (up to three slots) in the downlink direction.
- Low-speed state: The network transmits I frames in the dedicated slot, only.

Any other frames, i,e, supervisory and unnumbered frames will always be transmitted in the dedicated slot, only(in Low-speed mode).

In order to ensure the utilization of the maximum number of slots in *High-speed state* layer 2 must specify PH_DATA_REQ whether it has to be transmitted in the dedicated slot or whether it can be transmitted in any of the slots comprising the packet physical channel.

In the SDL diagrams for the network side, two procedures are shown where the signals sent to layer 1 indicate, whether I frames can be sent on any of the slots comprising the packet physical channel (High-speed state) or whether I frames must be sent on the dedicated slot, only (Low-speed state).

As a restriction for the network side, layer 2 shall not transmit any I frames in High-speed mode while the user is transmitting.

3.2.3 Transmission method

The network transmits I frames in High-speed mode unless one of the following events happens:

- The network receives an RR1 frame from the user, which means that the user is no longer ready to receives on all slots(Figure 29).

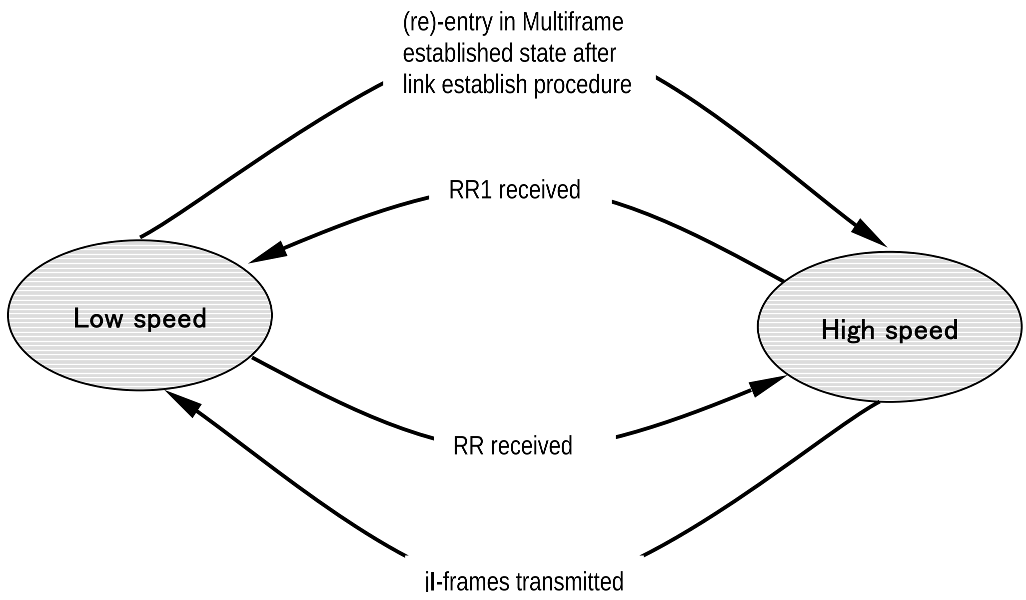


Figure 28 Half-duplex states on the network side

- The number of I frames transmitted by the network in High-speed mode has reached the number j (Figure 30).

After one of these events occurs, the network transmits I frames using the Low-speed mode until it receives an RR from the user. Then, the network can resume the transmission in High-speed mode.

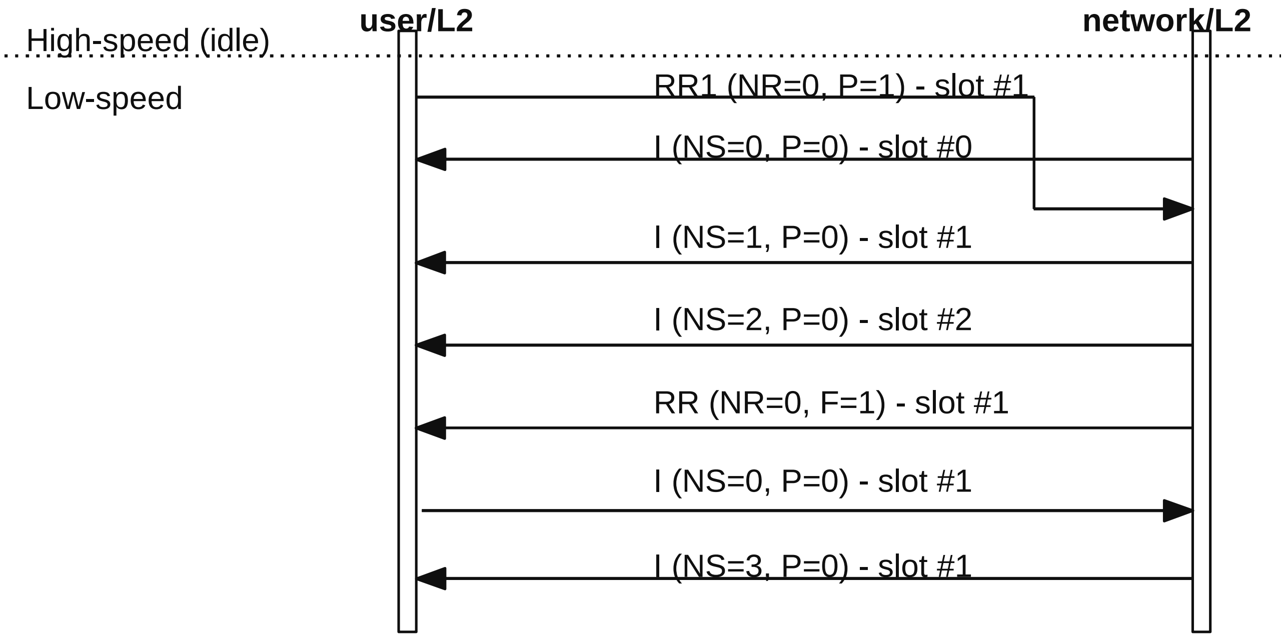


Figure 29.

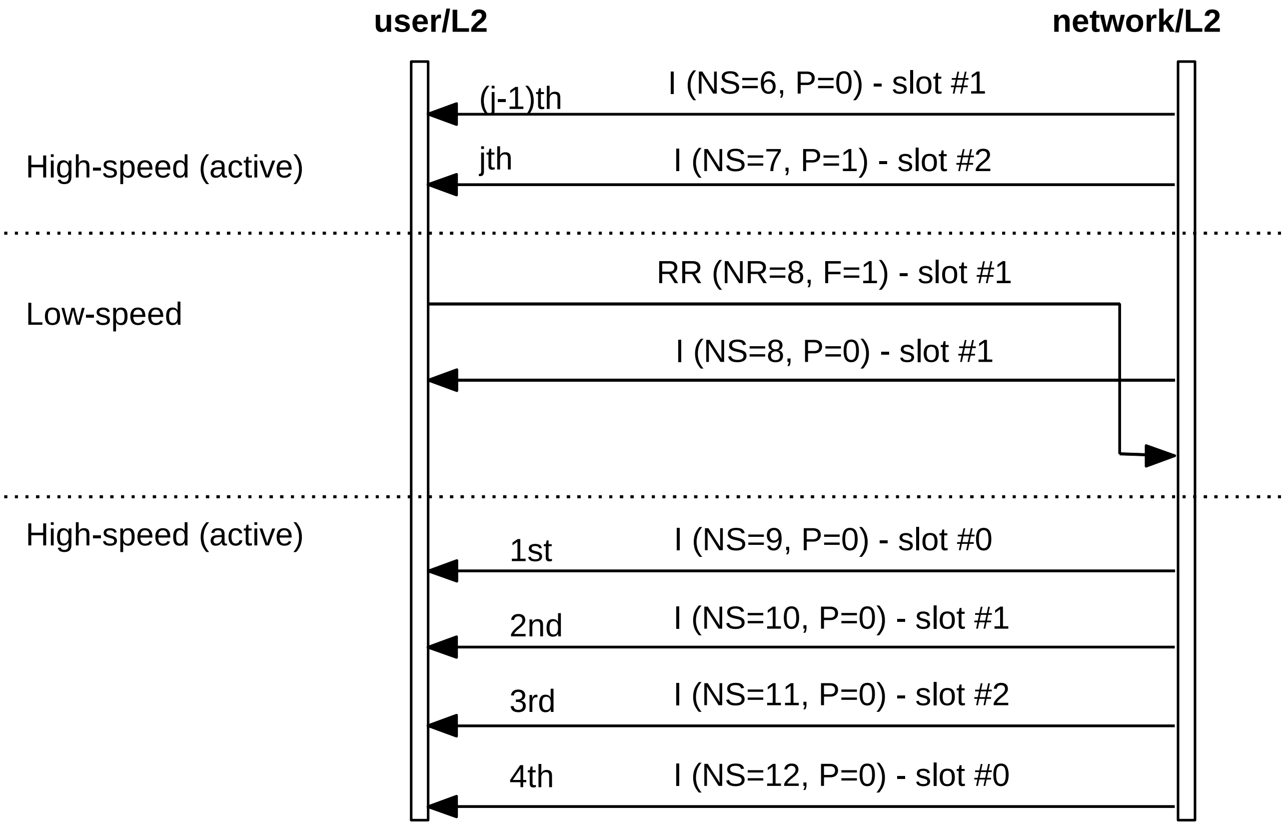


Figure 30.

A change to the layer 2 operation described in the layer 2 specification of the main text is the setting of the P bit to one in the last transmitted I frame.

The conditions for setting the P=1 in an I frame are:

- The number of transmitted I frames in High-speed mode has reached the number j (Figure 30). However, the network is still allowed to continue its I frame transmission in Low-speed mode.
- The maximum number of outstanding frames (windowsize k) has been reached (Figure 31).
- Layer 2 on the network side reaches the last I frame waiting in its transmission queue (Figure 32).

If the transmission of P=1 is impossible the I frame which would contain the P=1 is held back until the transmission of P=1 becomes possible (timeout of T200 or F=1 received).

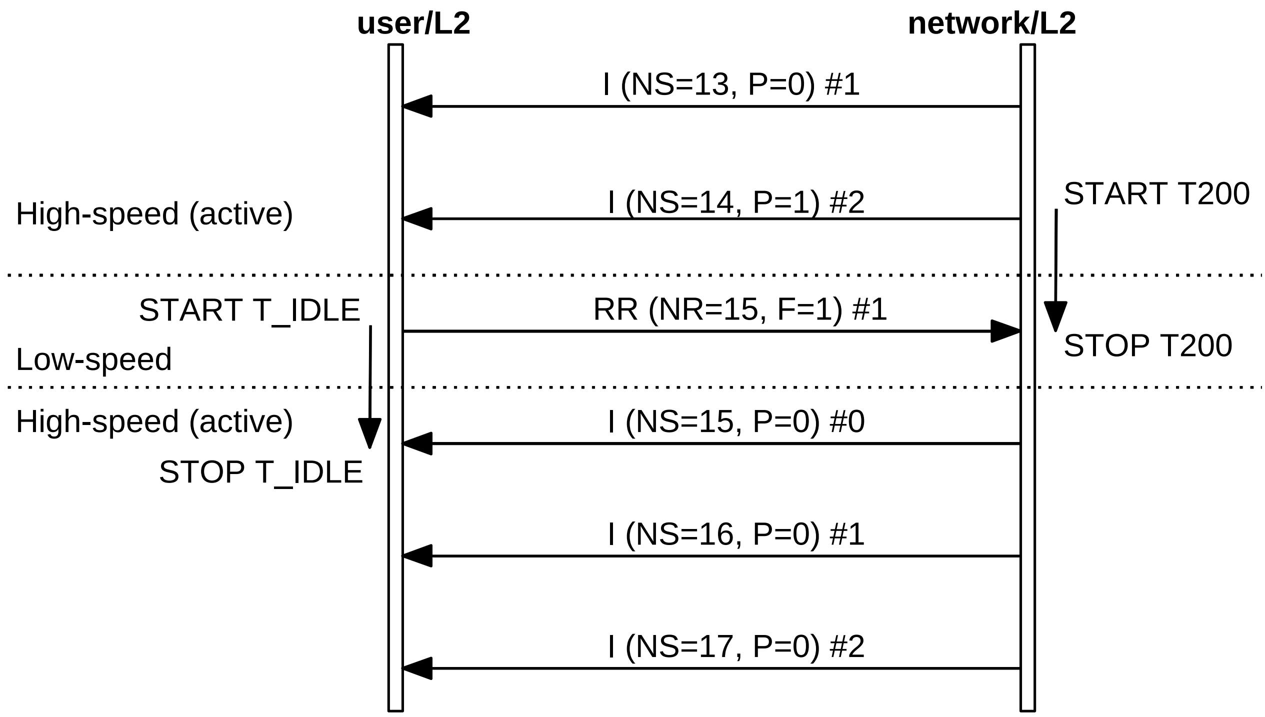


Figure 31.

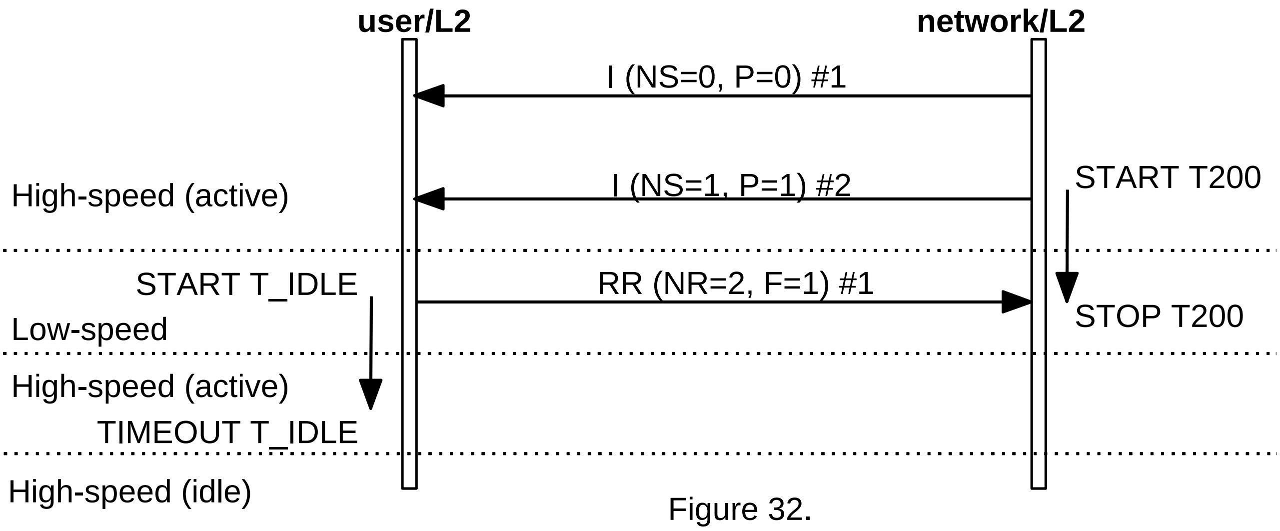


Figure 32.

After the transmission of P=1 in the jth I frame when layer 2 on the network side waits for an acknowledgement of the transmitted I frames or requests for retransmission, respectively, the network is still allowed to transmit I frames within its transmission window until the transmission of the I frame would require the setting of P=1 because the maximum number of outstanding frames has been reached
However, a retransmission of I frames requested by SREJ/SREJ' by the user shall not start before the RR/RR1 F=1 is received (Figure 33).

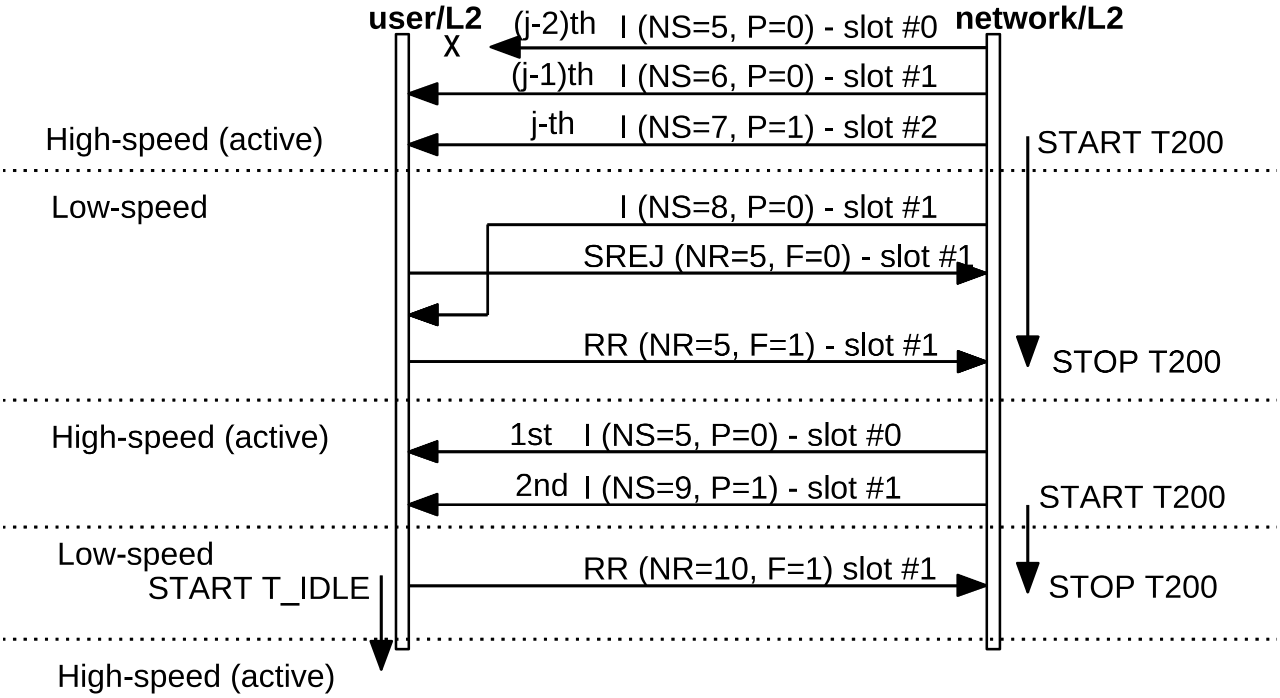


Figure 33.

Layer 2 on the network side shall not rely upon the reset of the receive queue in the user when it transmits an I frame with the P bit set to one.

In all other aspects the layer 2 transmitter on the network side behaves accordingly to the layer 2 protocol defined in the main text.

3.2.4 Reception method

On the reception of an I frame from the user layer 2 on the network side shall stop its currently ongoing I frame transmission in High-speed mode (Figure 34). (However, the network is still allowed to transmit in Low-speed mode.)

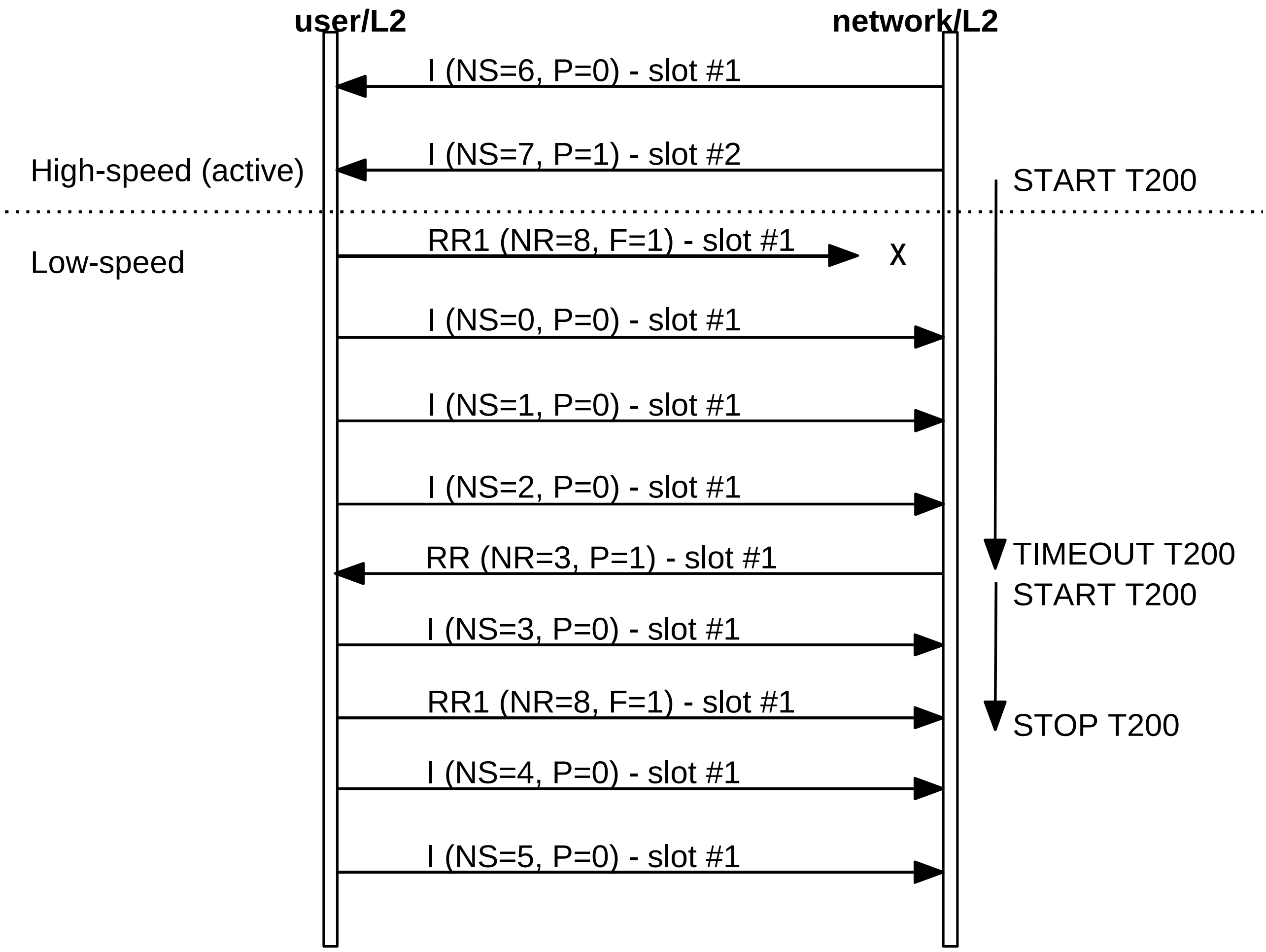


Figure 34.

Network layer 2 shall not reset its receive queue when the network receives an I frame containing a P bit set to one.

In all other aspects the layer 2 receiver on the network side behaves accordingly to the LAPDM protocol defined in the main text of this Standard.

3.2.5 Layer 2 parameters for Half-duplex mode

3.2.5.1 Timer T200

Timer T200 started at the transmission of a frame with a P bit set to one. It is stopped at the reception of a frame containing a F bit set to one, accordingly. T200 is not started at the transmission of an I frame with a P bit set to zero. Only I frames with a P bit set to one are monitored. The default value shall be the same as defined in the main text of this Standard.

3.2.5.2 Maximum number of I frames transmitted in High-speed mode (j)

j defines the maximum number of I frames which the network is allowed to transmit consecutively in High-speed mode.
The jth I frame is transmitted with P=1. After j is reached the network can continue its I frame transmission in Low-speed mode until the maximum number of outstanding I frames is reached.

The value for j can be set by the network. However, the maximum value of j is equal to the maximum number of outstanding frames (k).

3.2.5.3 Other parameters

The other layer 2 parameters, i.e. N200, N201, N202, k, T201, T202 and T203 operate and have the same default values as defined in the main text of this Standard.

3.2.6 Conditional receive ready (RR1) command/response

Layer 2 on the network side supports the Conditional receive ready (RR1) command/response defined in the main text of this standard. Whenever the RR1 command/response is received the network stops its possibly ongoing transmission in High-speed mode and does not resume to transmit in High-speed mode until an RR command/response is received from the user.

3.3 Layer 3

Layer 3 operation is the same as specified in the main text of this Standard.

3.4 Implications on the network side for support of Half-duplex communication

This annex does not support switching between Half-duplex and Full-duplex mode. Therefore all layer 2 entities between which the user may perform a reselection without re-establishing the layer 2, i.e. all layer 2 entities within a terminal registration area must provide identical capabilities for Half-duplex mode support. (Figure 35 and Figure 36 show a reselection within the same terminal registration area. In the same terminal registration area the Half-duplex mode is resumed.)

If the user performs a reselection to a different terminal registration area the link is re-established. Hence, layer 2 entities in different terminal registration areas may support different modes for packet communication. (Figure 37 and Figure 38 show the case of a reselection to a new terminal registration area. The layer 2 entity in the new terminal registration area supports Half-duplex mode, hence the Half-duplex operation is restarted. In Figure 39, the layer 2 entity in the new terminal registration area is not capable of Half-duplex communication. After layer 2 has been re-established the Low-speed (Full-duplex) mode is started.

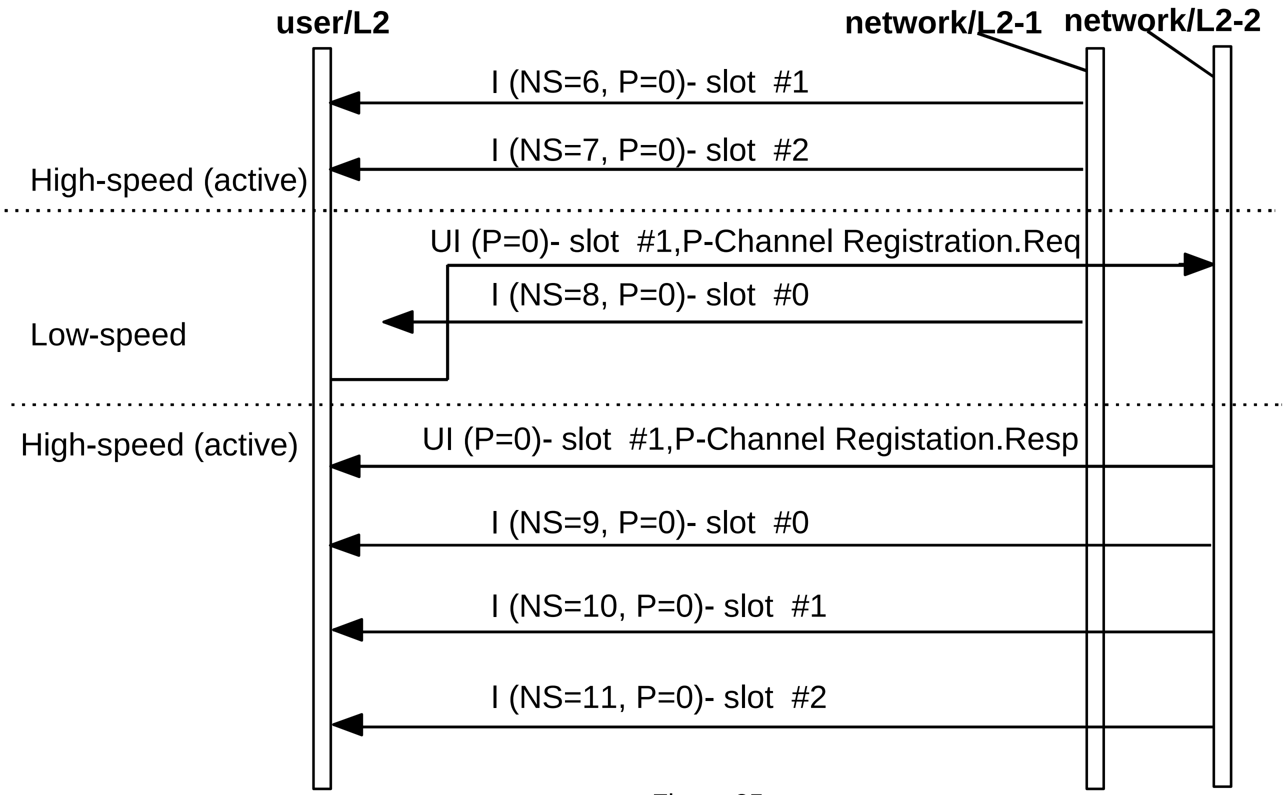


Figure 35.

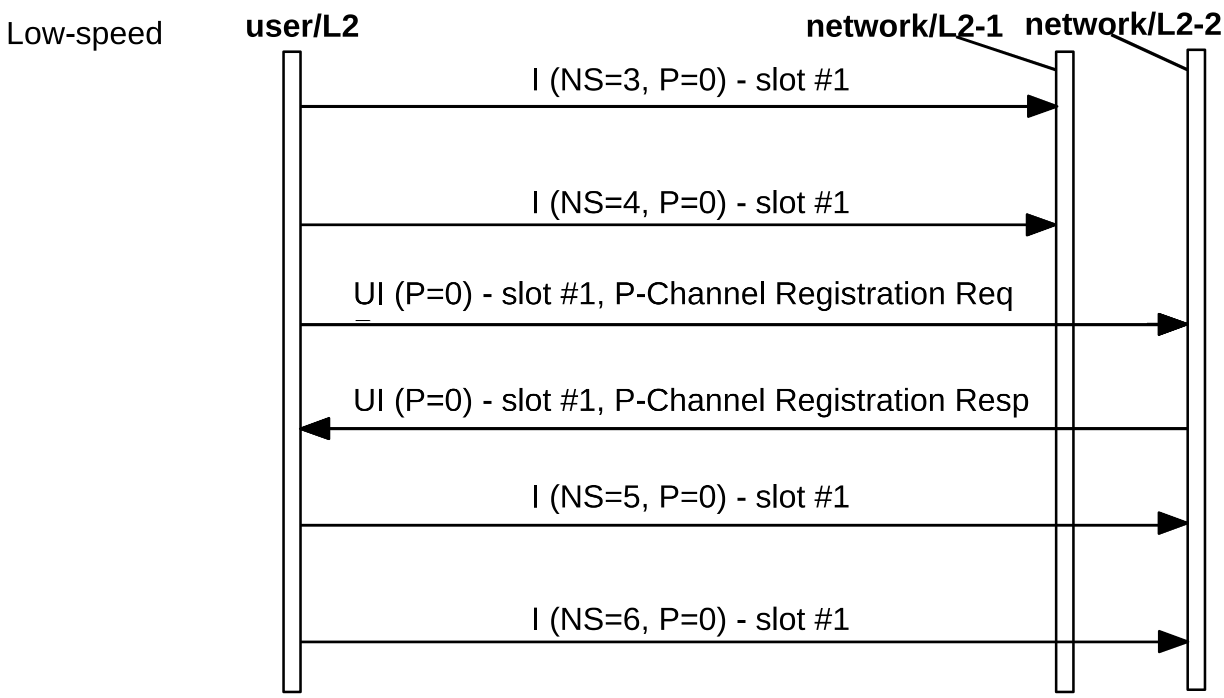


Figure 36.

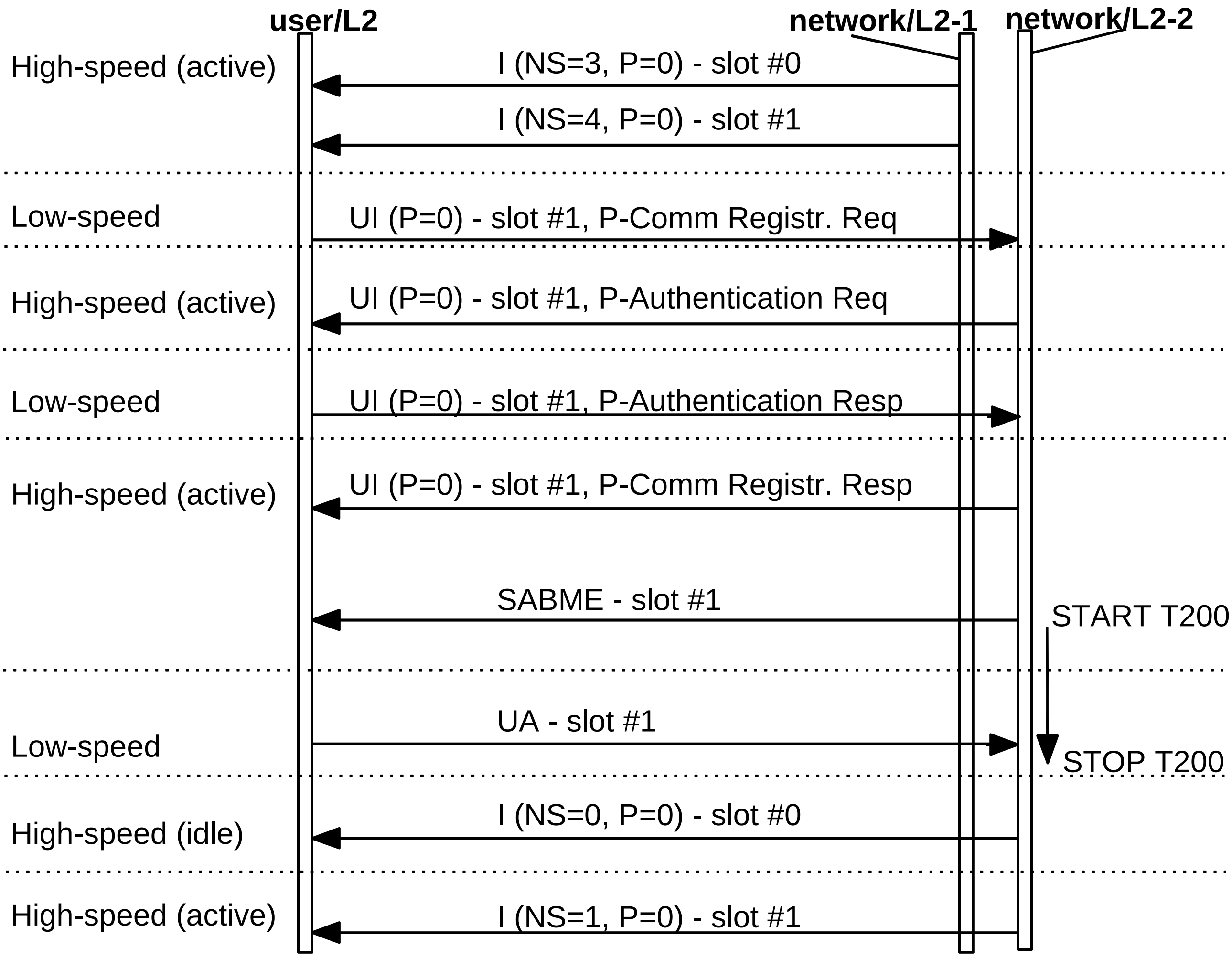
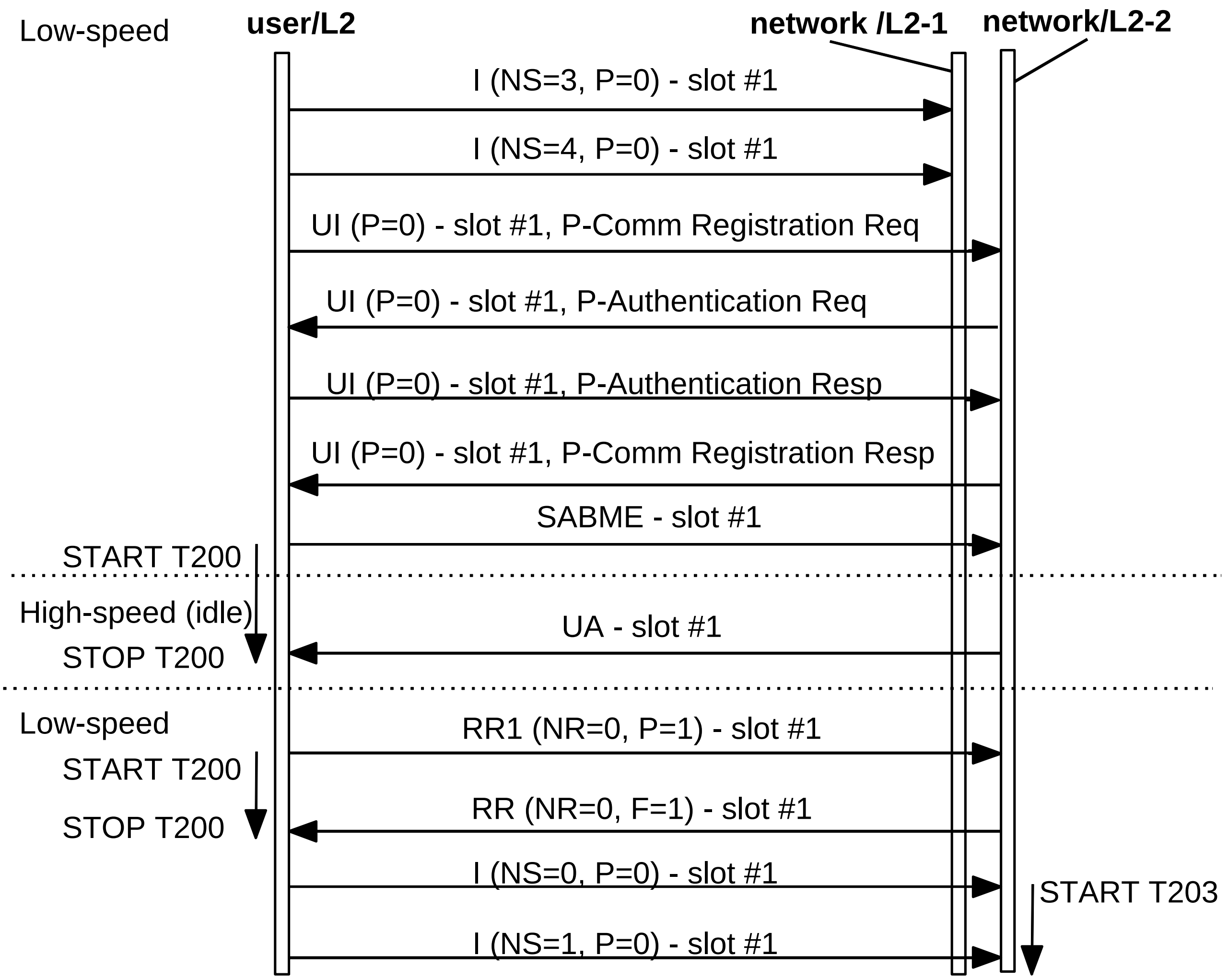

user/L2
network/L2-1
network/L2-2
High-speed (active)
I (NS=3, P=0) - slot #0
I (NS=4, P=0) - slot #1
Low-speed
UI (P=0) - slot #1, P-Comm Registr. Req
High-speed (active)
UI (P=0) - slot #1, P-Authentication Req
Low-speed
UI (P=0) - slot #1, P-Authentication Resp
High-speed (active)
UI (P=0) - slot #1, P-Comm Registr. Resp
SABME - slot #1
START T200
UA - slot #1
Low-speed
STOP T200
I (NS=0, P=0) - slot #0
High-speed (idle)
High-speed (active)
I (NS=1, P=0) - slot #1

Figure 37.



Low-speed
user/L2
network /L2-1
network/L2-2
I (NS=3, P=0) - slot #1
I (NS=4, P=0) - slot #1
UI (P=0) - slot #1, P-Comm Registration Req
UI (P=0) - slot #1, P-Authentication Req
UI (P=0) - slot #1, P-Authentication Resp
UI (P=0) - slot #1, P-Comm Registration Resp
SABME - slot #1
START T200
High-speed (idle)
UA - slot #1
STOP T200
Low-speed
RR1 (NR=0, P=1) - slot #1
START T200
RR (NR=0, F=1) - slot #1
STOP T200
I (NS=0, P=0) - slot #1
START T203
I (NS=1, P=0) - slot #1

Figure 38.

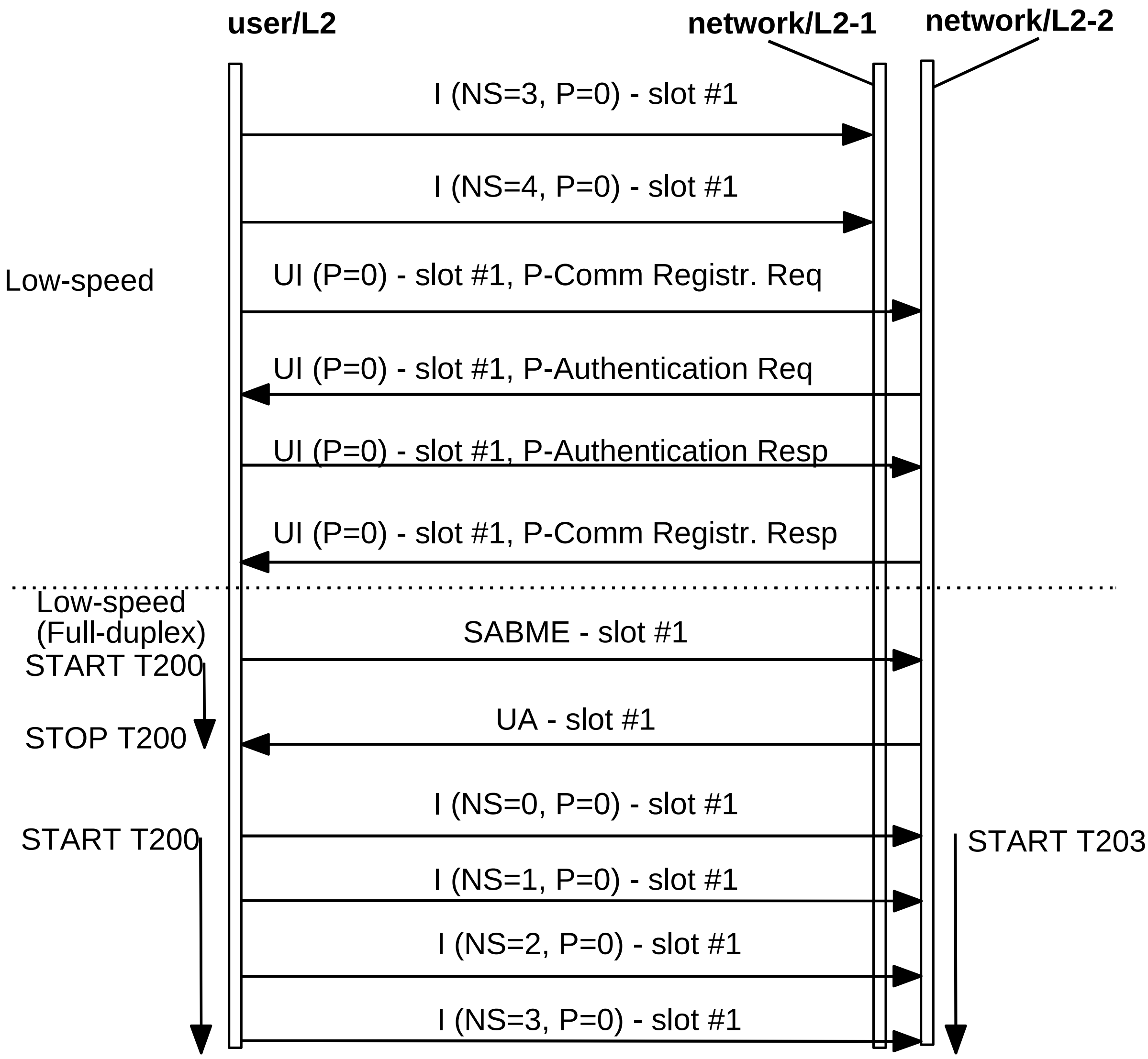

user/L2
network/L2-1
network/L2-2
I (NS=3, P=0) - slot #1
I (NS=4, P=0) - slot #1
Low-speed
UI (P=0) - slot #1, P-Comm Registr. Req
UI (P=0) - slot #1, P-Authentication Req
UI (P=0) - slot #1, P-Authentication Resp
UI (P=0) - slot #1, P-Comm Registr. Resp
Low-speed
(Full-duplex)
START T200
SABME - slot #1
STOP T200
UA - slot #1
START T200
I (NS=0, P=0) - slot #1
START T203
I (NS=1, P=0) - slot #1
I (NS=2, P=0) - slot #1
I (NS=3, P=0) - slot #1

Figure 39.

4 SDL diagrams

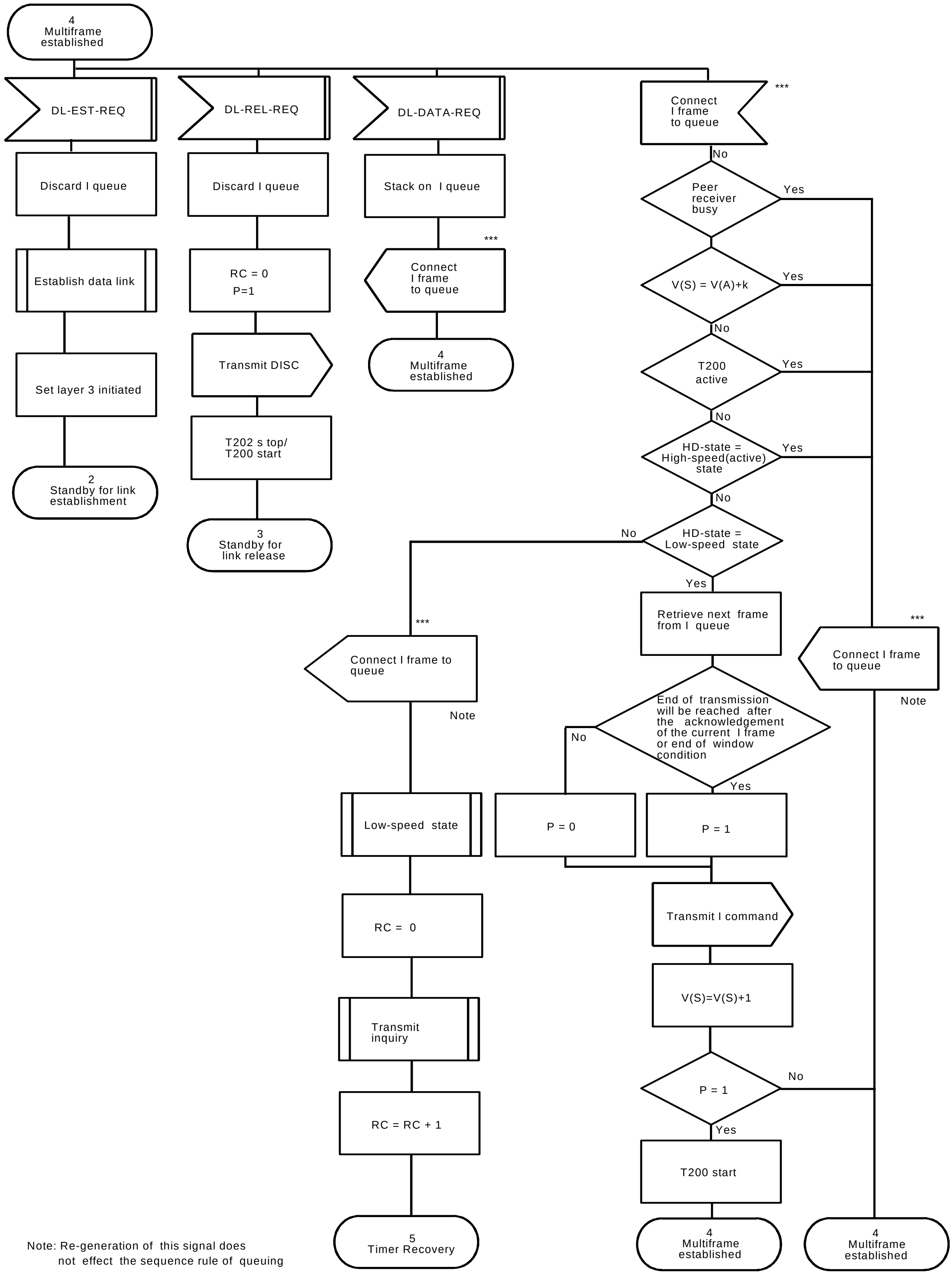
4.1 SDL diagrams (user side)

Layer 2 SDL diagrams on the user side for half-duplex packet communication method are specified in terms of differences from Fig. A.4.2 (Annex A).

Table 2.

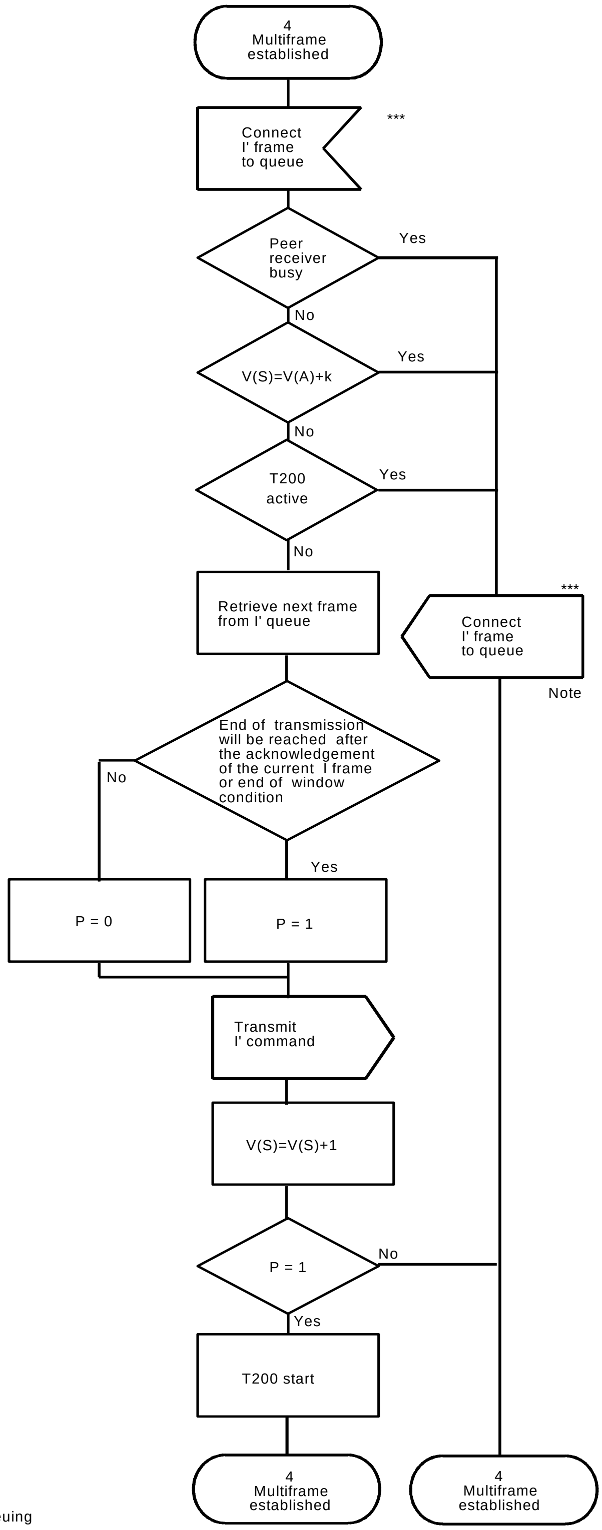
L2 SDL Diagram No.(SAPI=1,6)	Modification for Half-duplex packet communication (user side)
1(58)	Not modified, same as Fig. A.4.2
2(58)	not modified, same as Fig. A.4.2
3(58)	not modified, same as Fig. A.4.2
4(58)	not modified, same as Fig. A.4.2
5(58)	not modified, same as Fig. A.4.2
6(58)	not modified, same as Fig. A.4.2
7(58)	not modified, same as Fig. A.4.2
8(58)	modified, Figure 40 and Figure 41
9(58)	modified, Figure 42
10(58)	not modified, same as Fig. A.4.2
11(58)	modified, Figure 43
12(58)	modified, Figure 44
13(58)	modified, Figure 45
14(58)	modified, Figure 46
15(58)	modified, Figure 47
16(58)	modified, Figure 48
17(58)	modified, Figure 49
18(58)	modified, Figure 50
19(58)	modified, Figure 51
20(58)	modified, Figure 52
21(58)	modified, Figure 53
22(58)	modified, Figure 54
23(58)	modified, Figure 55
24(58)	modified, Figure 56
25(58)	modified, Figure 57
26(58)	modified, Figure 58
27(58)	modified, Figure 59
28(58)	not modified, same as Fig. A.4.2
29(58)	not modified, same as Fig. A.4.2
30(58)	not modified, same as Fig. A.4.2
31(58)	modified, Figure 60
32(58)	modified, Figure 61
33(58)	not modified, same as Fig. A.4.2

34(58)	not modified, same as Fig. A.4.2
35(58)	modified, Figure 62
36(58)	modified, Figure 63
37(58)	modified, Figure 64
38(58)	modified, Figure 65
39(58)	modified, Figure 66
40(58)	modified, Figure 67
41(58)	not modified, same as Fig. A.4.2
42(58)	modified, Figure 68
43(58)	modified, Figure 69
44(58)	modified, Figure 70
45(58)	modified, Figure 71
46(58)	modified, Figure 72
47(58)	not modified, same as Fig. A.4.2
48(58)	modified, Figure 73
49(58)	not modified, same as Fig. A.4.2
50(58)	not modified, same as Fig. A.4.2
51(58)	modified, Figure 74
52(58)	modified, Figure 75
53(58)	modified, Figure 76
54(58)	not modified, same as Fig. A.4.2
55(58)	not modified, same as Fig. A.4.2
56(58)	not modified, same as Fig. A.4.2
57(58)	not modified, same as Fig. A.4.2
58(58)	not modified, same as Fig. A.4.2
----	new, Figure 77



Note: Re-generation of this signal does
not effect the sequence rule of queuing

Figure 40. Layer 2 SDL diagram (8/59)



Note: Re-generation of this signal does
Not effect the sequence rule of queuing

Figure 41. Layer 2 SDL diagram (8/59)

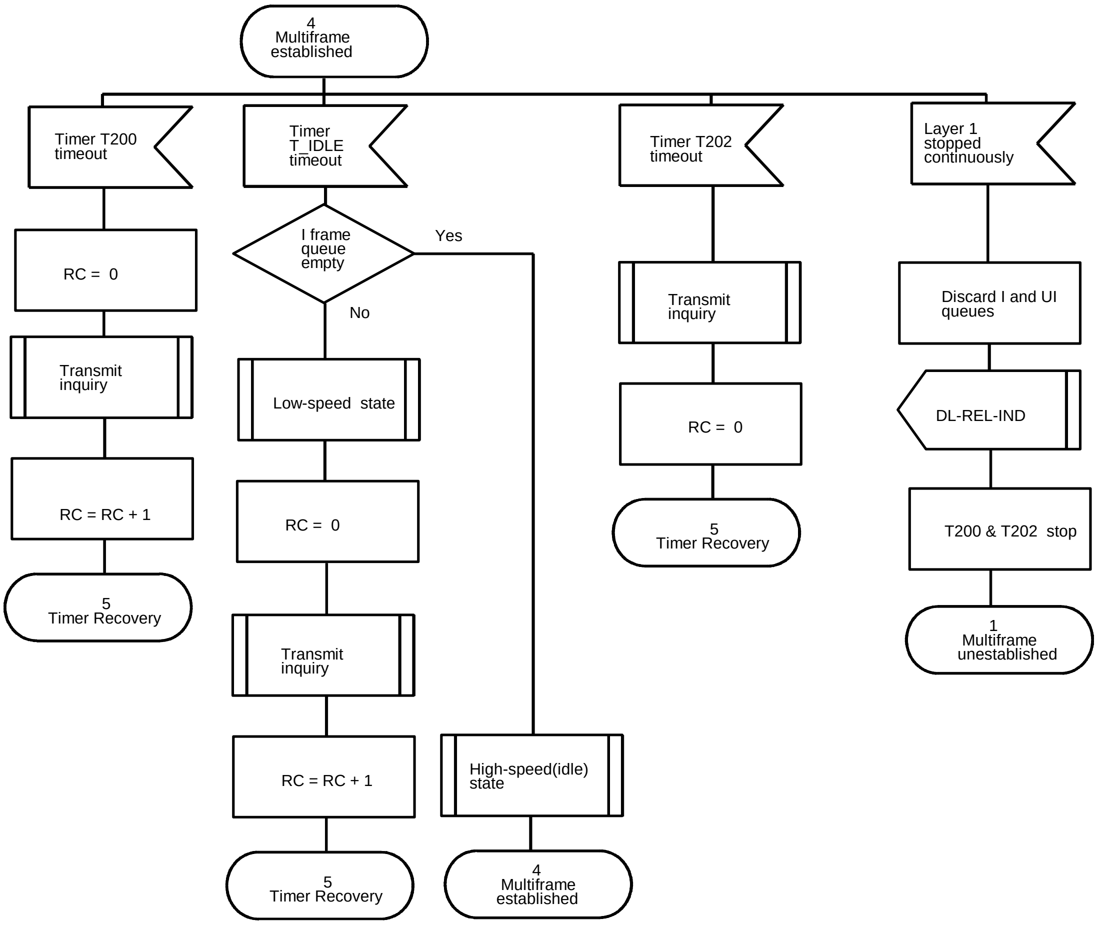
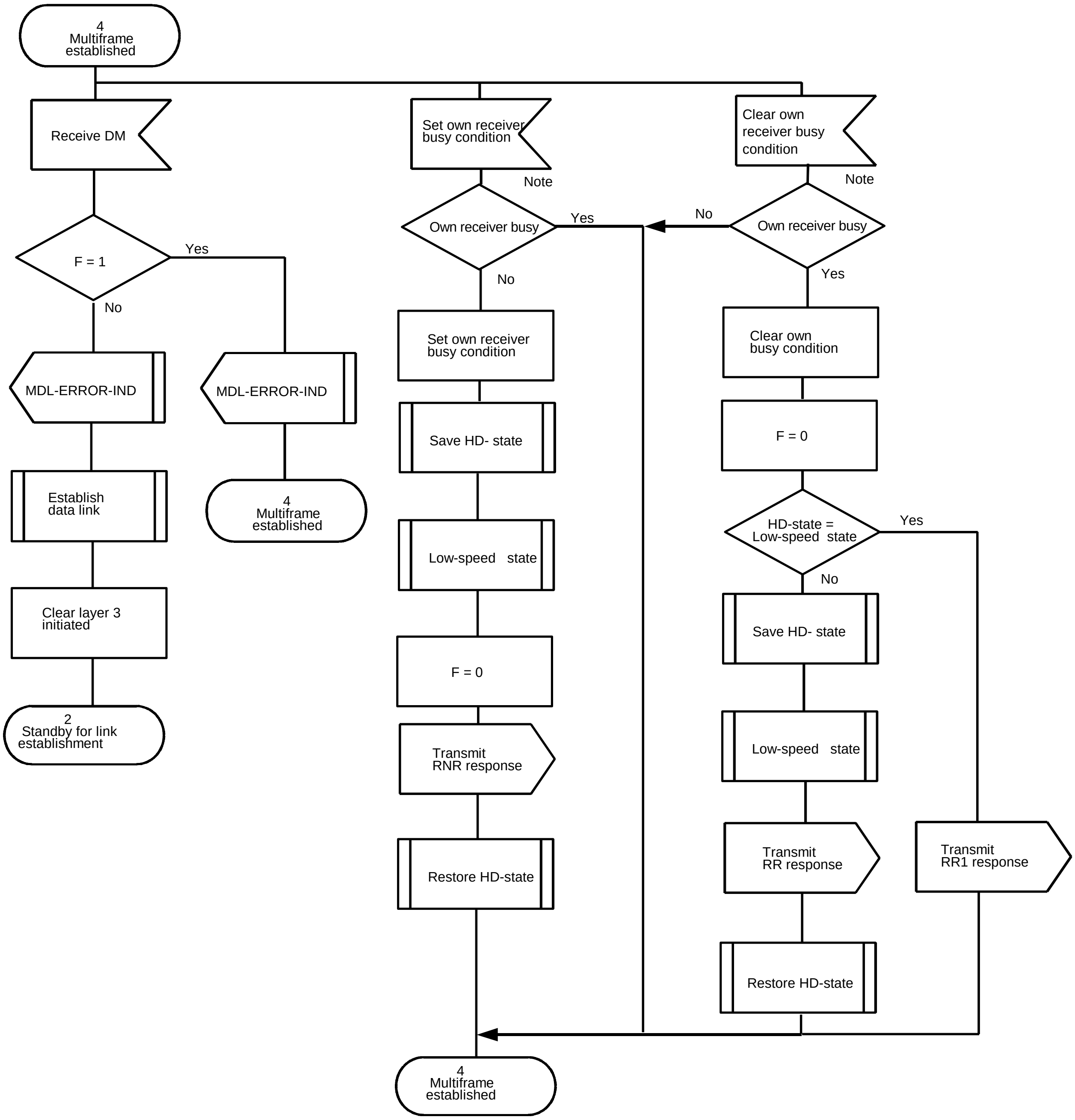


Figure 42. Layer 2 SDL diagram (9/59)



Note: These signals are generated outside of the scope of these SDLs
and can also be generated by the connection management entity.

Figure 43. Layer 2 SDL diagram (11/59)

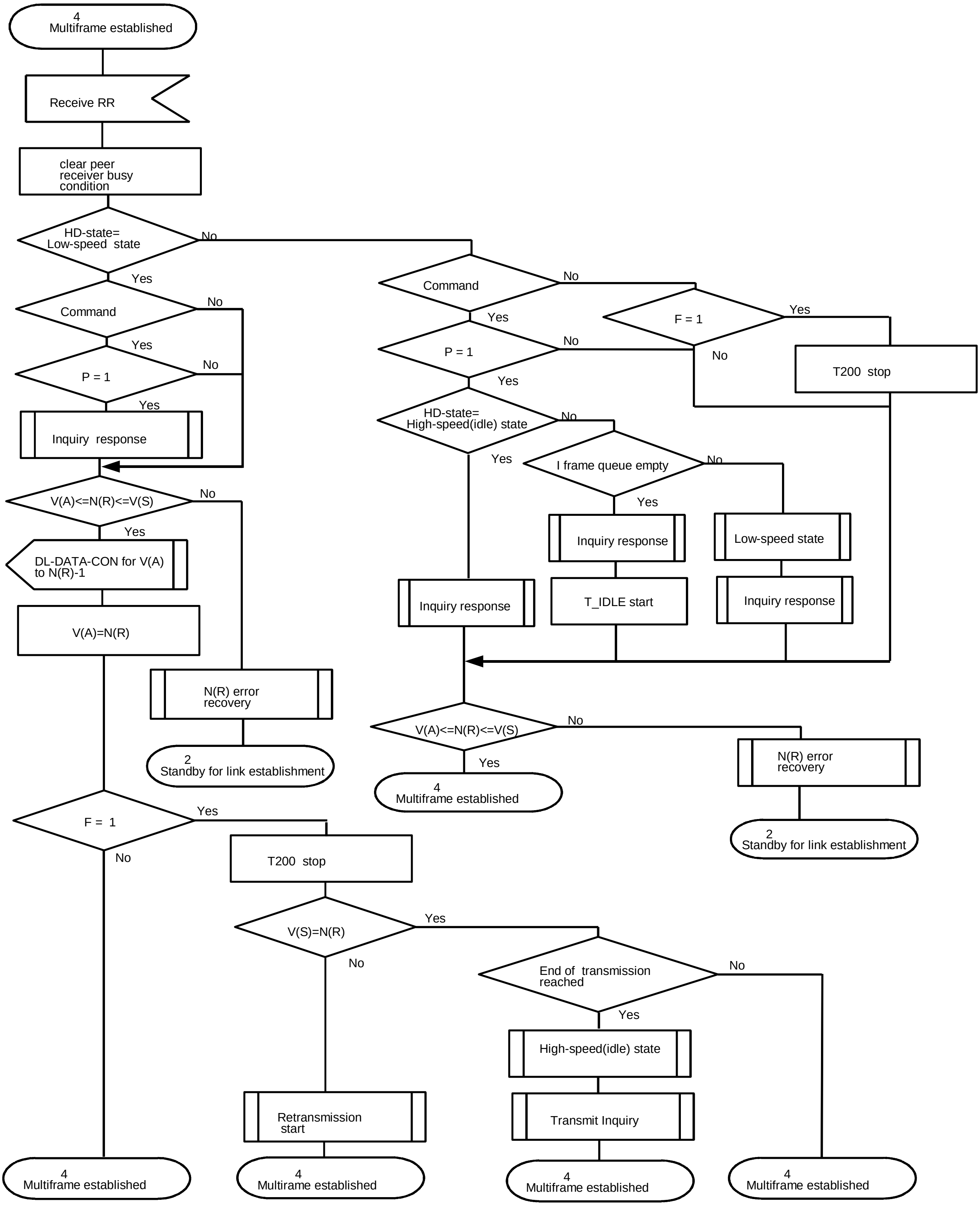
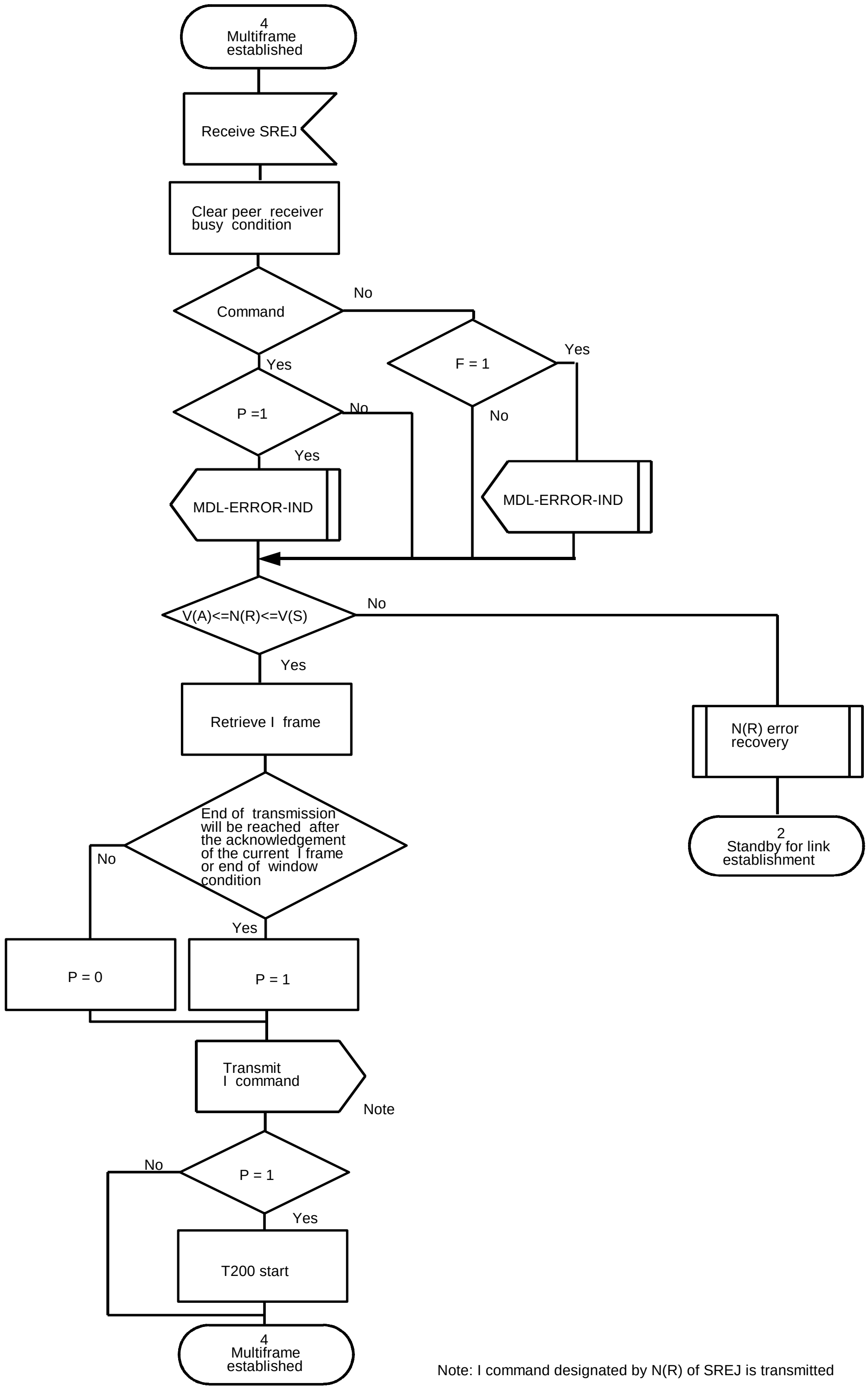


Figure 44. Layer 2 SDL diagram (12/59)



Note: I command designated by N(R) of SREJ is transmitted

Figure 45. Layer 2 SDL diagram (13/59)

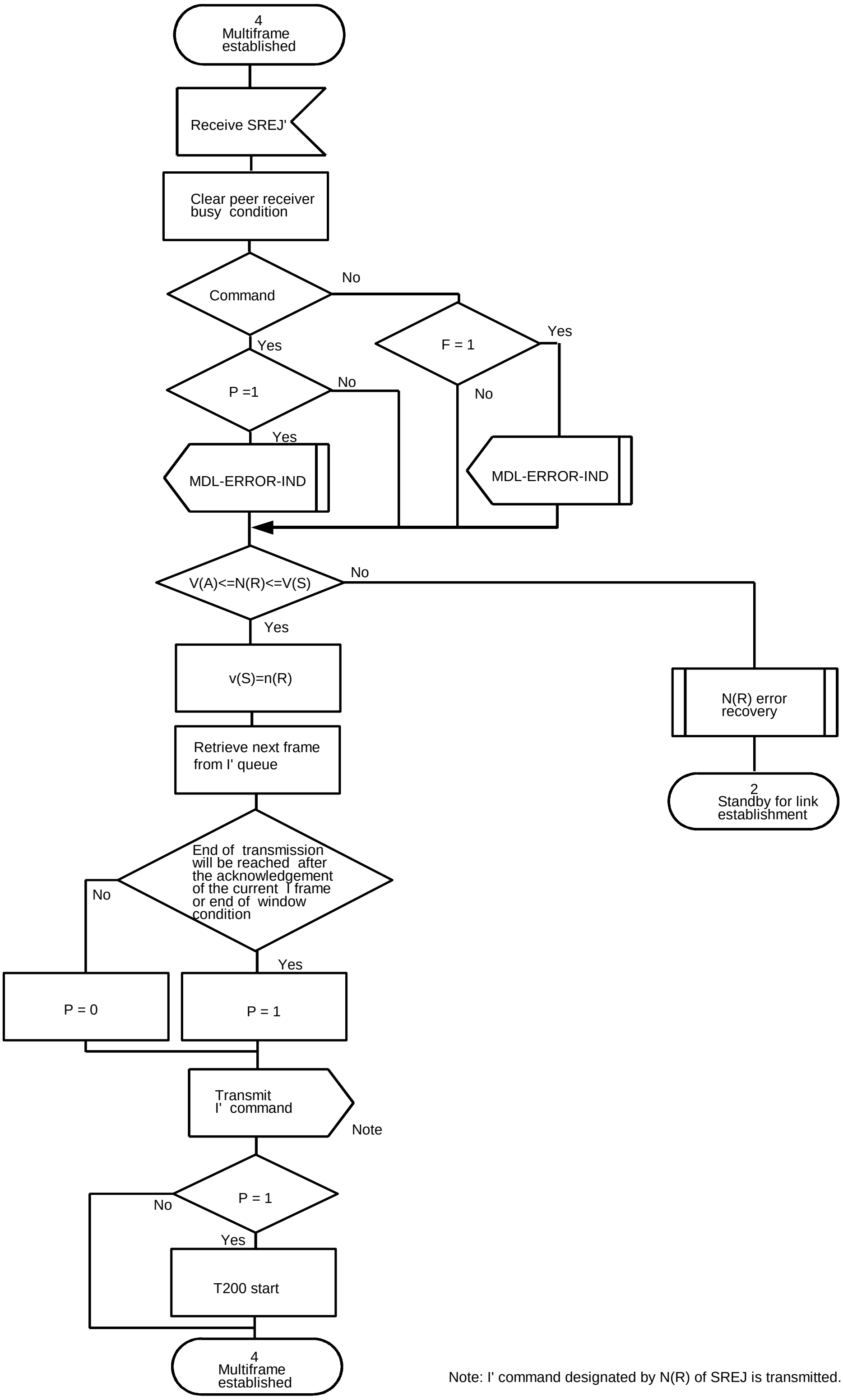


Figure 46. Layer 2 SDL diagram (14/59)

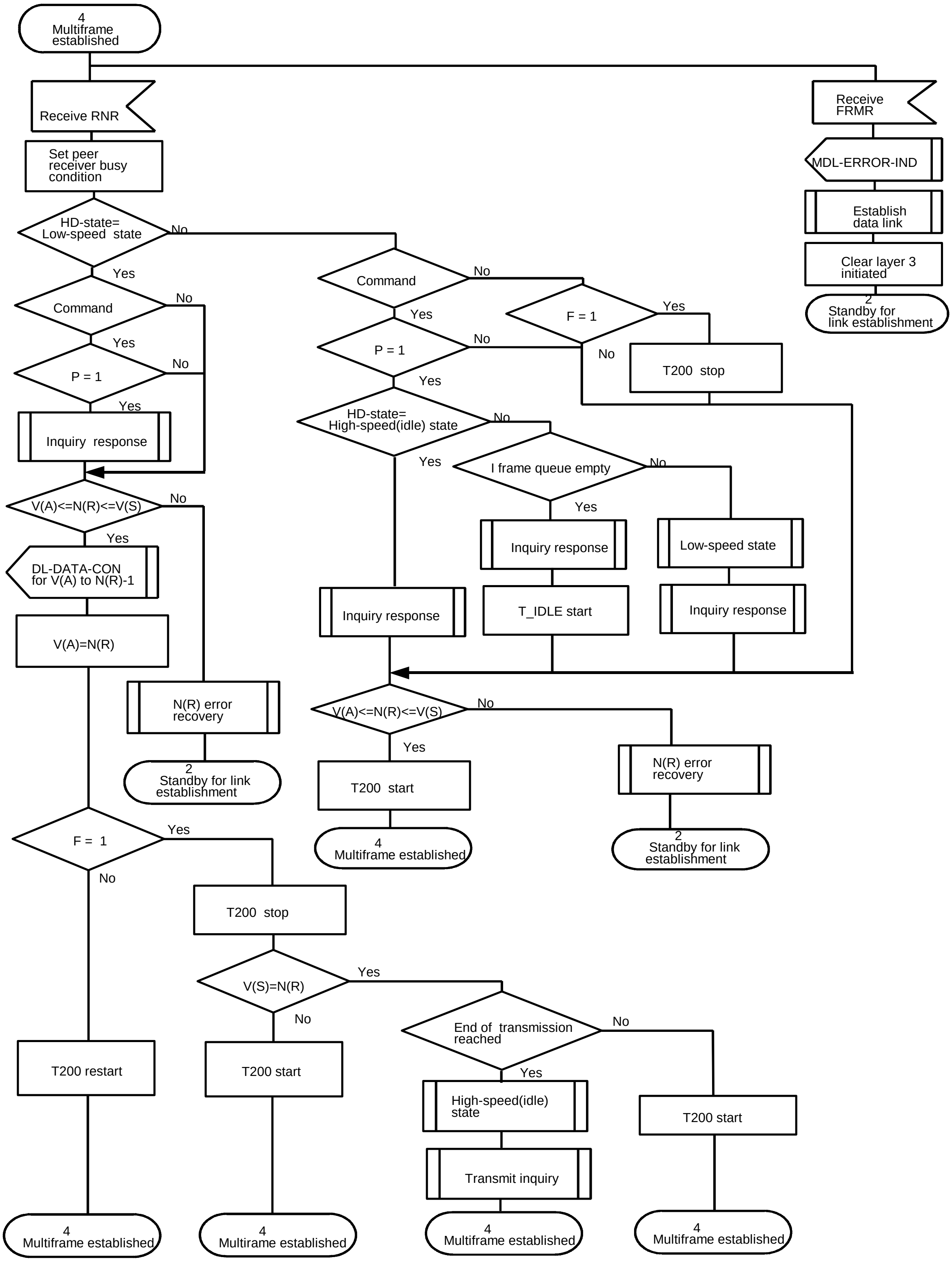


Figure 47. Layer 2 SDL diagram (15/59)

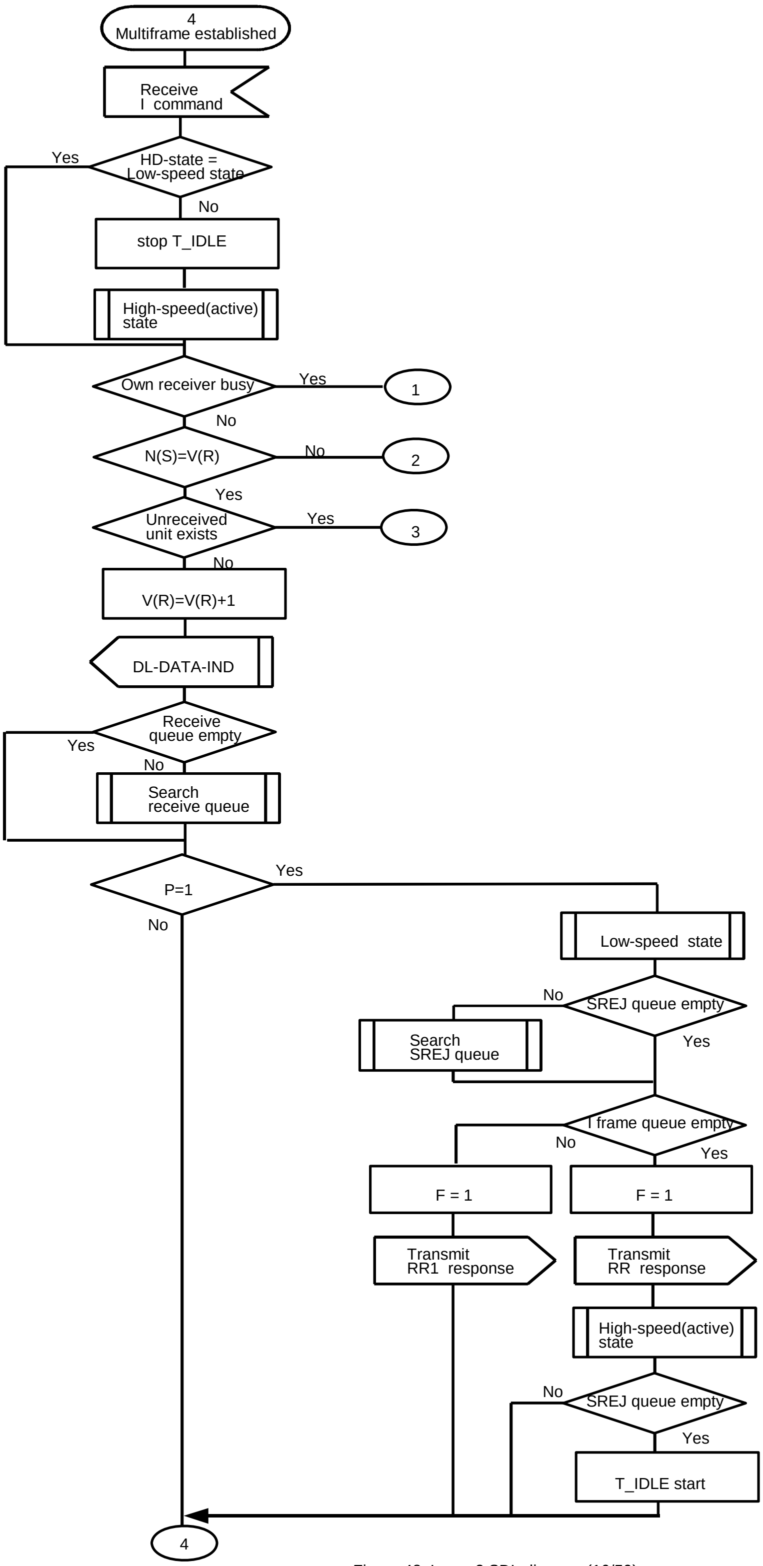


Figure 48. Layer 2 SDL diagram (16/59)

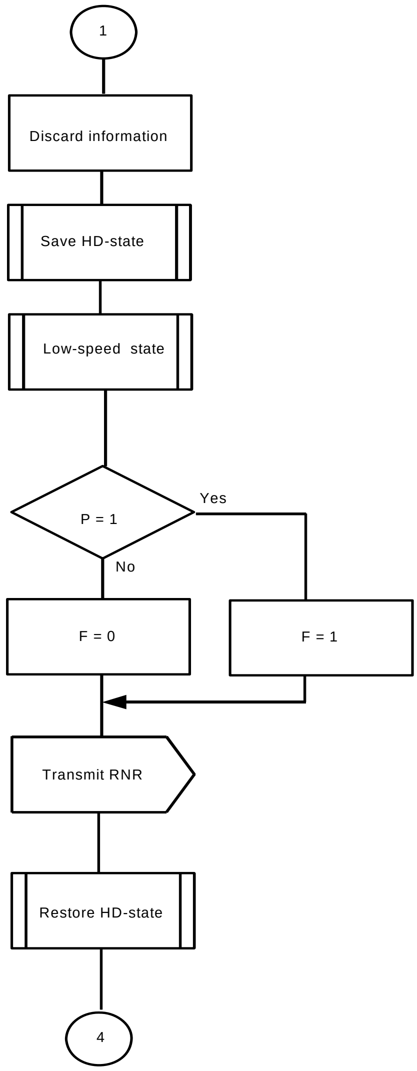


Figure 49. Layer 2 SDL diagram (17/59)

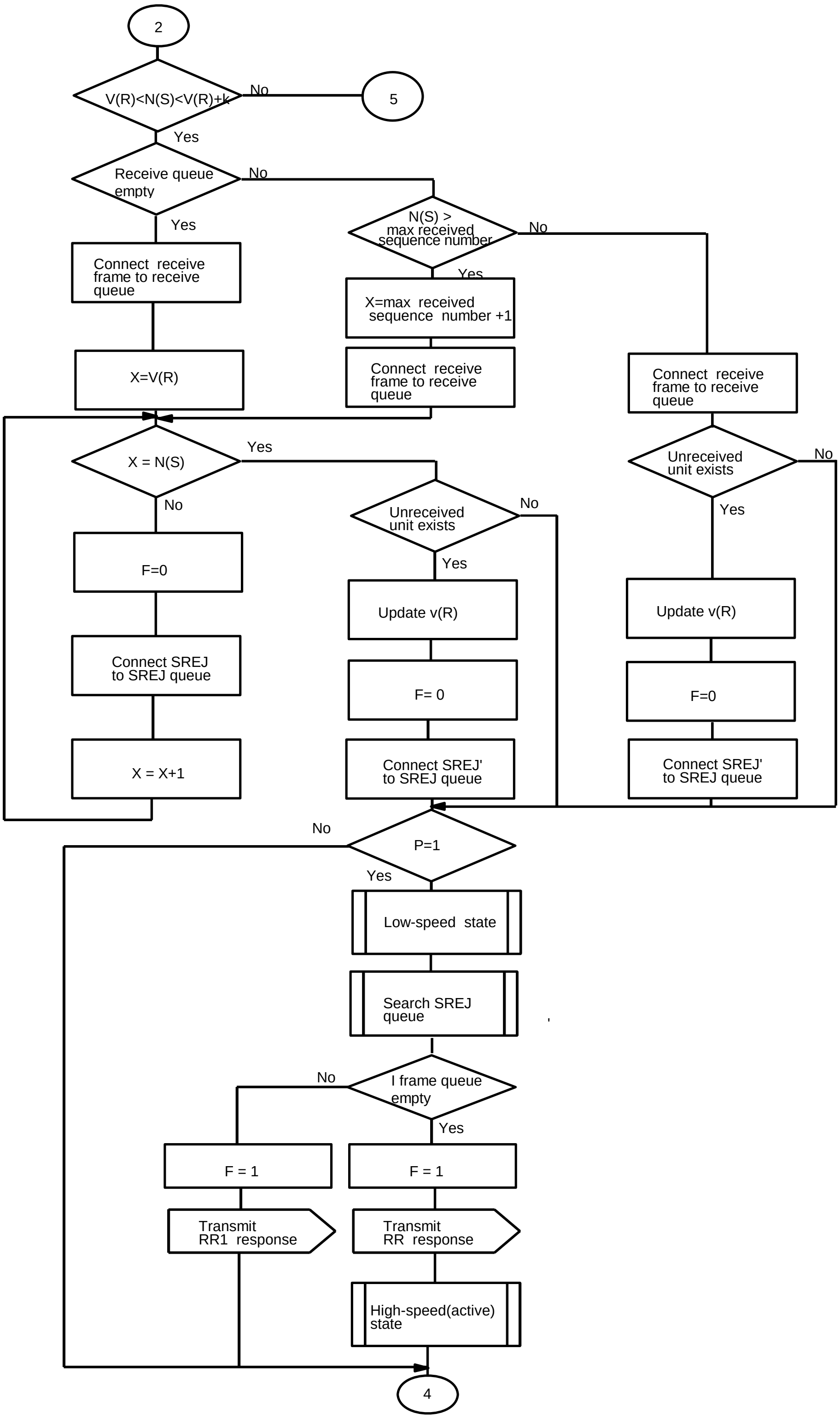


Figure 50. Layer 2 SDL diagram (18/59)

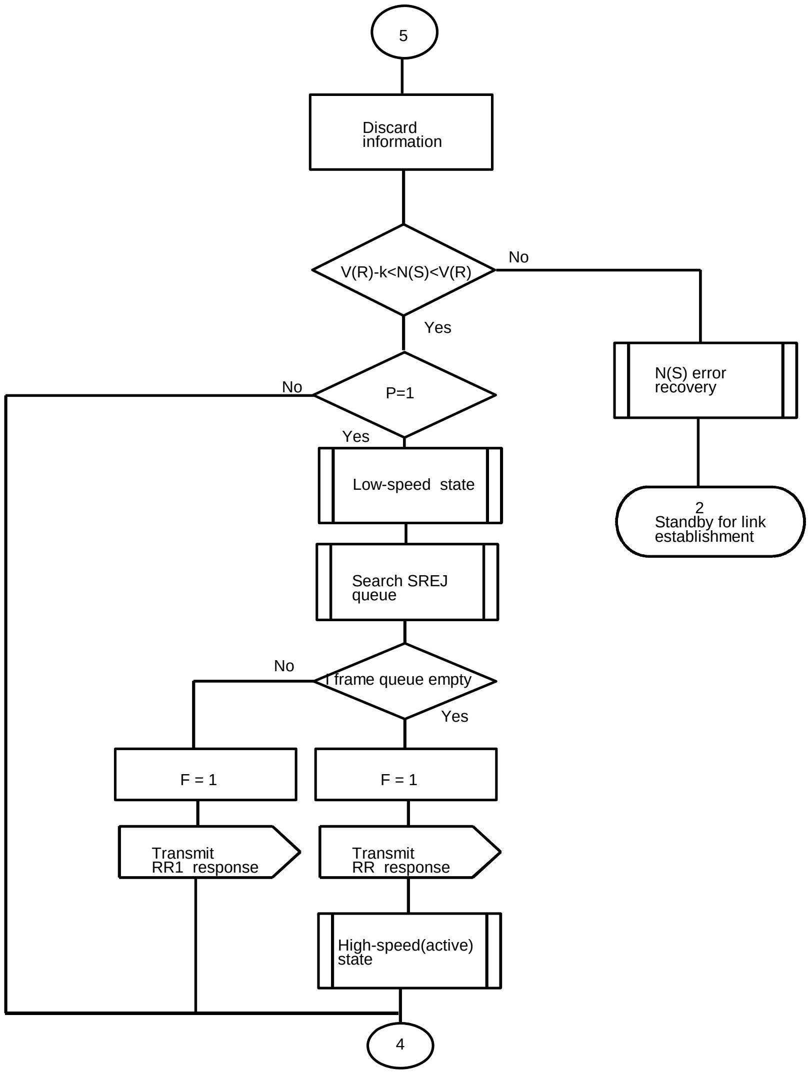


Figure 51. Layer 2 SDL diagram (19/59)

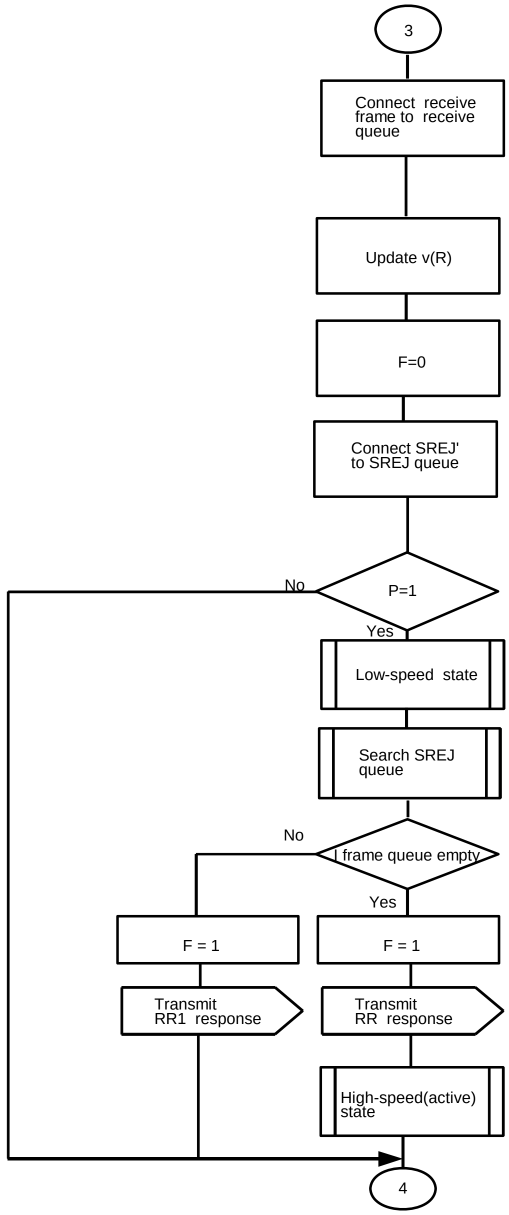


Figure 52. Layer 2 SDL diagram (20/59)

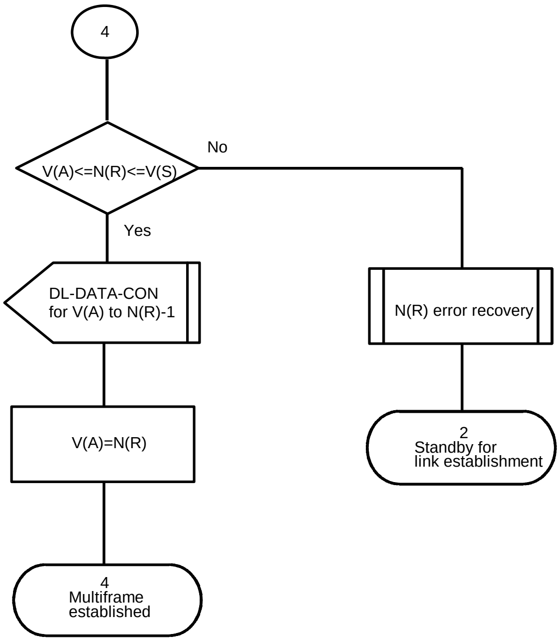


Figure 53. Layer 2 SDL diagram (21/59)

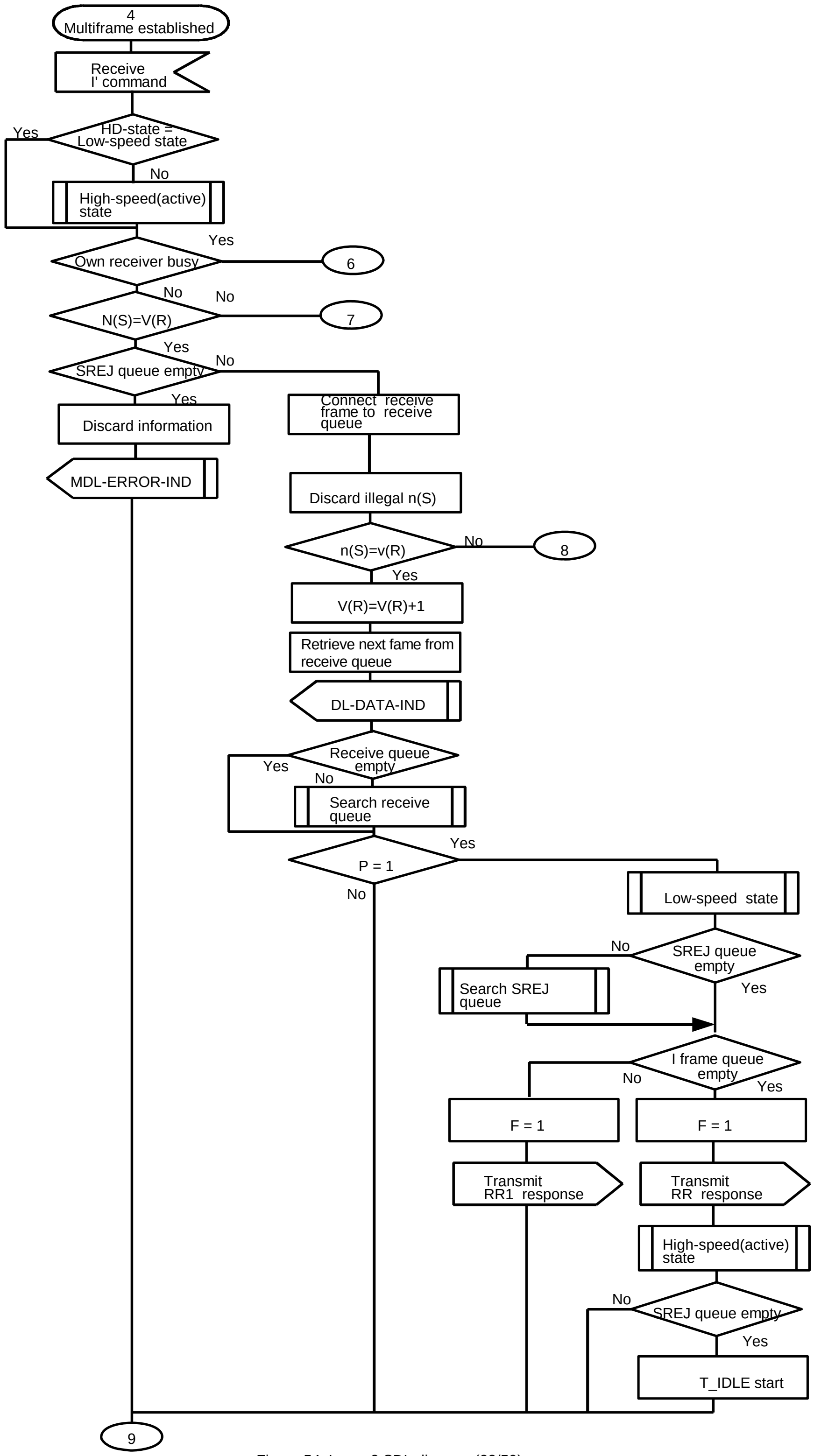


Figure 54. Layer 2 SDL diagram (22/59)

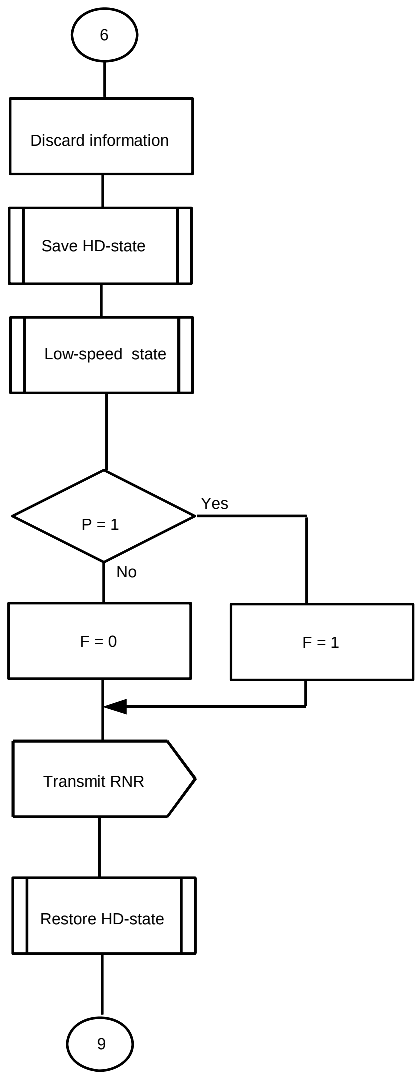
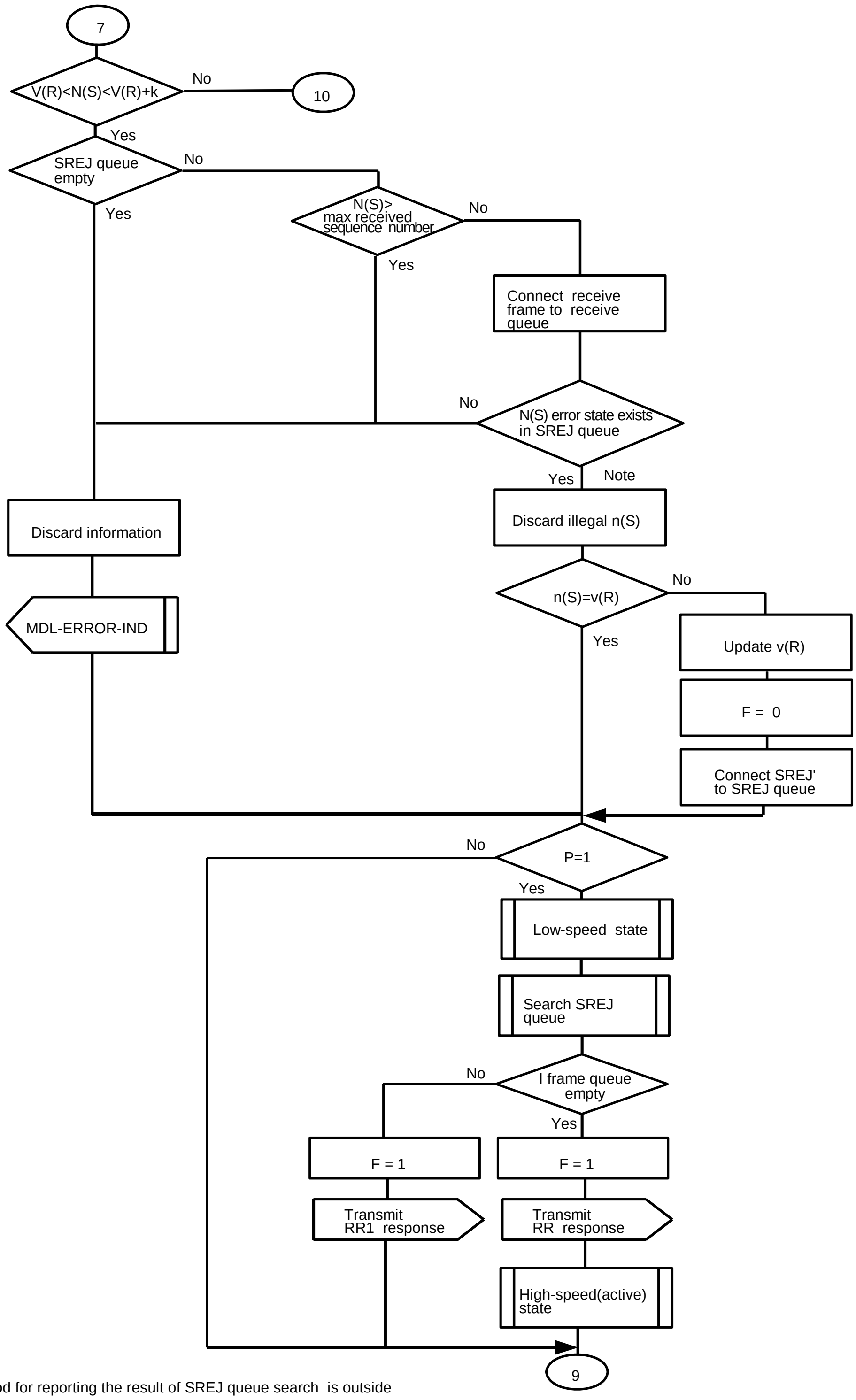


Figure 55. Layer 2 SDL diagram (23/59)



Note: A method for reporting the result of SREJ queue search is outside the scope of the SDLs

Figure 56. Layer 2 SDL diagram (24/59)

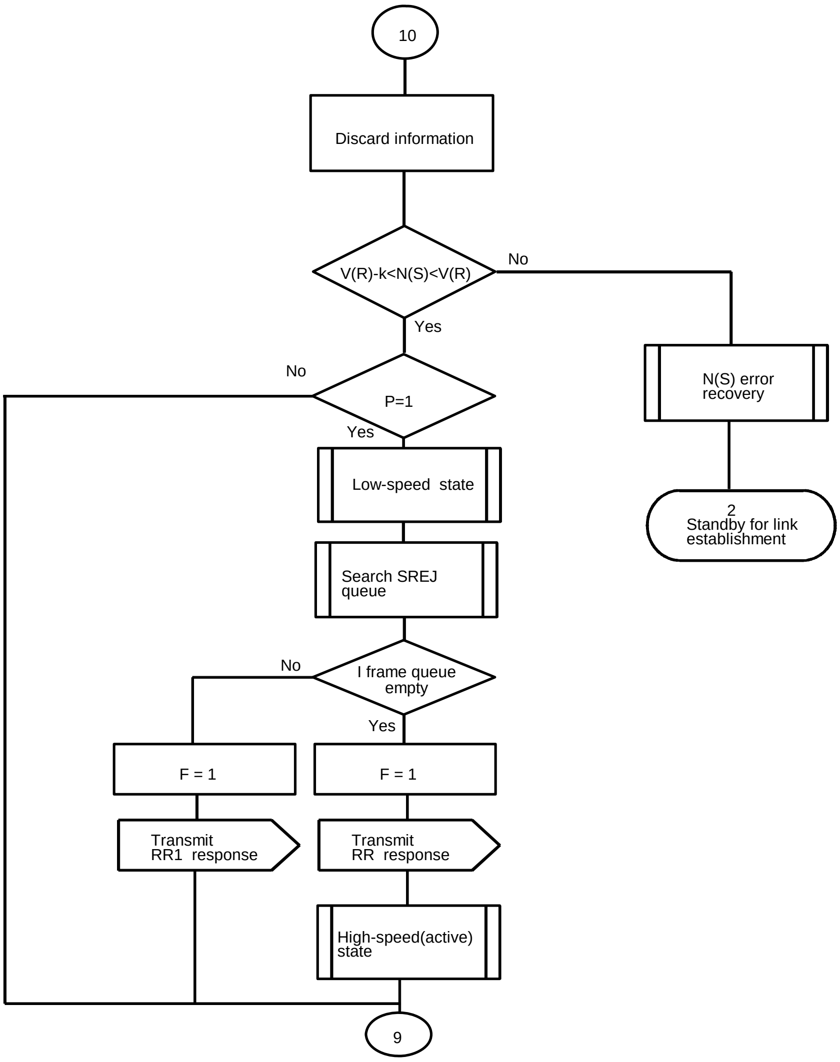


Figure 57. Layer 2 SDL diagram (25/59)

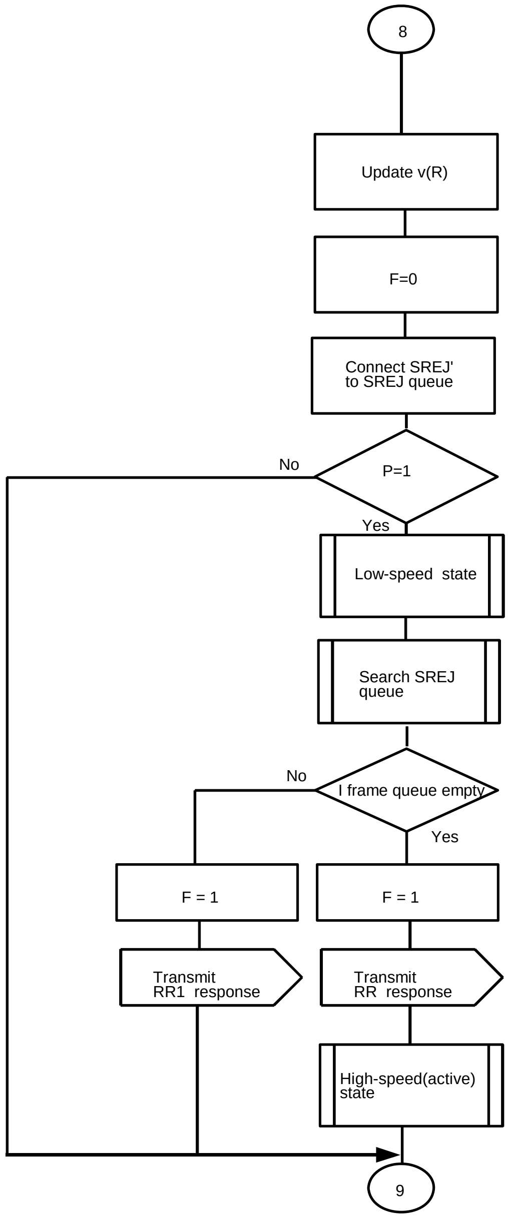


Figure 58. Layer 2 SDL diagram (26/59)

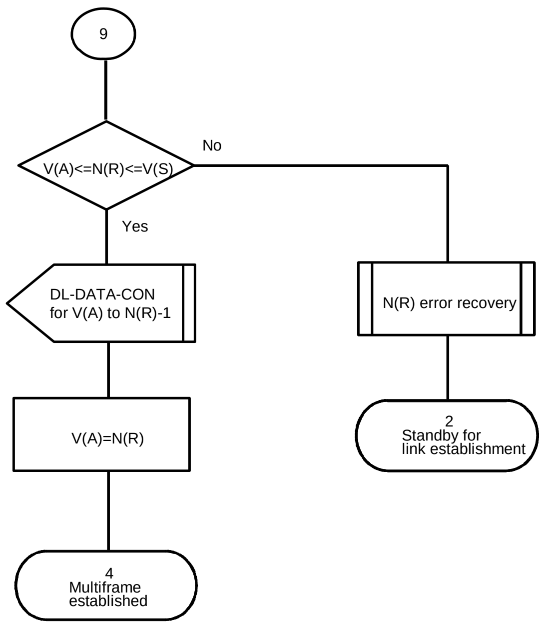
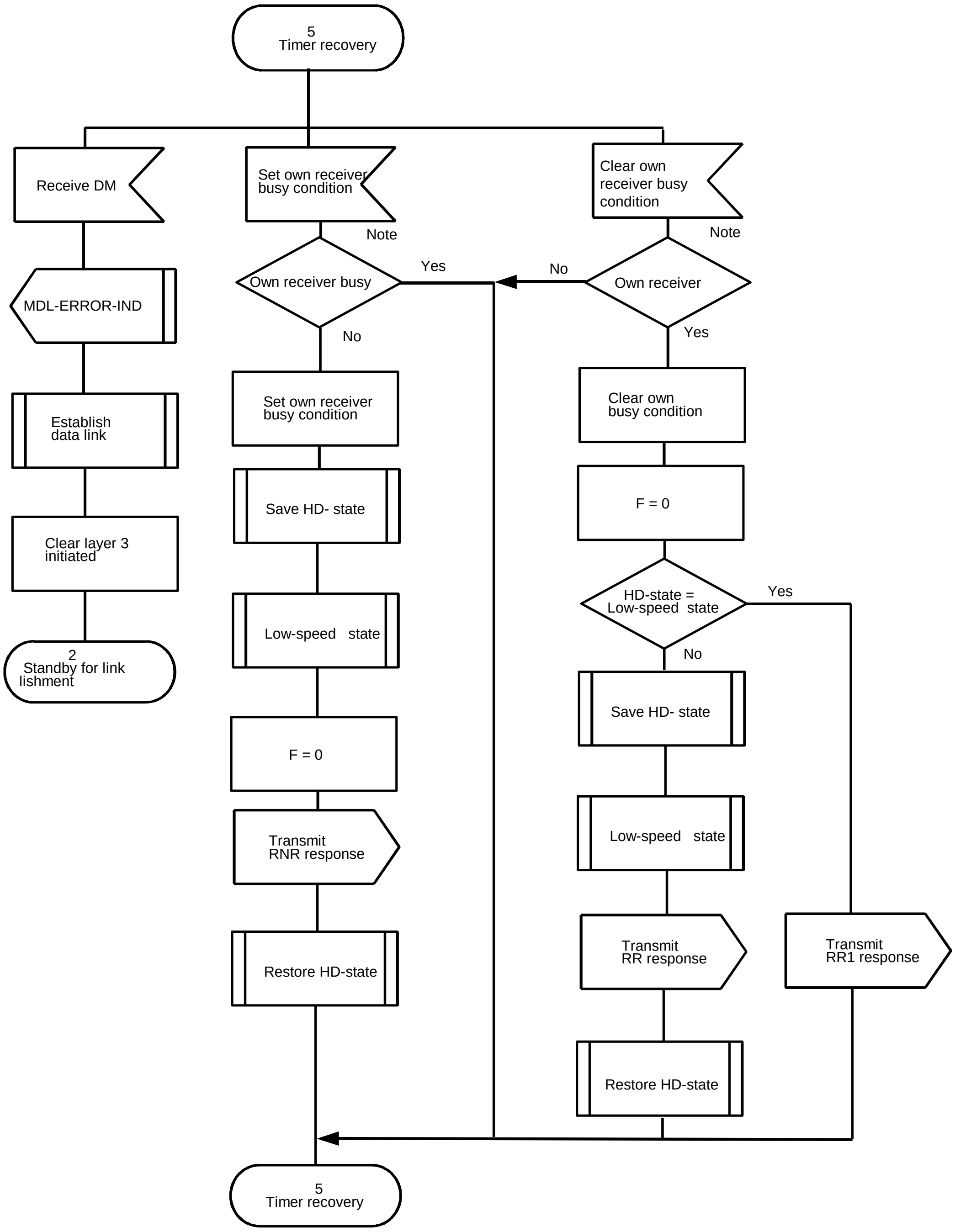


Figure 59. Layer 2 SDL diagram (21/59)



Note: These signals are generated outside of the scope of these SDLs
and can also be generated by the connection management entity.

Figure 60. Layer 2 SDL diagram (31/59)

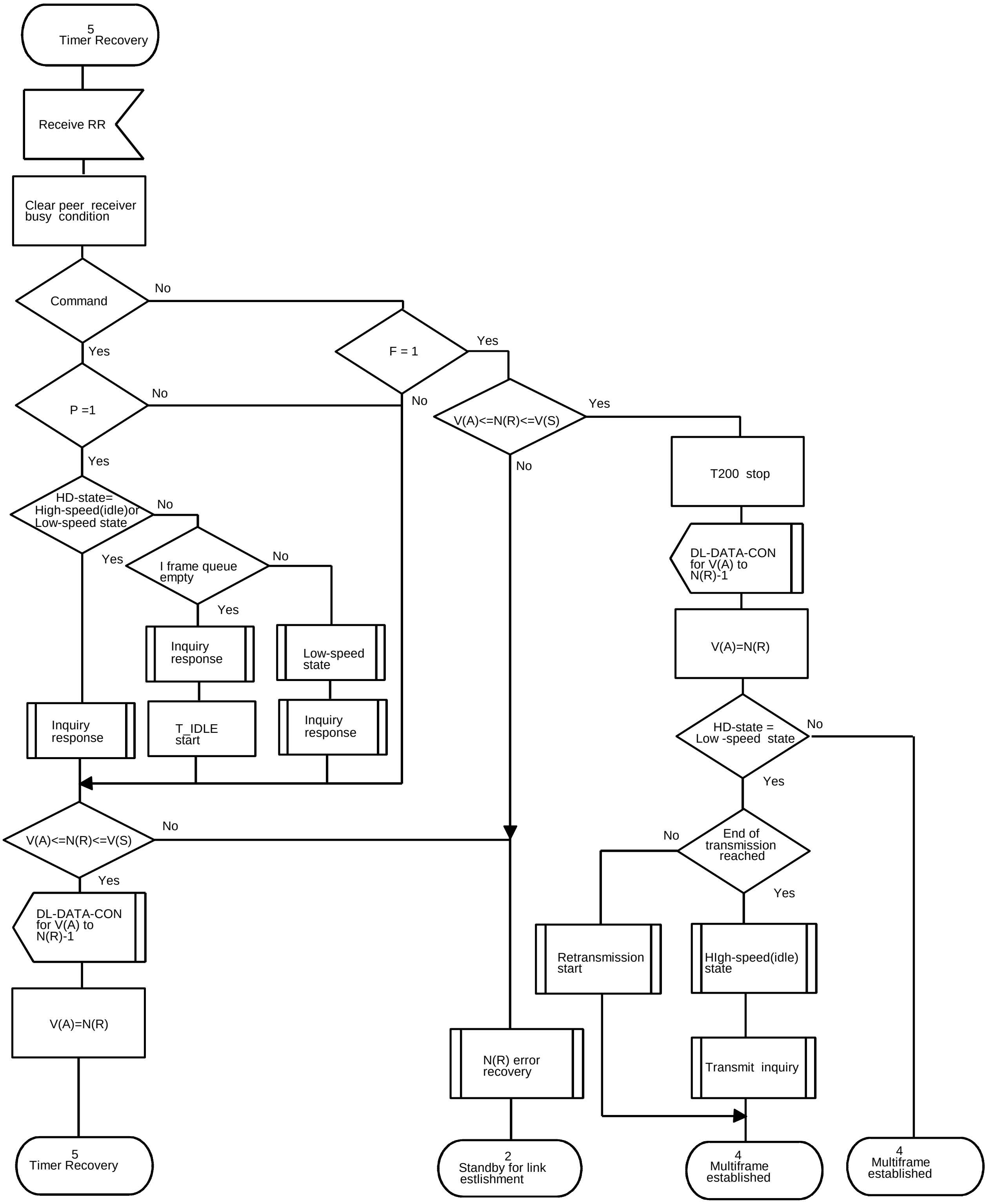


Figure 61. Layer 2 SDL diagram (32/59)

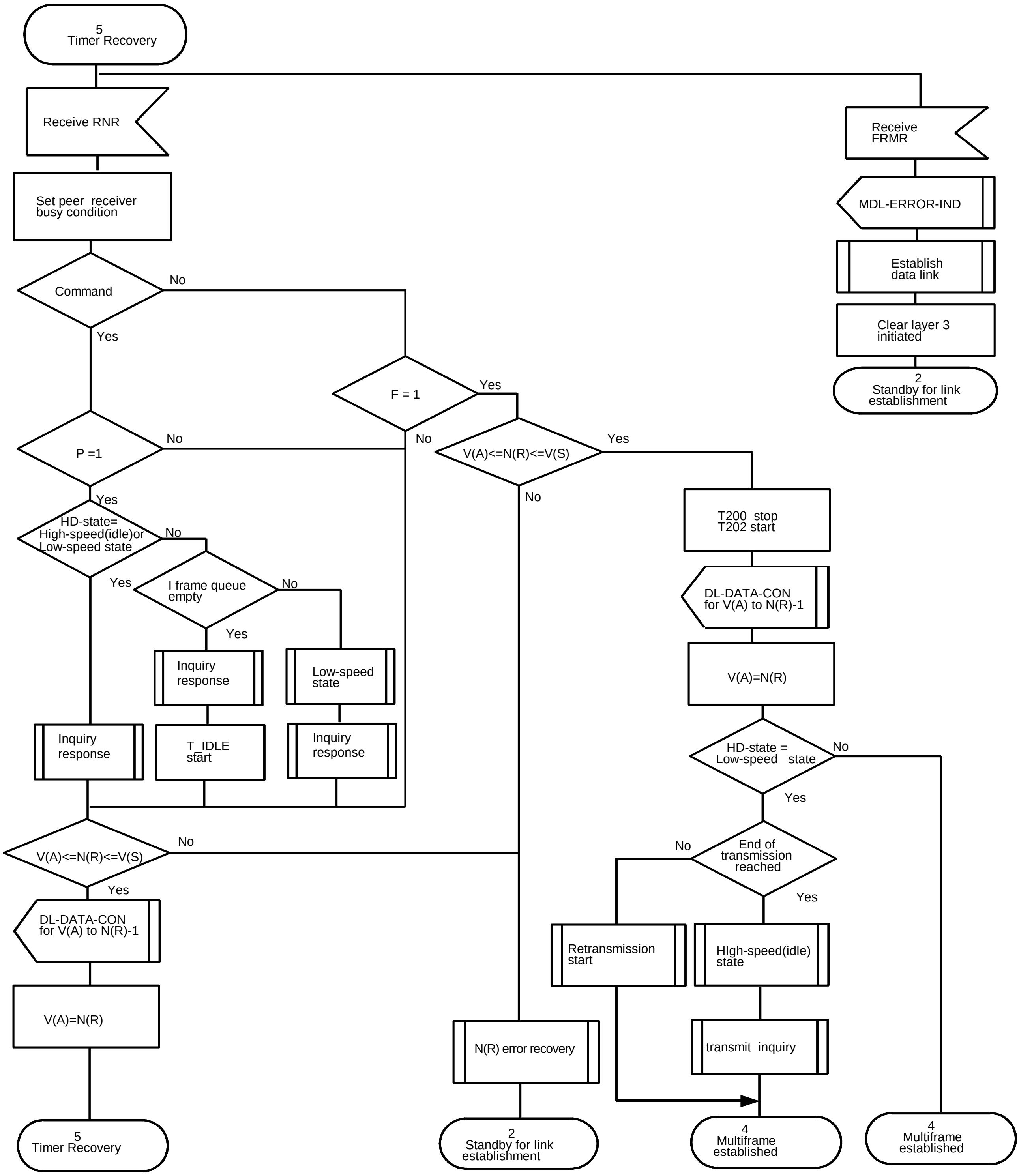


Figure 62. Layer 2 SDL diagram (35/59)

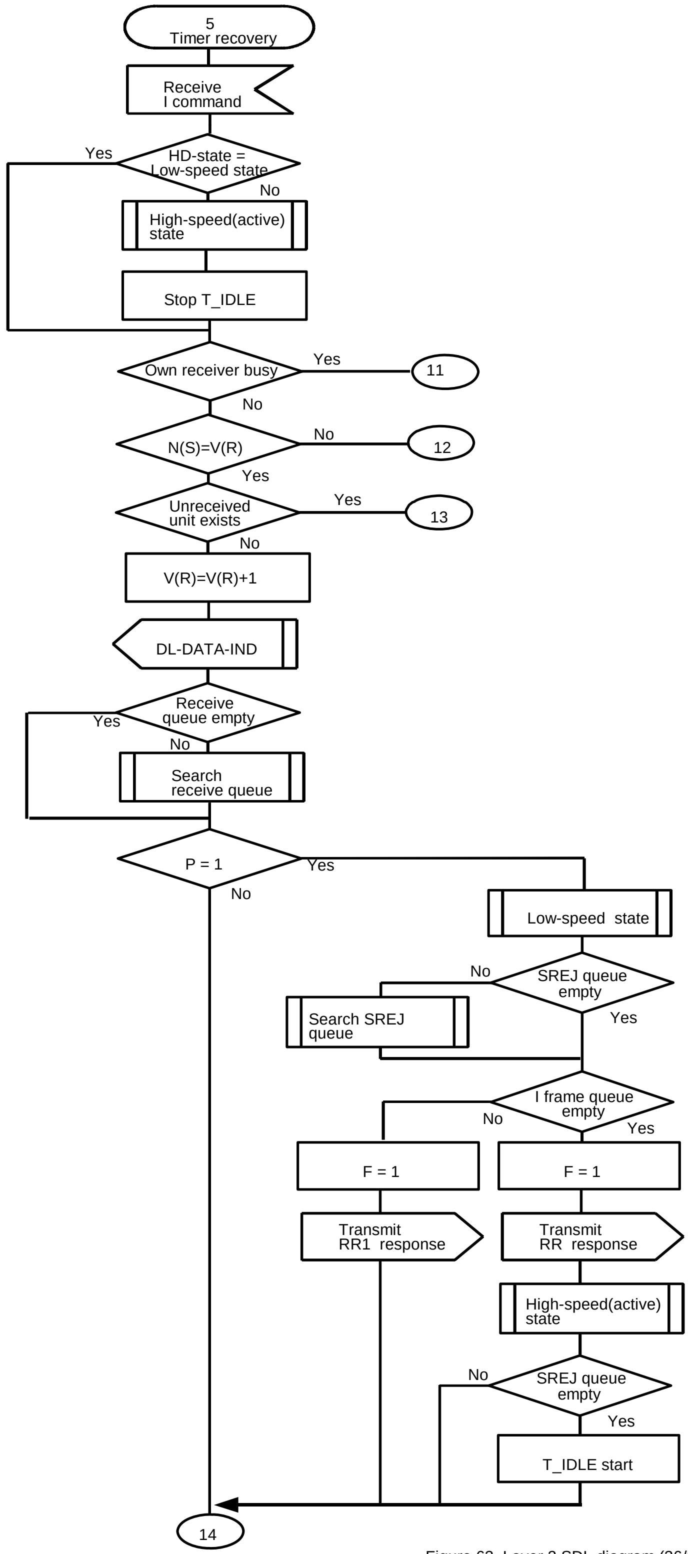


Figure 63. Layer 2 SDL diagram (36/59)

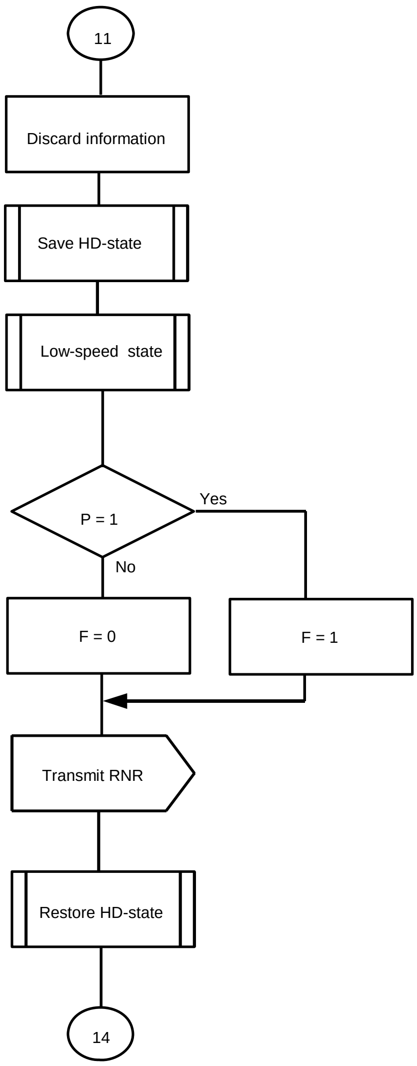


Figure 64. Layer 2 SDL diagram (37/59)

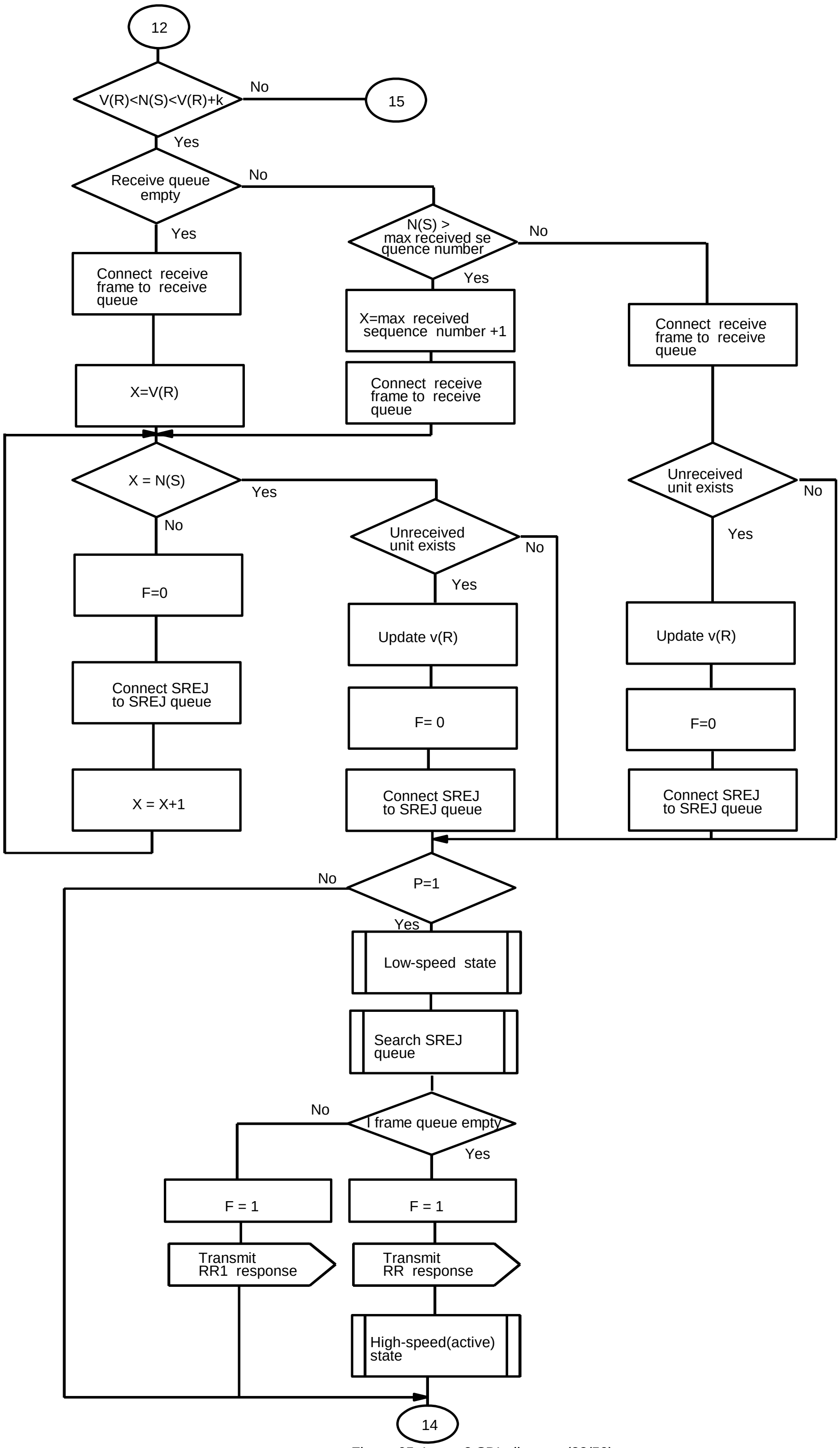


Figure 65. Layer 2 SDL diagram (38/59)

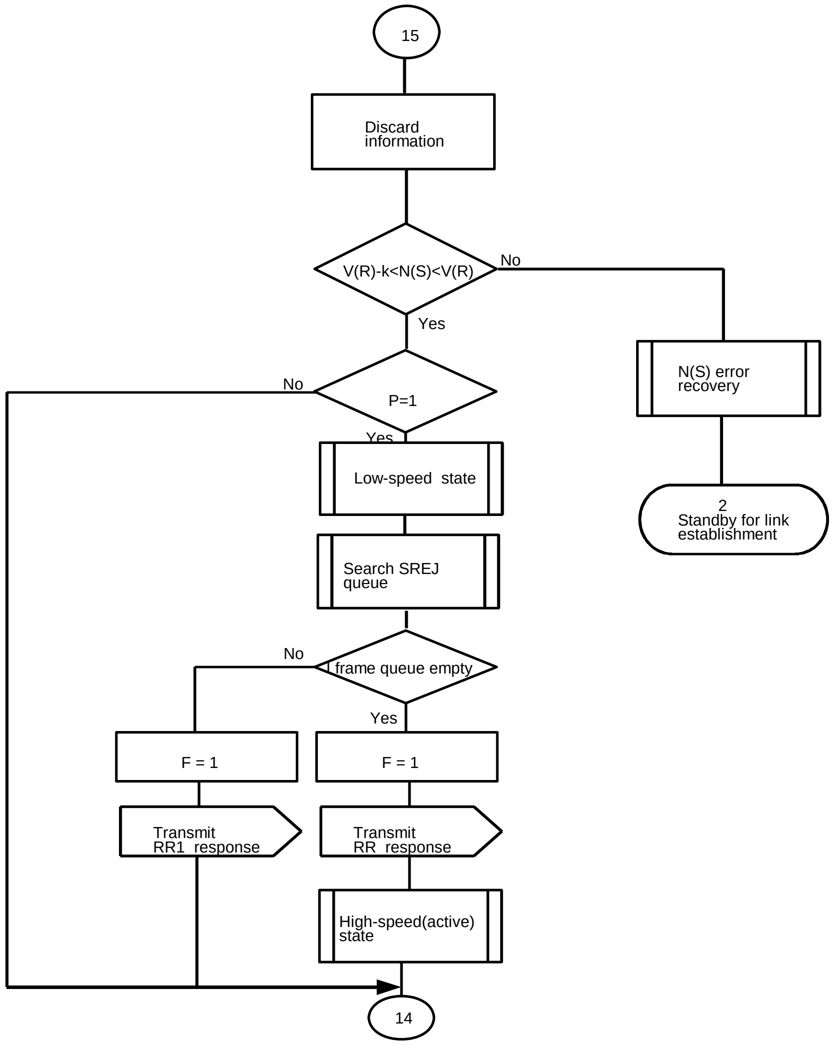


Figure 66. Layer 2 SDL diagram (39/59)

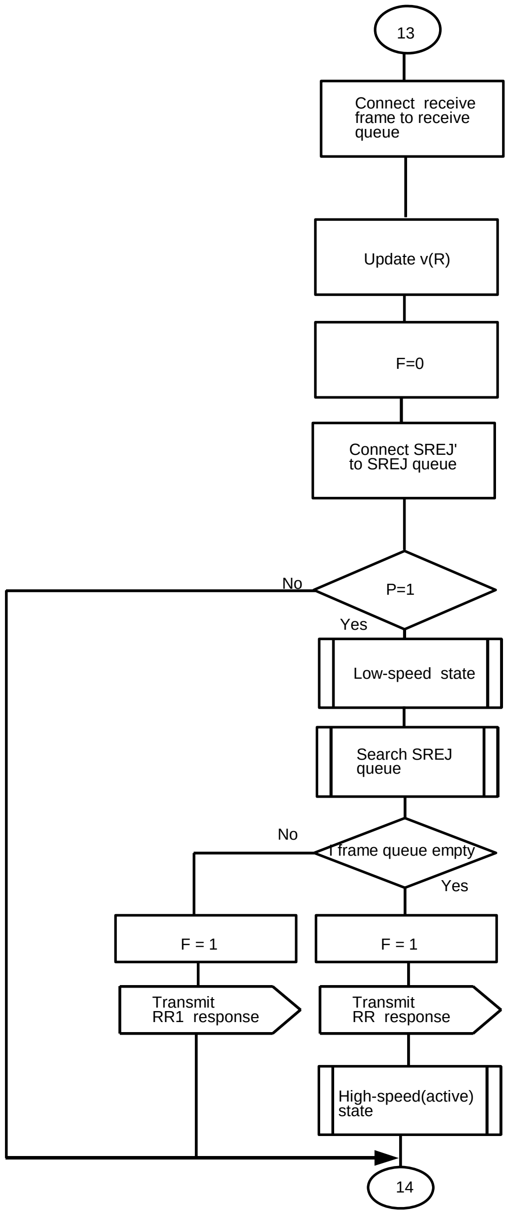


Figure 67. Layer 2 SDL diagram (40/59)

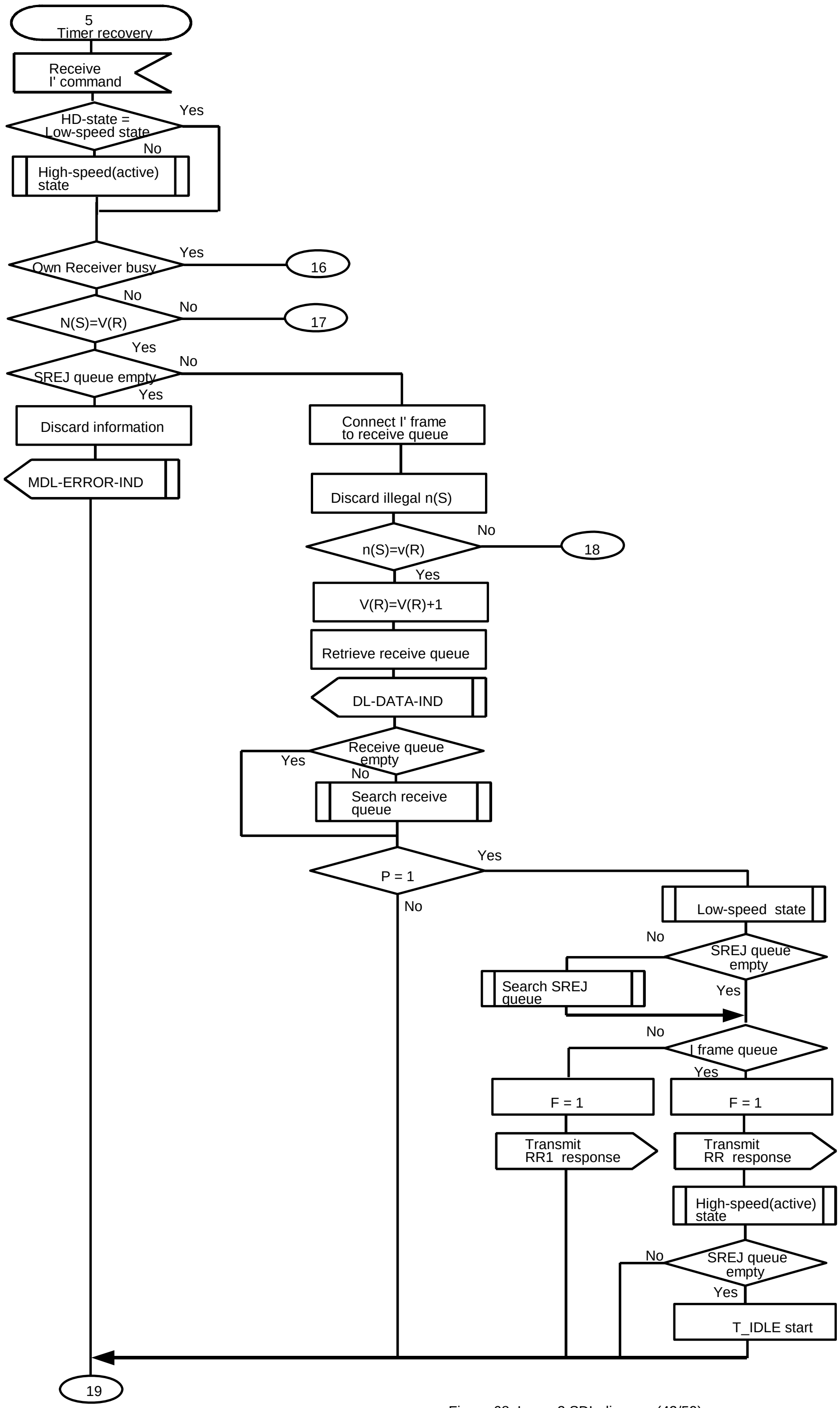


Figure 68. Layer 2 SDL diagram (42/59)

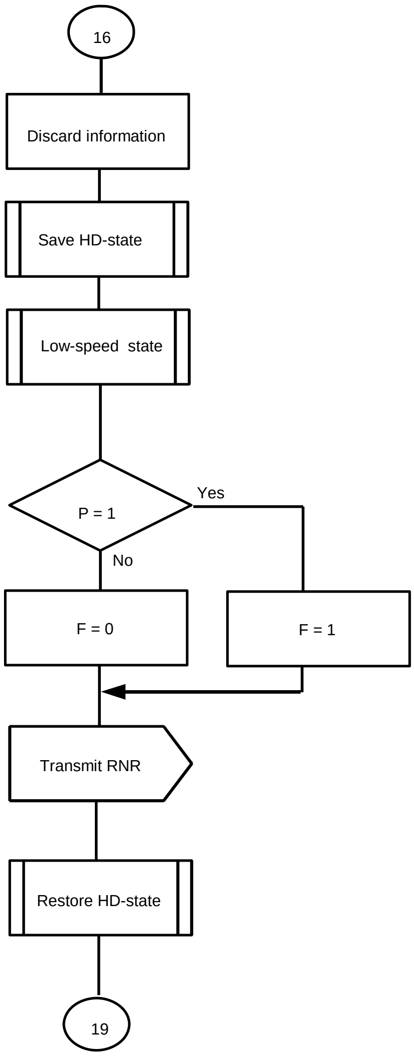
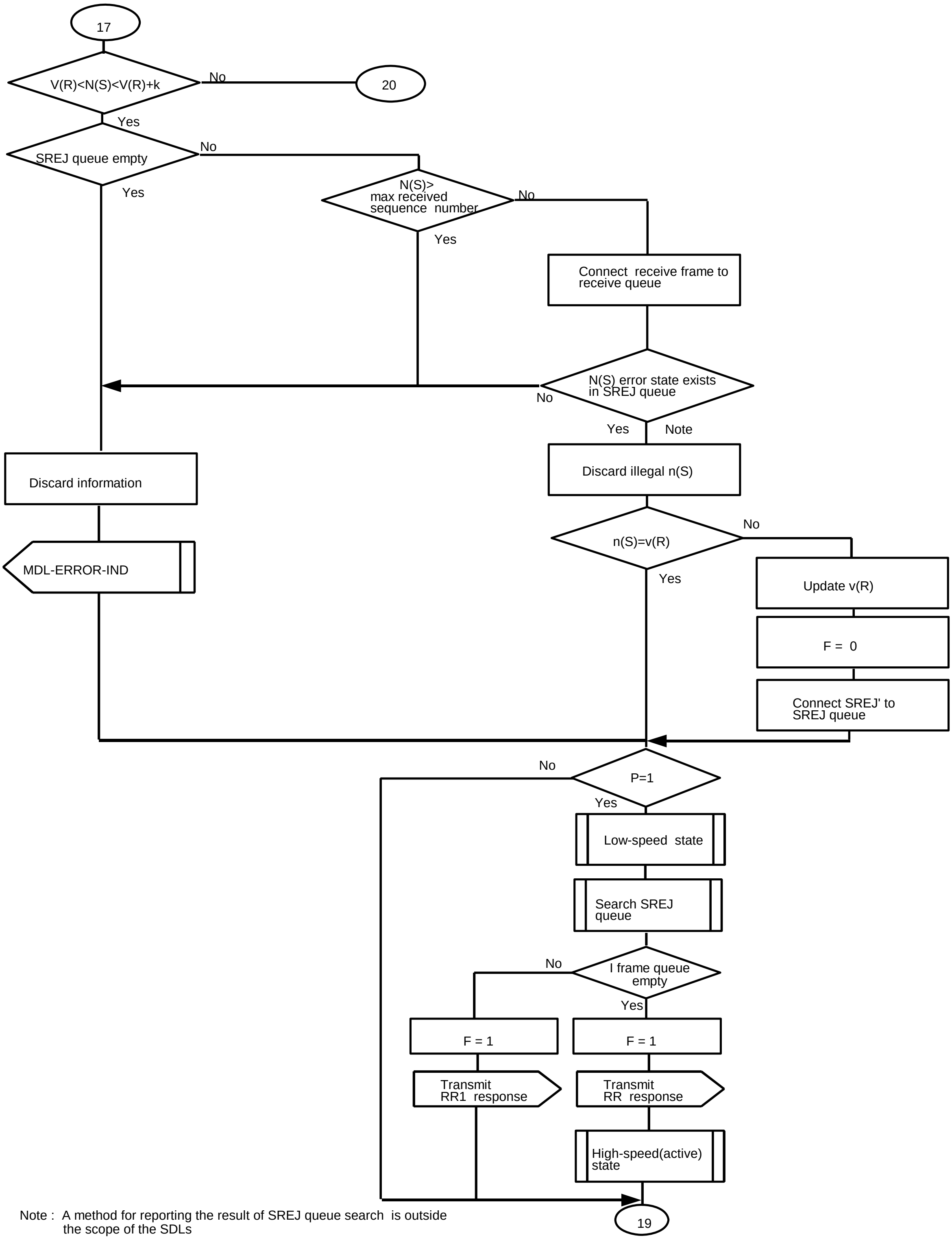


Figure 69. Layer 2 SDL diagram (43/59)



Note : A method for reporting the result of SREJ queue search is outside the scope of the SDLs

Figure 70. Layer 2 SDL diagram (44/59)

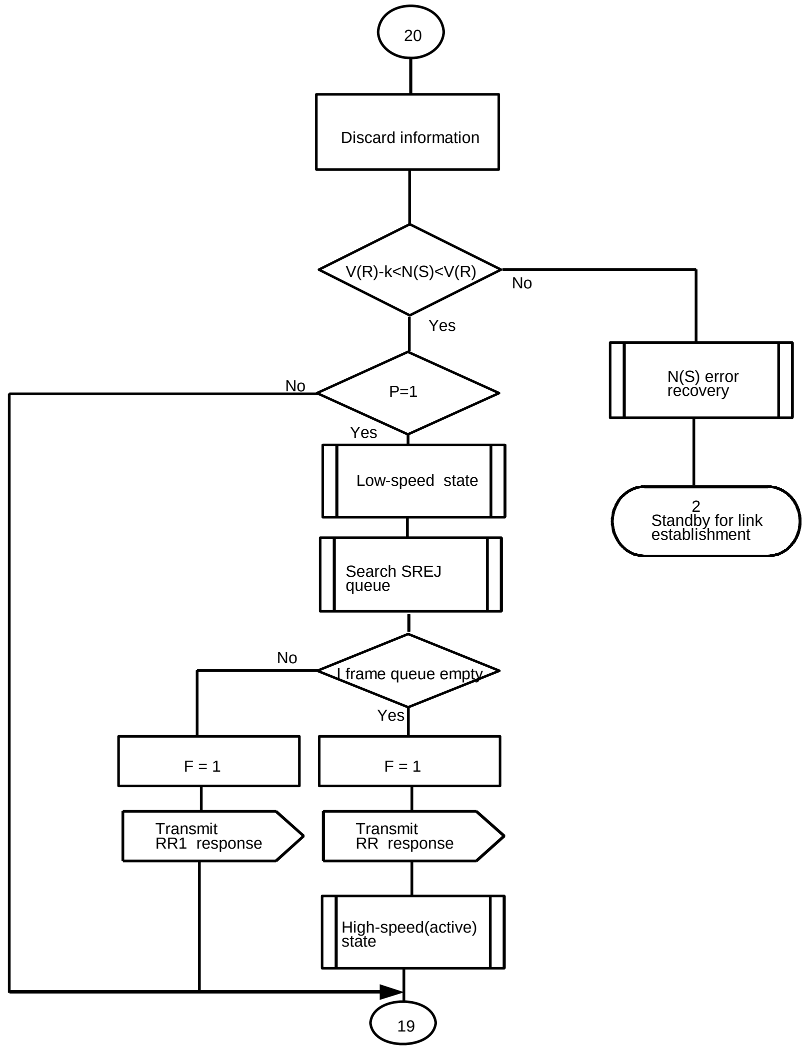


Figure 71. Layer 2 SDL diagram (45/59)

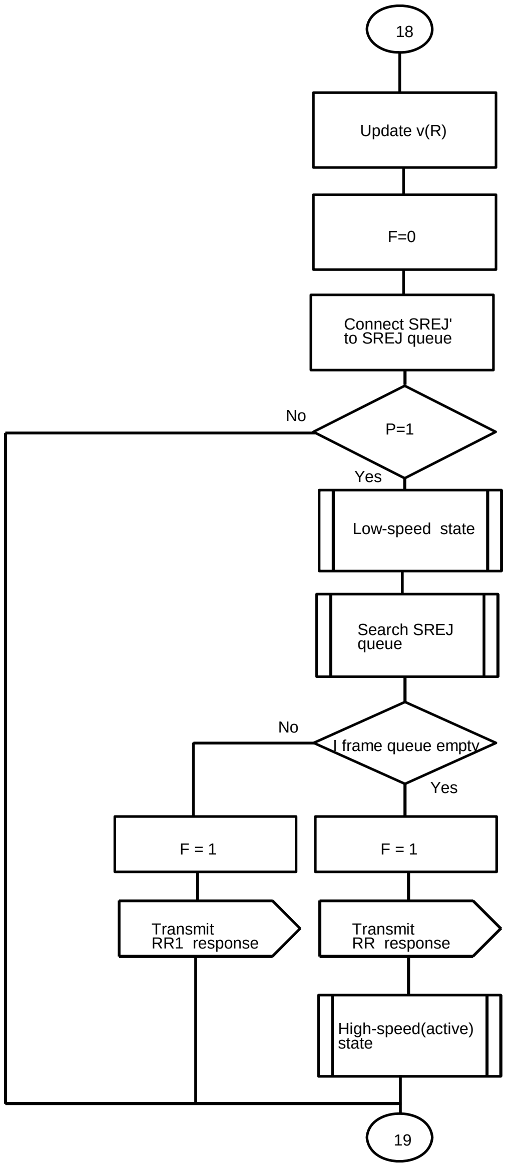
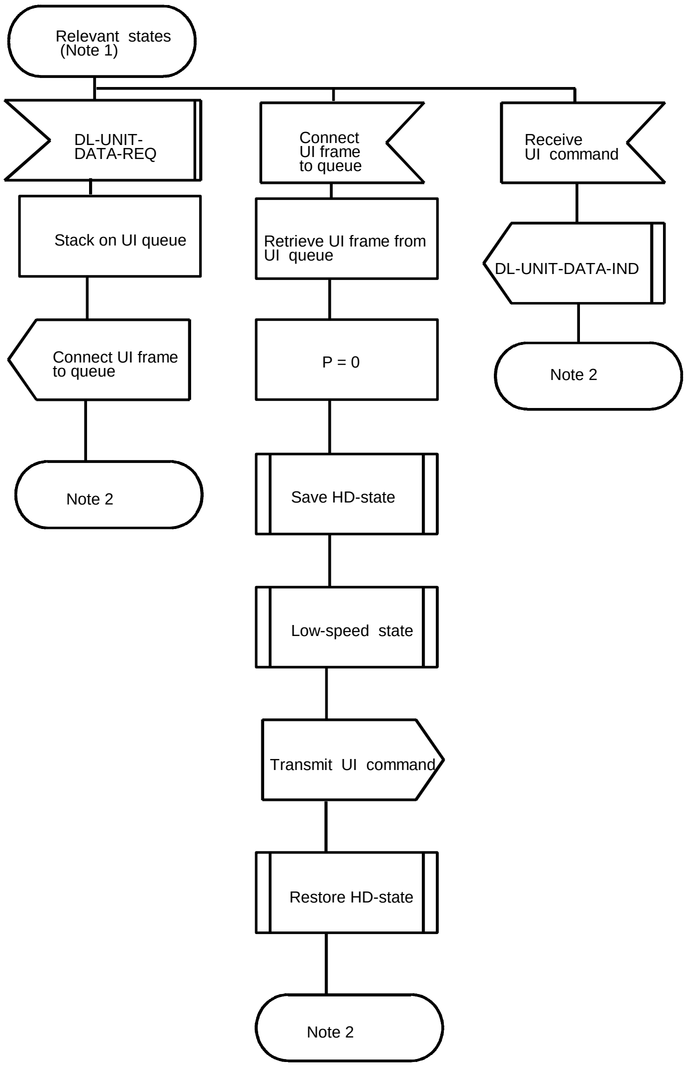


Figure 72. Layer 2 SDL diagram (46/59)



Note 1: "Relevant states" are listed below.
1. Multiple frame unestablished
2.Standby for link establishment
3. Standby for link release
4. Multiple frame established
5. Timer recovery
Note 2: Data link layer resets to the previously set state of the above states.

Figure 73. Layer 2 SDL diagram (48/59)

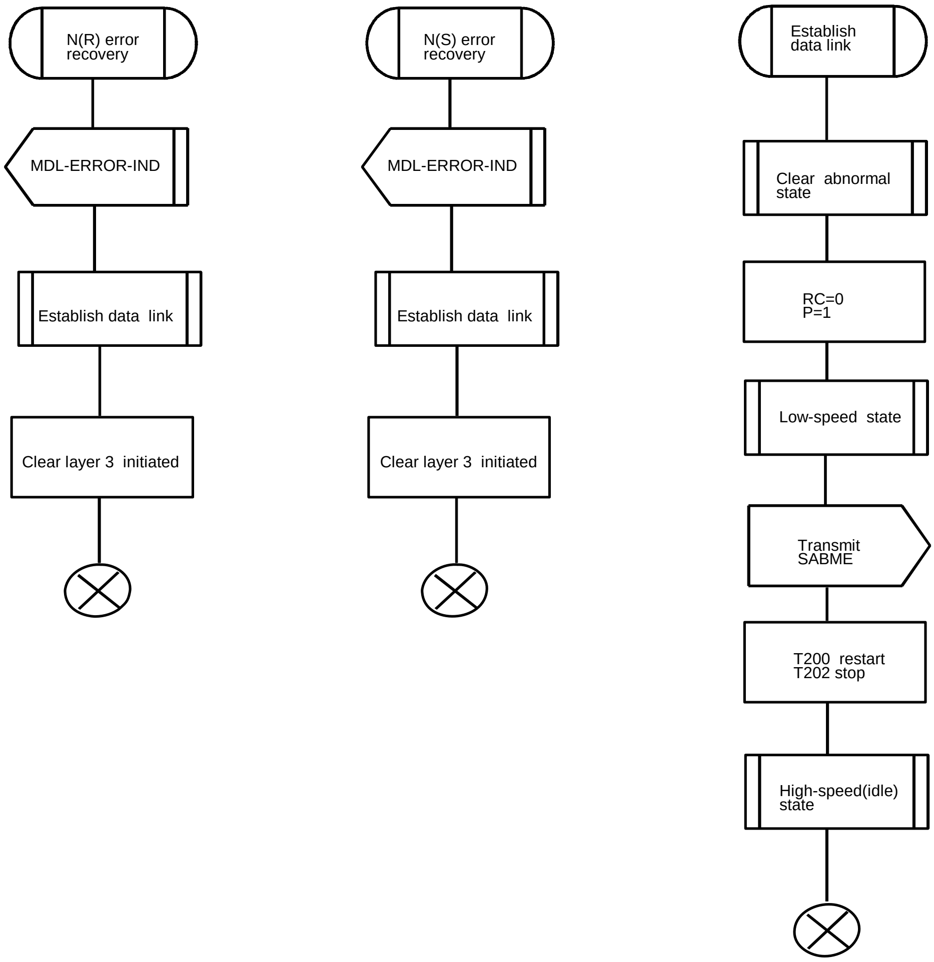


Figure 74. Layer 2 SDL diagram (51/59)

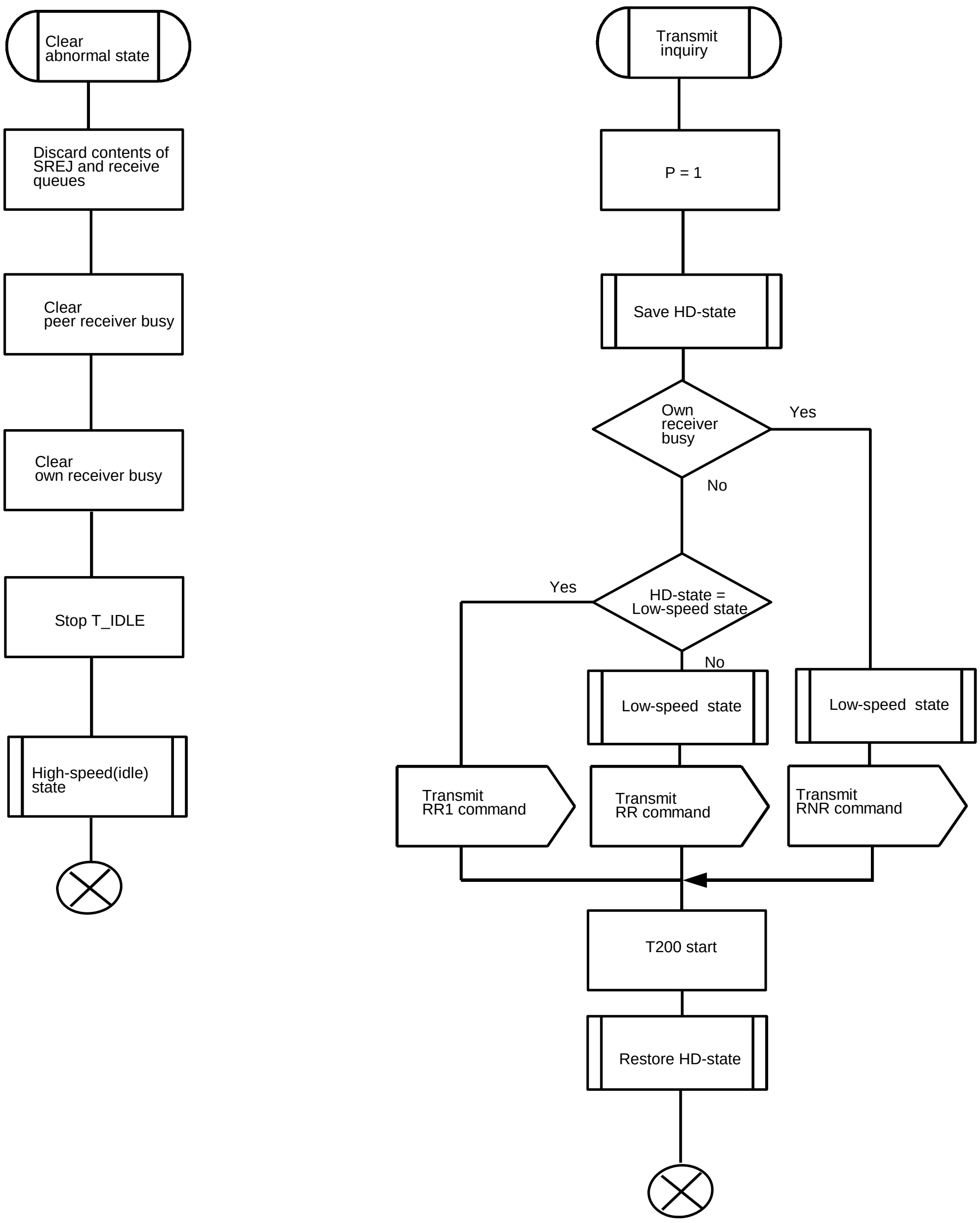


Figure 75. Layer 2 SDL diagram (52/59)

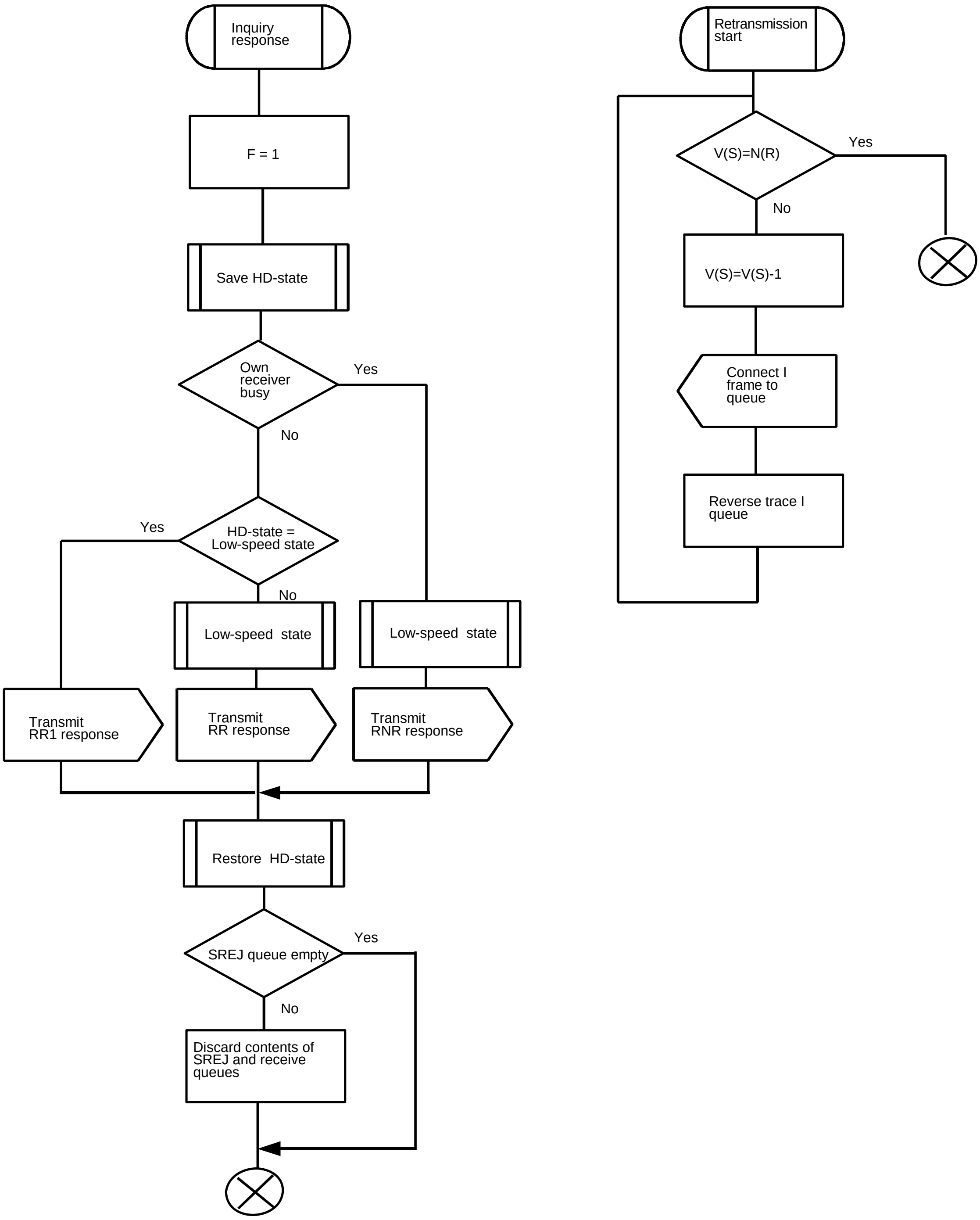


Figure 76. Layer 2 SDL diagram (53/59)

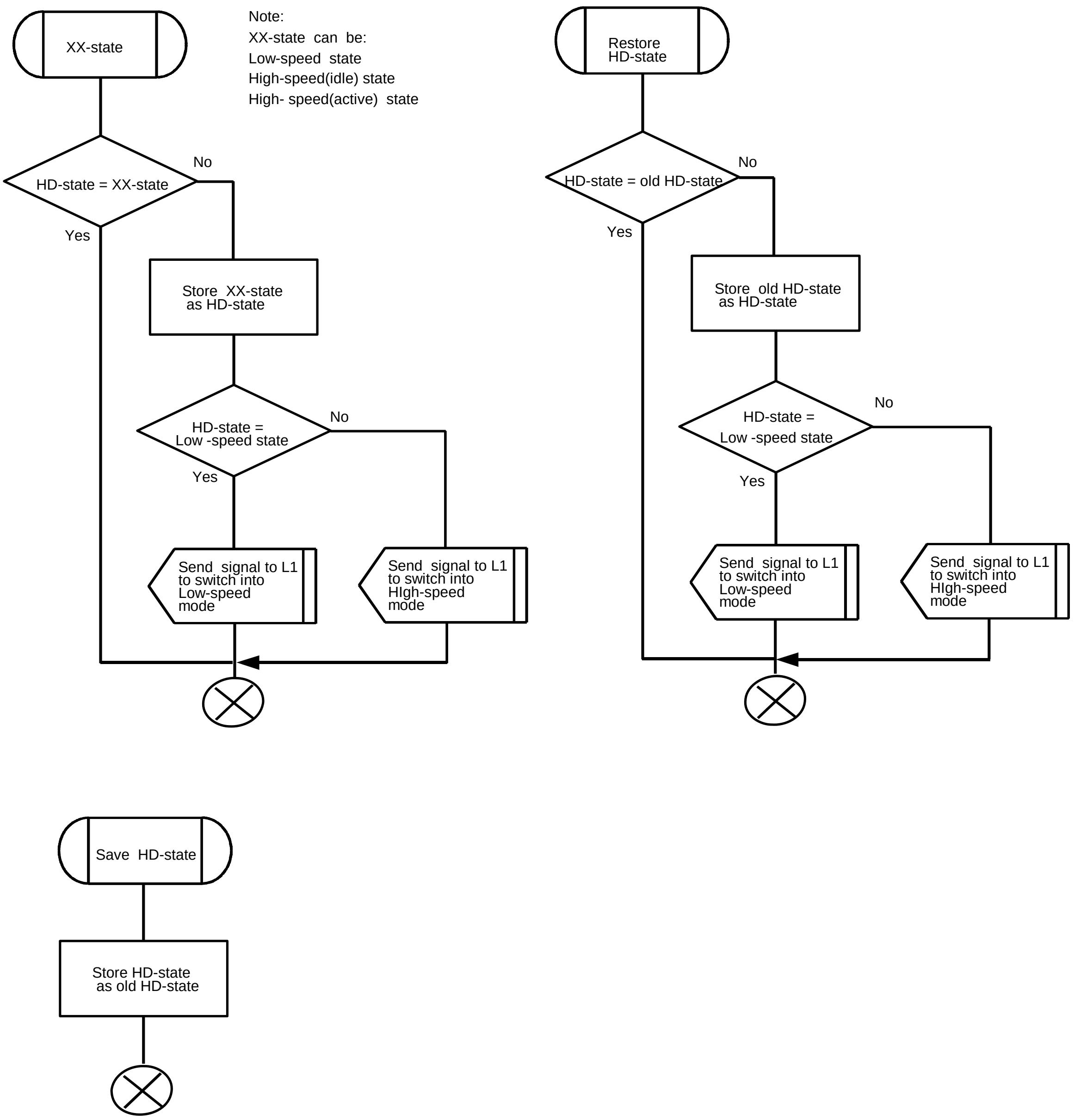


Figure 77. Layer 2 SDL diagram (59/59)

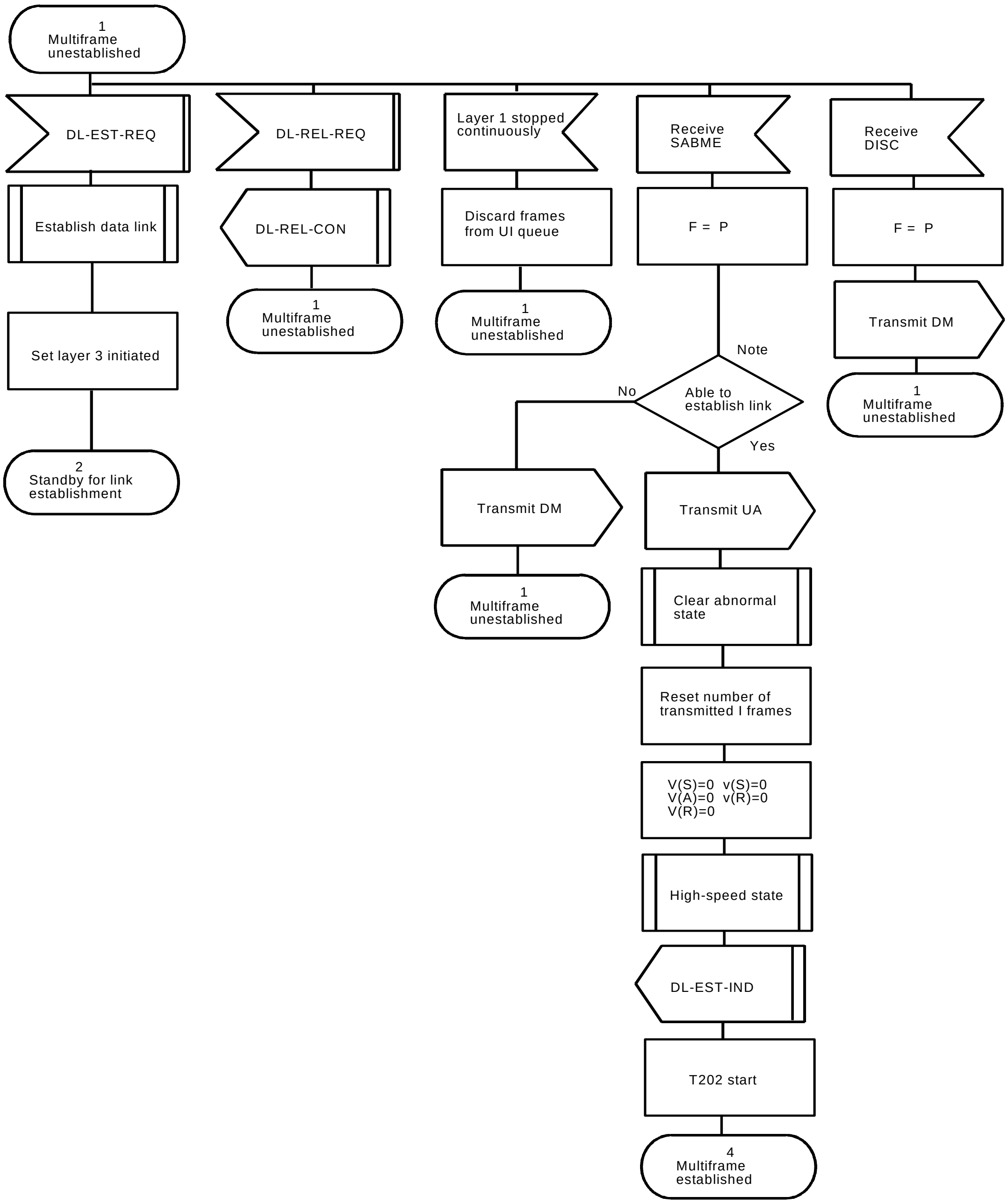
4.2 SDL diagrams (network side)

Layer 2 SDL diagrams on the network side for Half-duplex packet communication method are specified in terms of differences from Fig. A.4.2 (Annex A).

Table 3.

L2 SDL Diagram No.(SAPI=1,6)	Usage in Half-duplex packet communication (network side)
1(58)	modified, Figure 78
2(58)	not modified, same as Fig. A.4.2
3(58)	not modified, same as Fig. A.4.2
4(58)	modified, Figure 79
5(58)	not modified, same as Fig. A.4.2
6(58)	not modified, same as Fig. A.4.2
7(58)	not modified, same as Fig. A.4.2
8(58)	modified, Figure 80 and Figure 81
9(58)	not modified, same as Fig. A.4.2
10(58)	modified, Figure 82
11(58)	not modified, same as Fig. A.4.2
12(58)	modified, Figure 83
13(58)	modified, Figure 84
14(58)	modified, Figure 85
15(58)	not modified, same as Fig. A.4.2
16(58)	not modified, same as Fig. A.4.2
17(58)	not modified, same as Fig. A.4.2
18(58)	not modified, same as Fig. A.4.2
19(58)	not modified, same as Fig. A.4.2
20(58)	not modified, same as Fig. A.4.2
21(58)	not modified, same as Fig. A.4.2
22(58)	not modified, same as Fig. A.4.2
23(58)	not modified, same as Fig. A.4.2
24(58)	not modified, same as Fig. A.4.2
25(58)	not modified, same as Fig. A.4.2
26(58)	not modified, same as Fig. A.4.2
27(58)	not modified, same as Fig. A.4.2
28(58)	not modified, same as Fig. A.4.2
29(58)	not modified, same as Fig. A.4.2
30(58)	modified, Figure 86
31(58)	not modified, same as Fig. A.4.2
32(58)	modified, Figure 87
33(58)	not modified, same as Fig. A.4.2
34(58)	not modified, same as Fig. A.4.2
35(58)	not modified, same as Fig. A.4.2

36(58)	not modified, same as Fig. A.4.2
37(58)	not modified, same as Fig. A.4.2
38(58)	not modified, same as Fig. A.4.2
39(58)	not modified, same as Fig. A.4.2
40(58)	not modified, same as Fig. A.4.2
41(58)	not modified, same as Fig. A.4.2
42(58)	not modified, same as Fig. A.4.2
43(58)	not modified, same as Fig. A.4.2
44(58)	not modified, same as Fig. A.4.2
45(58)	not modified, same as Fig. A.4.2
46(58)	not modified, same as Fig. A.4.2
47(58)	not modified, same as Fig. A.4.2
48(58)	not modified, same as Fig. A.4.2
49(58)	not modified, same as Fig. A.4.2
50(58)	not modified, same as Fig. A.4.2
51(58)	not modified, same as Fig. A.4.2
52(58)	modified, Figure 88
53(58)	not modified, same as Fig. A.4.2
54(58)	not modified, same as Fig. A.4.2
55(58)	not modified, same as Fig. A.4.2
56(58)	not modified, same as Fig. A.4.2
57(58)	not modified, same as Fig. A.4.2
58(58)	not modified, same as Fig. A.4.2
----	new, Figure 89
----	new, Figure 90



Note: Whether or not data link can be set is decided depending on whether or not the data link layer entity can receive/transmit messages and primitives normally with the L3, L1 and management entity

Figure 78. Layer 2 SDL diagram (1/60)

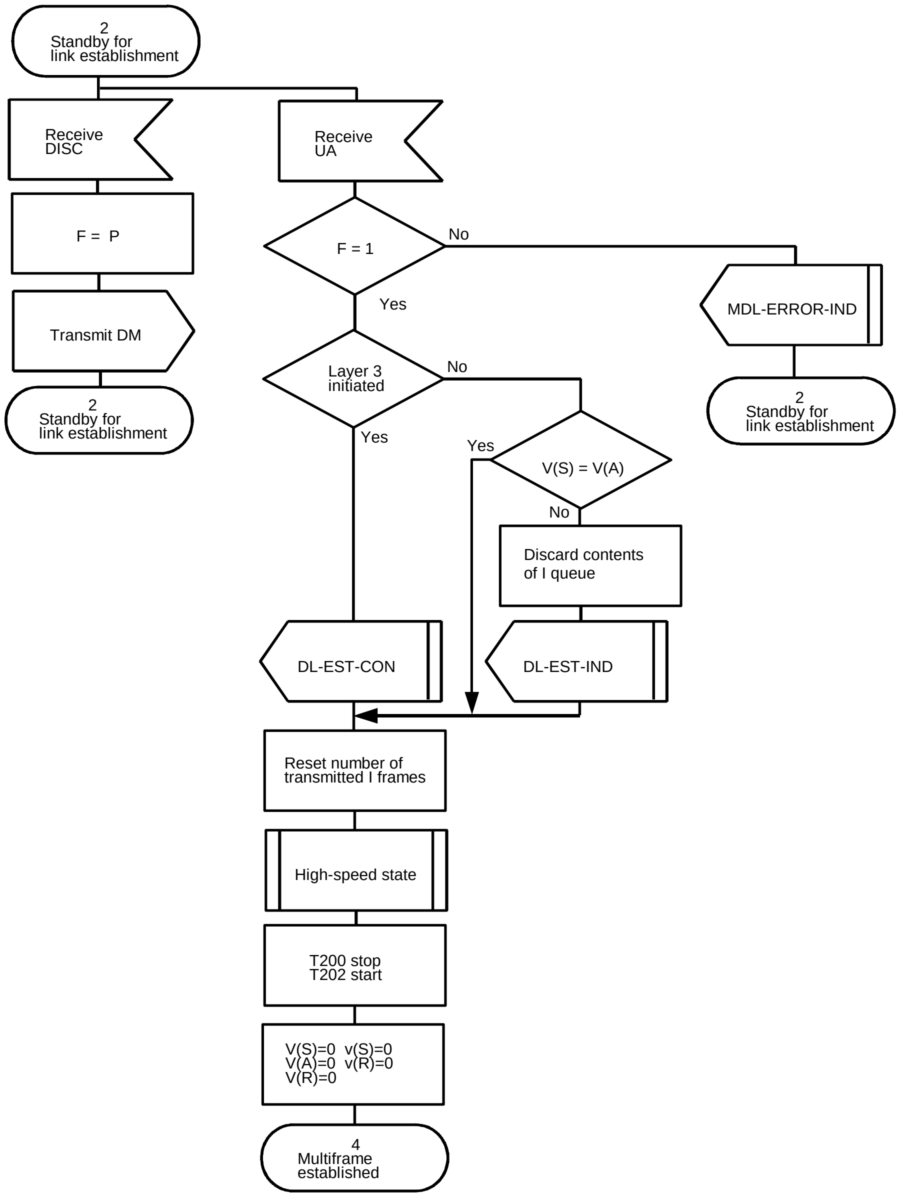
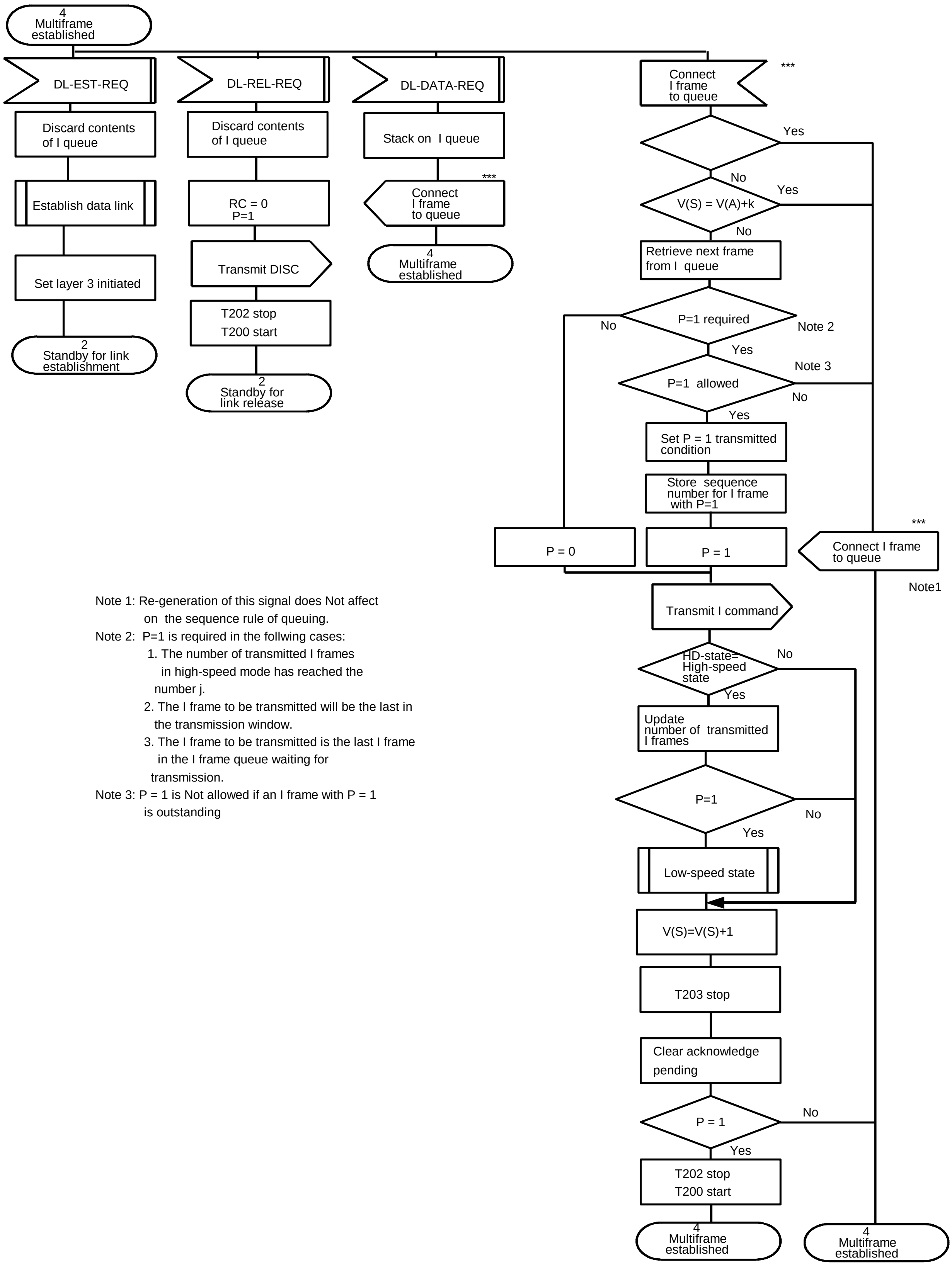


Figure 79. Layer 2 SDL diagram (4/60)



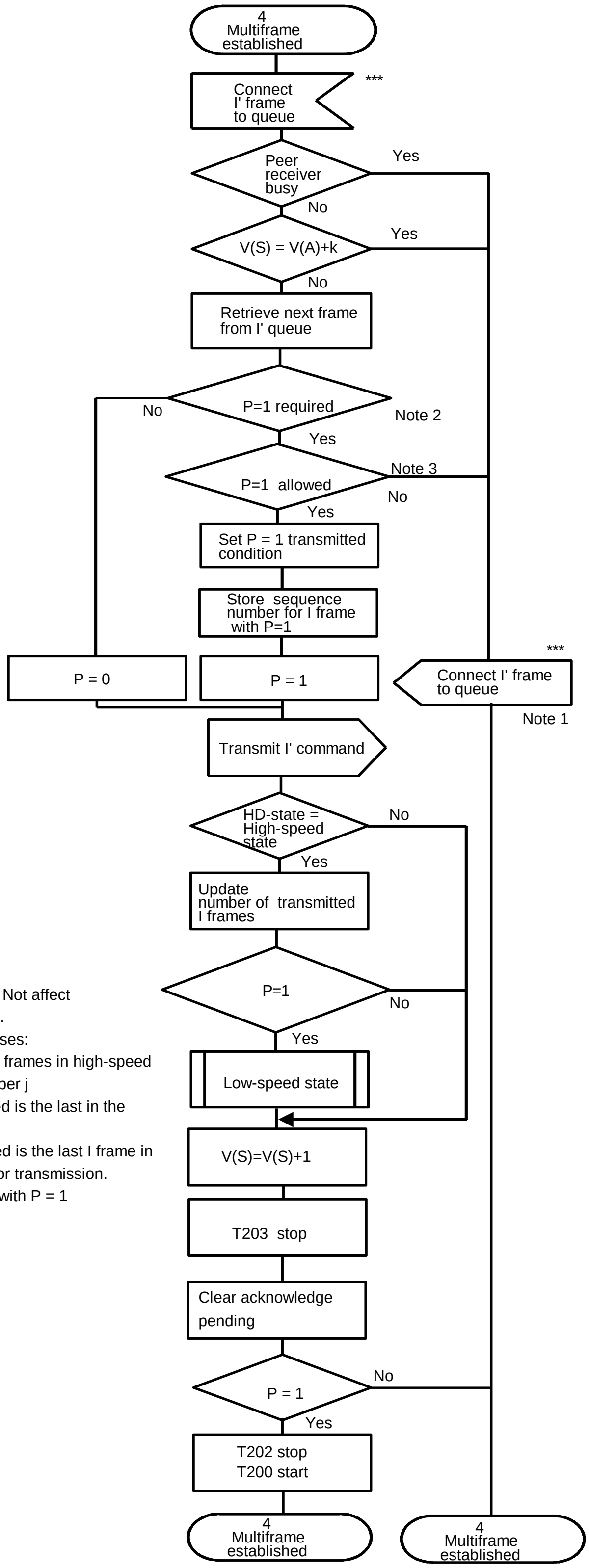
Note 1: Re-generation of this signal does Not affect on the sequence rule of queuing.

Note 2: P=1 is required in the follwing cases:

1. The number of transmitted I frames in high-speed mode has reached the number j.
2. The I frame to be transmitted will be the last in the transmission window.
3. The I frame to be transmitted is the last I frame in the I frame queue waiting for transmission.

Note 3: P = 1 is Not allowed if an I frame with P = 1 is outstanding

Figure 80. Layer 2 SDL diagram (8/60)



Note 1: Re-generation of this signal does Not affect
on the sequence rule of queuing .

Note 2: P=1 is required in the follwing cases:

1. The number of transmitted I frames in high-speed mode has reached the number j
2. The I frame to be transmitted is the last in the transmission window
3. The I frame to be transmitted is the last I frame in the I frame queue waiting for transmission.

Note 3: P = 1 is Not allowed if an I frame with P = 1
is outstanding

Figure 81. Layer 2 SDL diagram (8/60)

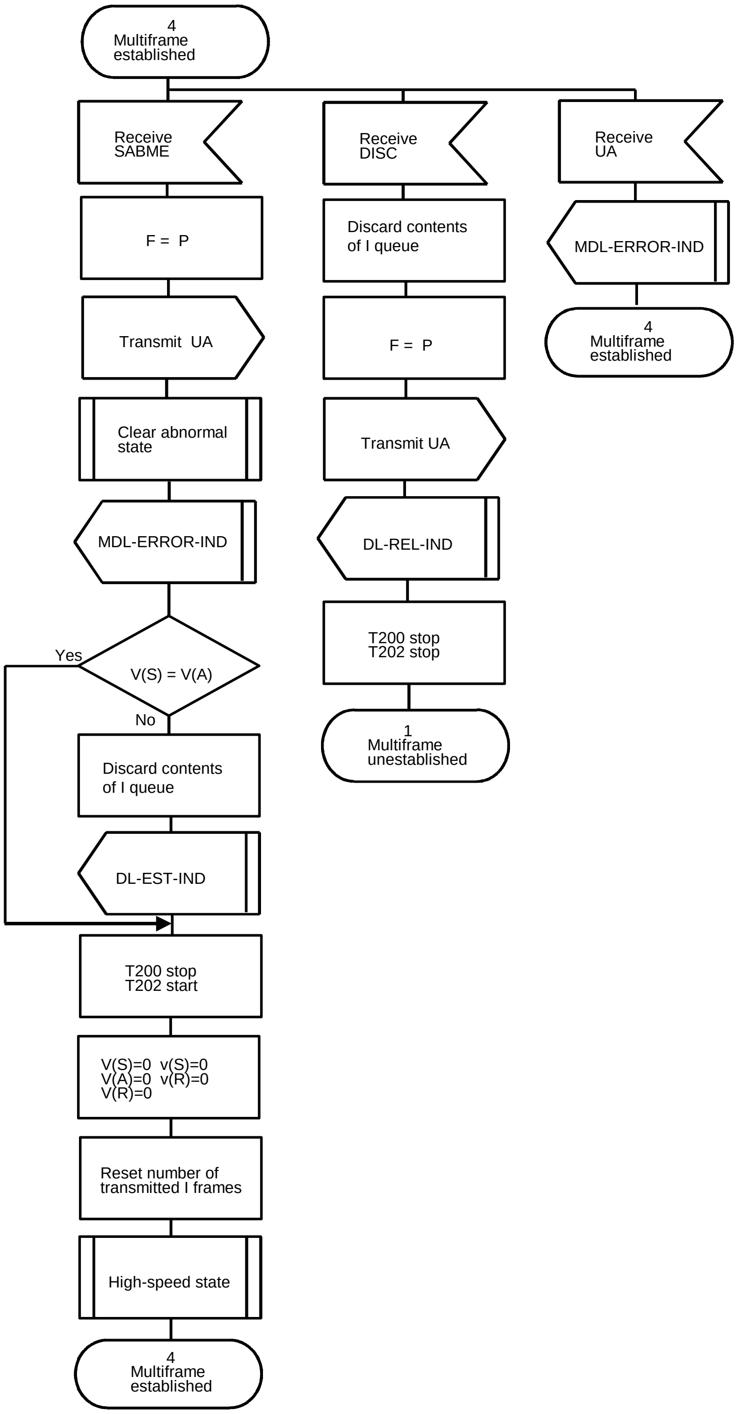


Figure 82. Layer 2 SDL diagram (10/60)

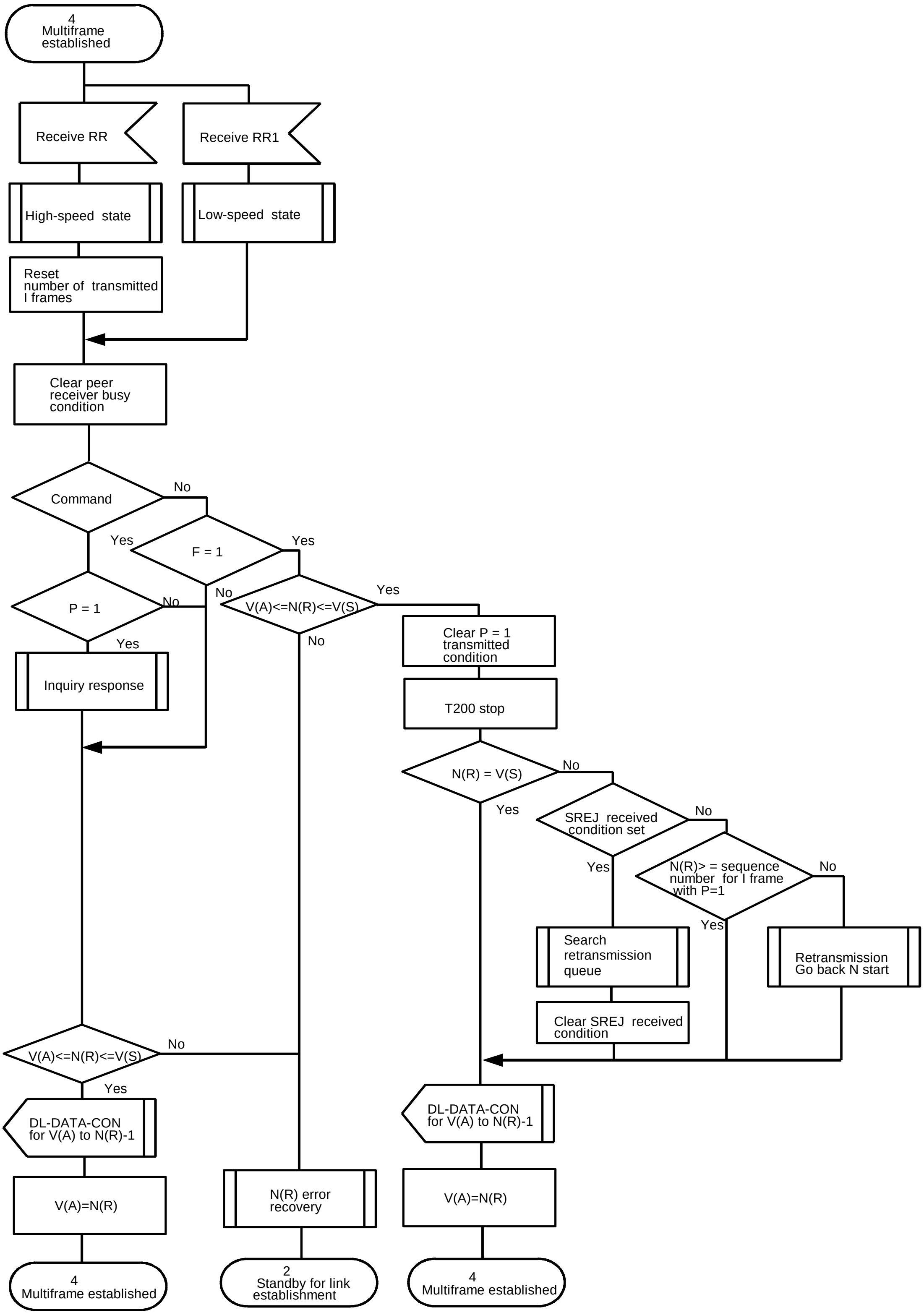


Figure 83. Layer 2 SDL diagram (12/60)

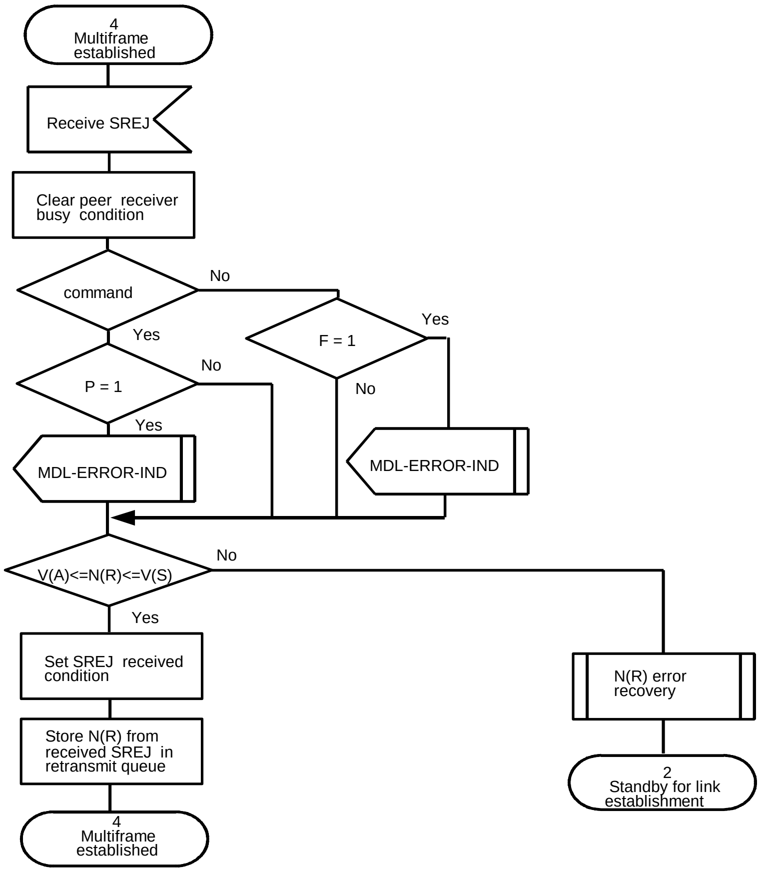


Figure 84. Layer 2 SDL diagram (13/60)

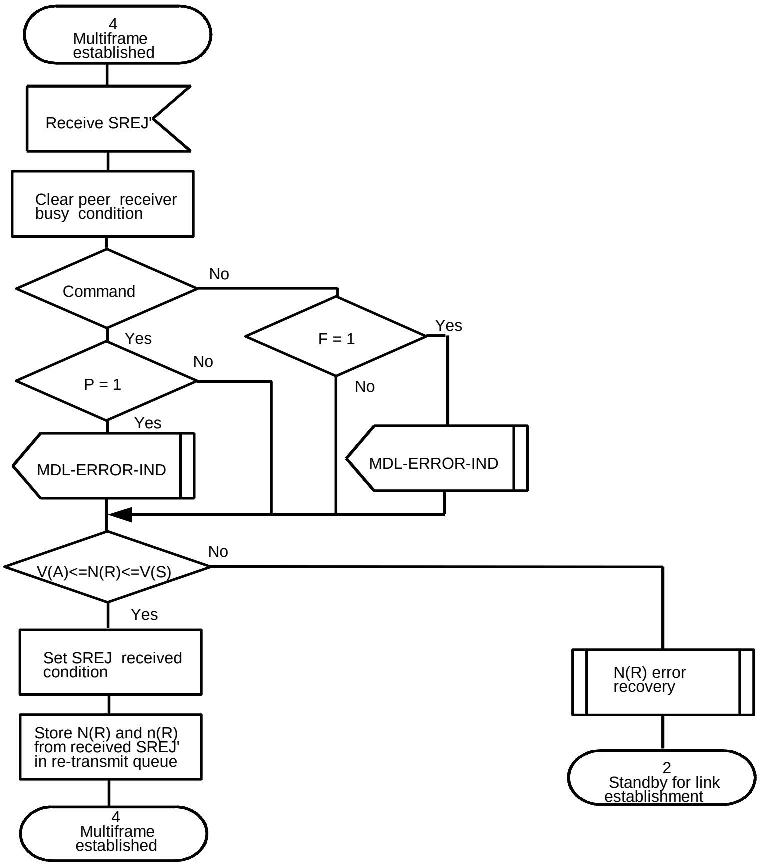


Figure 85. Layer 2 SDL diagram (14/60)

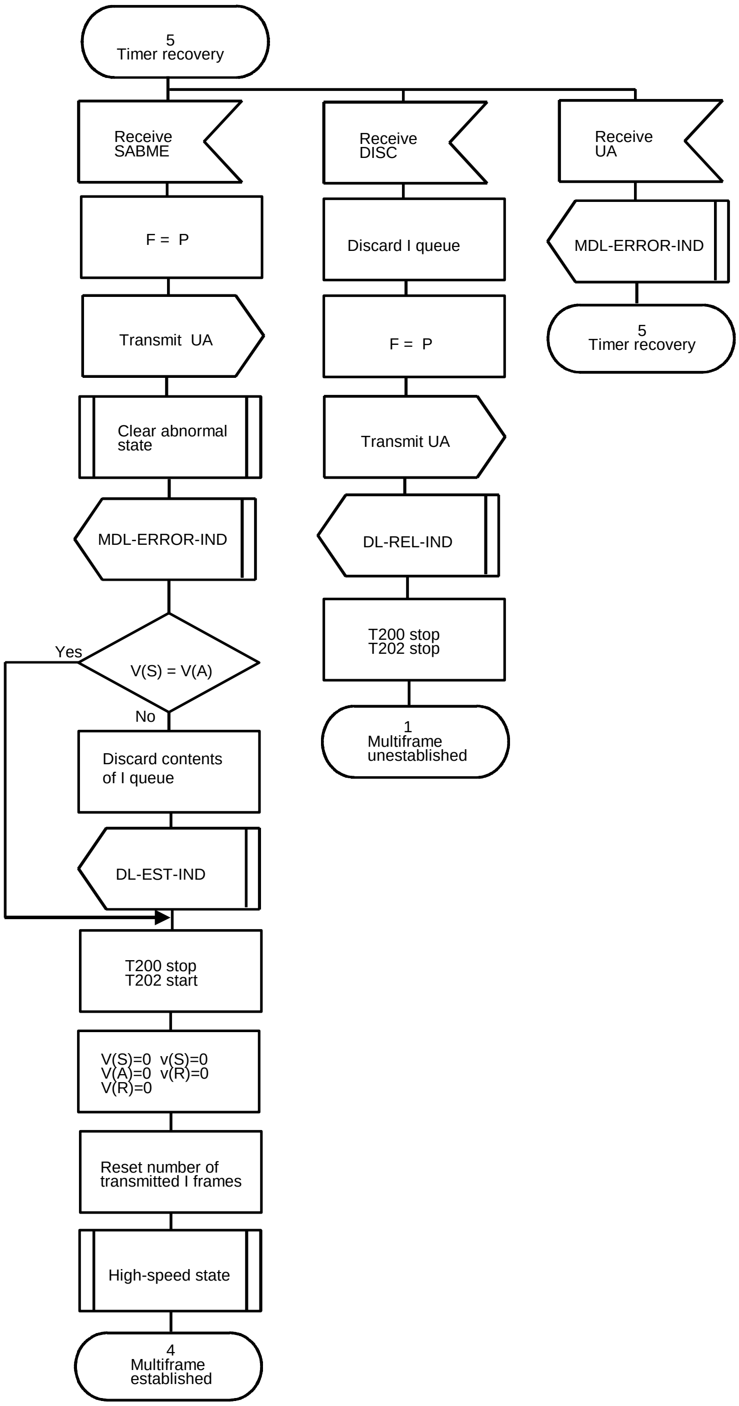


Figure 86. Layer 2 SDL diagram (30/60)

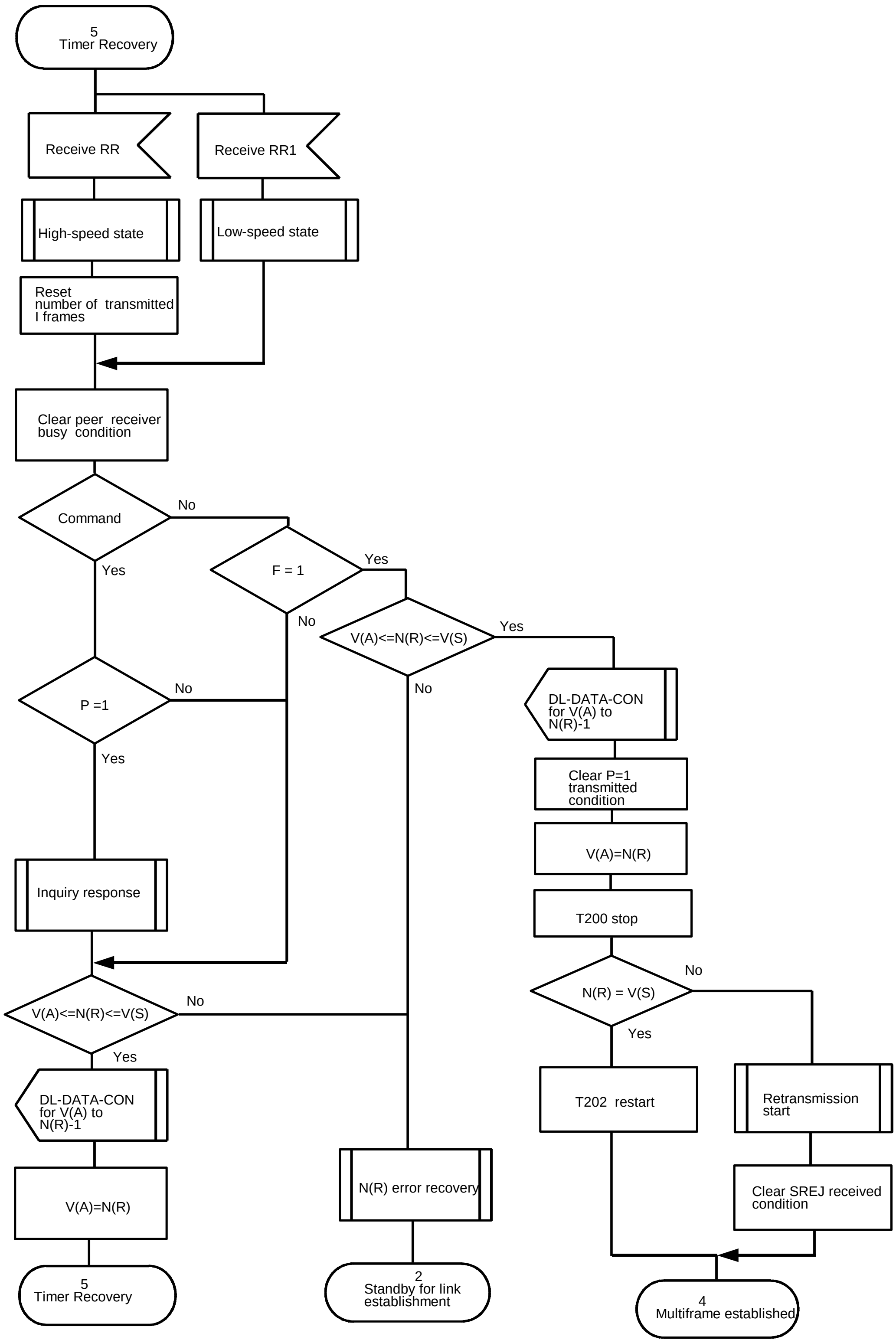


Figure 87. Layer 2 SDL diagram (31/60)

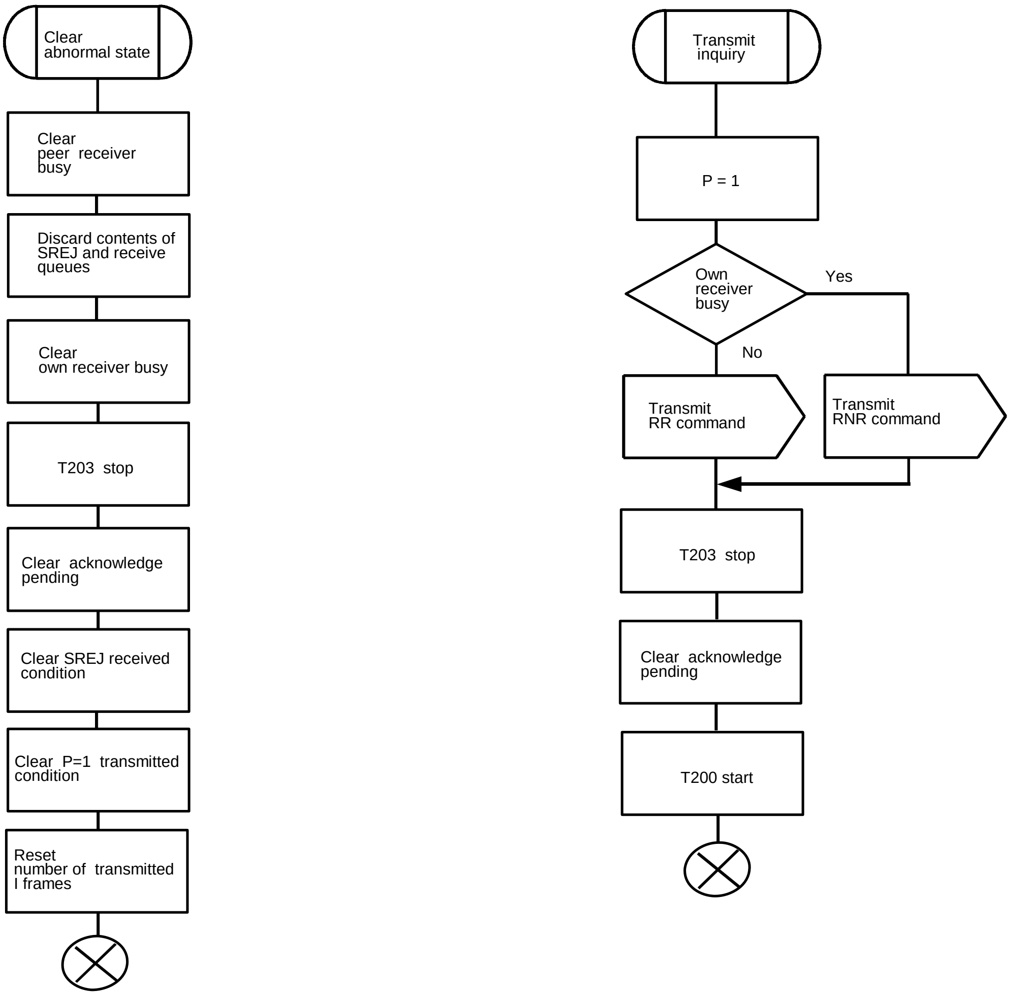
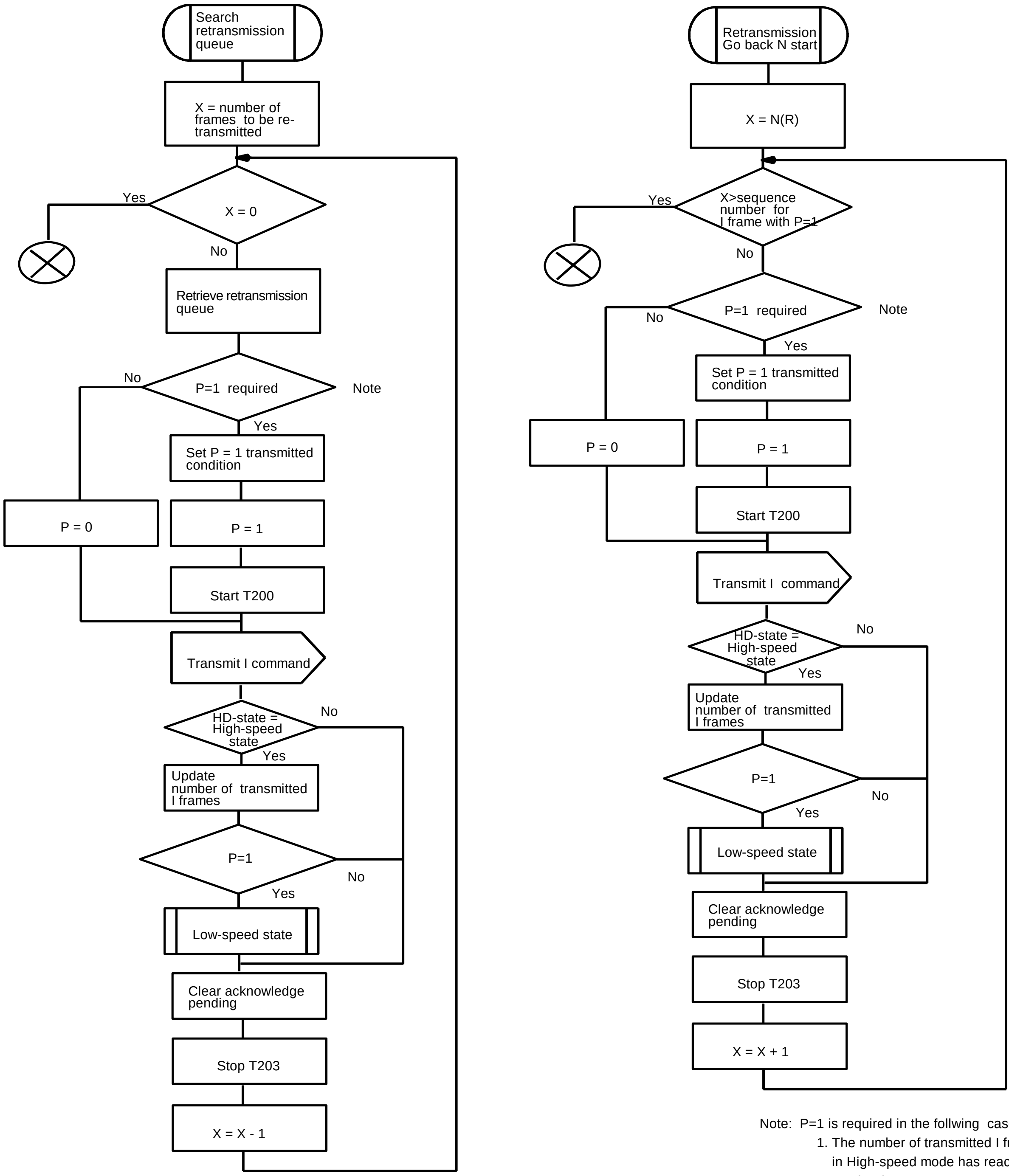


Figure 88. Layer 2 SDL diagram (52/60)



Note: P=1 is required in the follwing cases:
1. The number of transmitted I frames in High-speed mode has reached the number j.
2. The I frame to be transmitted is the last the transmission window.
3. The I frame to be transmitted is the last I frame in the I frame queue waiting for transmission.

Figure 89. Layer 2 SDL diagram (59/60)

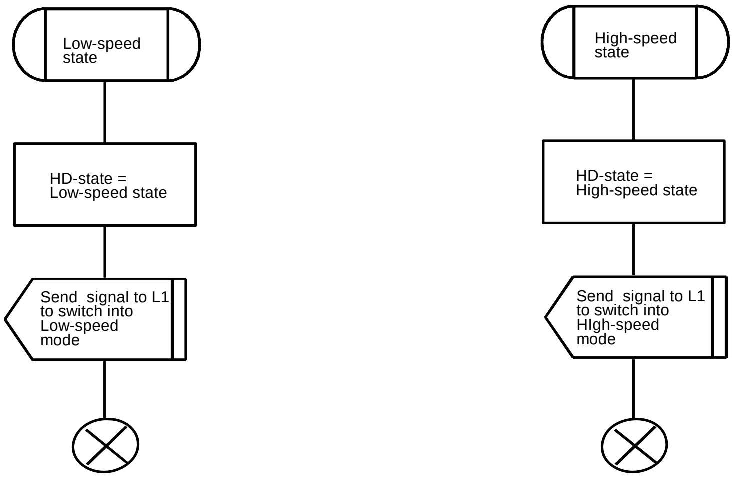


Figure 90. Layer 2 SDL diagram (60/60)

Annex 6 Standard for the Radio Interface of the Wireless Local Loop System

Introduction

This Annex is developed for “Radio Interface of the Wireless Local Loop System” and specifies the requirements to apply the Personal Digital Cellular Telecommunication System to the Wireless Local Loop System in overseas country.

Description in this annex

1. This Annex (Standard for the Radio Interface of the Wireless Local Loop System) fundamentally complies with the main text (the definition of the “main text” is described in Chapter 1) and has the same structure. In this Annex, only the parts which are changed from the main text are described and other parts are quoted from the main text.
2. Chapter 1 is newly created and the main text is quoted when necessary. For Chapters 2 through 4, and appendices, the table of contents of the main text is referred to indicate the changed sections. Only those changed sections are described in this Annex.
3. Chapters 5 through 7 in the main text and Annexes (excluding Annex 6) apply as they are to this Annex.

Notes:
1. This Annex is not applied to domestic use. The equipment and the systems manufactured based on this Annex shall not be used in Japan.
2. The declaration regarding industrial property right described in the note of the introduction in the Standard for the Personal Digital Cellular Telecommunications System (RCR STD-27) does not apply to this Annex.

CONTENTS

1. General

1.1 Overview

This Annex specifies the radio interface for the Wireless Local Loop System (hereinafter referred to as “WLL System”) using the Personal Digital Cellular Telecommunications System technology.

1.2 Scope of application

The WLL System consists of a mobile station and a base station as shown in Figure 1.1 (refer to Attached document 1). This Annex specifies the radio interface for the WLL System as indicated in Figure 1.1 below.

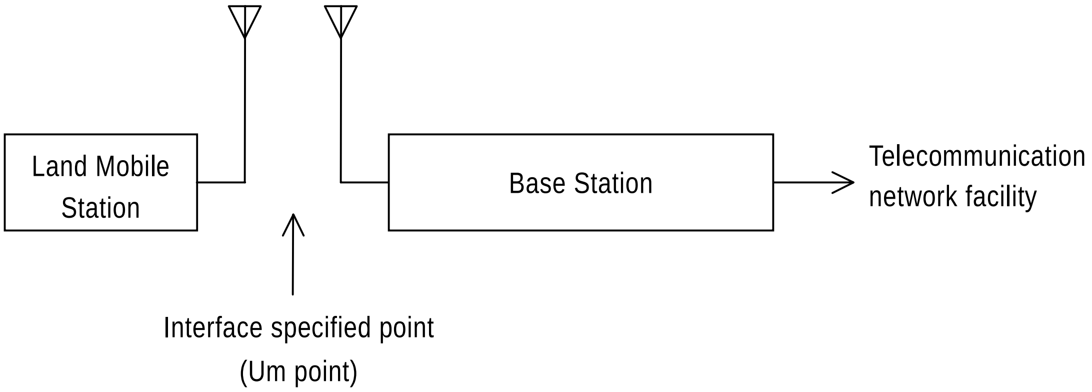


Figure 1.1 Radio interface specified point for WLL System

1.3 Normative References

In this Annex, the “main text” refers to Chapters 1 through 7 and Annexes (excluding Annex 6) of the Personal Digital Cellular Telecommunications System standard (RCR STD-27).

“Test Items and Conditions for Mobile Station Compatibility Confirmation-Technical Report (RCR TR-22) ” is a related document.

This Annex is limited to overseas use; therefore, no domestic law or regulation (ordinance, rule, notice, etc.) is applicable.

Therefore, no law or regulation corresponding to the radio interface standard is referred to in this Annex.

2. System Overview

Except for the changed sections mentioned below, this chapter complies with Chapter 2 of the main text.

The sections with the changed contents are indicated in the reference table in the next page which is made from the table of the contents of Chapter 2 of the main text. Only the changed sections and their contents are described in this chapter.

[Reference table to Chapter 2 of the main text]

Note: Sections marked with an asterisk mean they are changed.

2.1 Structure of the system

A WLL System consists of a land mobile station and a base station (refer to Attached document 1).

2.1.1 Land mobile station (MS)

The land mobile station provides the wireless communications together with the base station and is used as communication circuit terminating equipment at subscriber side.

The land mobile station consists of one or more antennas, radio equipment which includes both transmitter and receiver, a speech codec, a handset, control devices, and so on. Supplemental equipment for the subscriber can be connected to the mobile station if it is required (refer to Attached document 1).

Hereinafter, unless otherwise specified, a “land mobile station” or an “MS” described in this Annex indicates the mobile station or the MS for the WLL System and does not mean the general mobile station or the MS for the Personal Digital Cellular Telecommunication System.

2.1.2 Base station

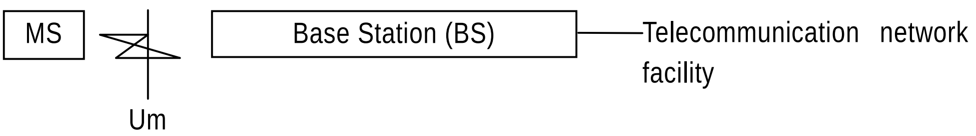
The base station provides the wireless communications together with the land mobile station.

The base station consists of one or more antennas, radio equipment which includes both transmitter and receiver, a speech codec, control devices, and so on (refer to Attached document 1).

Hereinafter, unless otherwise specified, a “base station” or a “BS” described in this Annex indicates the base station or the BS for the WLL System and does not mean the general mobile station or the BS for the Personal Digital Cellular Telecommunication System.

2.2 Definition of the interface

The interface specified point in the WLL System is only one point (Um) shown in Figure 2.1.



Interface Um : Interface between the mobile station and the base station. Refer to the main text and this Annex.

Figure 2.1 Interface specified point

2.3 Basic functions of the system

The WLL System is a wireless local loop network providing comprehensive telecommunications services, including voice, data, etc., through the general-purpose radio interface (interface Um) and shall meet the following requirements as basic functions.

(1) Digitized network

The system shall allow the efficient use of frequencies, along with offering communications quality and confidentiality at least equivalent to, or surpassing those of conventional analog cellular mobile telephone systems.

(2) Interconnectivity with other communications network

The system shall be capable of being interconnected with conventional analog telephone network, ISDN, and packet data network.

(3) ISDN services capability

Along with offering the basic services provided by conventional cellular telephone systems, the WLL System shall also provide such various services as can be offered by ISDN.

2.3.2.2 Service types

(2) Teleservices

The teleservices provided via the information transfer channel are listed in Table 2.3 below.

Table 2.3 Teleservices

Item	Service
G3 facsimile *	Service enabling communications between G3 fax terminals according to ITU-T. T.30 procedure.
G4 facsimile	Service enabling communications between G4 fax terminals.
Videotex	Video information transmission service using the Captain method.
JUST-PC	Service enabling data communications between personal computers using the MPT recommended method.
JUST-MHS	Message handling service using a higher layer of MPT recommended method for PC data communications.
Modem (V.42 ANNEX) *	Service enabling data communications between personal computers using a modem which conforms to V.42 ANNEX.
Short message	Service which sends a message to a single user or broadcasts a message to multiple users and subsequently reports a reception acknowledgement to the party who transmitted the message.

Note: Items marked with an asterisk are items stipulated by this standard.

Chapter 3 Technical Requirements for Radio Facilities

Except for the changed sections mentioned below, this chapter complies with Chapter 3 of the main text.

The sections with the changed contents are indicated in the reference table in the next pages which is made from the table of contents of Chapter 3 of the main text. Only the changed sections and their contents are described in this chapter.

The Japanese laws and regulations, such as the Ordinance for executing the Radio Law and the Ordinance for regulating radio equipment quoted in the main text are not quoted in this Annex. When a requirement such as especially that relating to radio wave emission does not conform to the laws and regulations of the concerned country, it shall be revised to comply with the laws and regulations of the concerned country.

[Reference table to Chapter 3 of the main text]

Note: Sections marked with an asterisk mean they are changed.

3.1 Overview

This chapter the specifies the technical requirements for facilities constituting the air interface in the WLL System.

3.2 General conditions

3.2.1 Radio frequency bands

As this system is limited to overseas use, the radio frequency band to be used shall, in principle, comply with the laws and regulations of the concerned country.

3.2.2 Carrier frequency spacing

The same rule is adopted as 3.2.1 for carrier frequency spacing.

3.2.3 Transmit-receive frequency separation

The same rule as 3.2.1 is adopted for transmit-receive frequency separation.

3.4 Conditions relating to transmitter and receiver

3.4.1 Frequency bands and channel allocation

3.4.1.1 Frequency bands

As this system is limited to oversea use, the radio frequency band to be used shall, in principle, complies with the laws and regulations of the concerned country.

3.4.1.2 Channel frequency separation

The same rule as 3.4.1.1 is adopted for channel frequency separation.

Chapter 4 Communications Control System

Except for the changed sections mentioned below, this chapter complies with Chapter 4 of the main text.

The sections with the changed contents are indicated in the reference table in the next pages which is made from the table of contents of Chapter 4 of the main text. Only the changed sections and their contents are described in this chapter.

[Reference table to Chapter 4 of the main text]

Note: Sections marked with an asterisk mean they are changed.

Appendices

K. Handling of Spare Bits

L. Operation of the Data Link Layer During Channel Handover Failure

M. Division of Messages During Partial Retransmission Control

N. Definition of Cause Indications

O. The Correspondence Between ITU-T I-Interface Recommendations and Pertinent Sections of the Layer 2 and Layer 3 Interfaces in the RCR Standard

P. Control method for Periodical Location Registration

Q. Layer 2 Frame Unit Structure When the Address and Control Field Spanning Over Multiple Units

R. Reception Conditions for RT and MM Messages

S. User-User Information Transfer (UUS) Supplementary Services

T. Examples of operation of the MS for packet communications

U. Restriction Control for Packet Communication Physical channel

4.3.5.3.3.25 Network identity

The Network identity information element indicates the number which identifies the mobile telecommunications network provided by each telecommunication operator as indicated in Fig. 4.3.5.3.3-24.

The user can decide whether a particular operator option is valid or not, as well as whether roaming is permitted or not using this number. This information element is 2 octets long.

Bit Octet	8	7	6	5	4	3	2	1
1	Spare	System type		Country number				
2	Operator group number				Network identity in group			

Fig. 4.3.5.3.3-24 : Network identity information element

The content of this information element is listed below.

(1) System type (Octer 1): Identifies the system type

Bit 7	6		System type
0	0	:	PDC
0	1	:	WLL
Others			Reseved

(2) Country number (Octet 1) : Identifies country

Bit 5	4	3	2	1		Country
0	0	0	0	1	:	Japan
			Others		:	Reserved

(3) Operator group number (Octet 2) : Binary numbers ranging from 0 to 15 which identify each operator group.

Bit 8	7	6	5		Operator group
0	0	1	0	:	NTT DoCoMo Group
0	1	0	1	:	IDO
0	1	1	1	:	Cellular Group
1	0	0	0	:	TU-KA Group
1	0	0	1	:	Digital Phone Group
1	0	1	0	:	Digital TU-KA Group
		Others		:	Reserved

(4) Network identity in group (Octet 2) : Binary numbers ranging from 0 to 15 which identify the local network in the operator group.

Appendix F. Location Registration Control

（F.1 in the main text is changed to F1.1 to F1.3 as shown below.）

F1.1 Outline

The WLL System principally differs from the standard for cellular system in the following two points;

(1) Mobility from a cell to another cell is not required.

(2) The system is connected to a local switching office and mobile telephone switching office (MTSO) which controls the entire base station network for the cellular system does not exist.

According to the conditions above, the location registration control for the cellular system is not applied to the WLL System. The following additions and revisions are required in Appendix F of the main text for the WLL System.

(1) Location registration algorithm performed by the mobile station of the WLL System (addition)

(2) Changes in the cellular protocol

(3) WLL switch interface service (addition)

F1.2 Purpose of location registration in the WLL System

The purpose of location registration in the WLL System is, in consideration of cases that multiple base stations exist in the accessible area of the mobile station, to control the mobile station to interface only to the switching office which the mobile station is registered through the base station. Therefore, in the WLL System, selection of the control channel by the mobile station should be limited to the control channel to be connected to the switching office which the mobile station is registered, not to select the optimum control channel at every location registration occasion like the procedure used in the cellular system.

F1.3 Location registration procedure for the WLL System

(1) Location registration area code

(i) The broadcast information on the control channel which is sent from the base station includes a single location registration area code corresponding to the WLL switch interface to which the base station is connected. If the WLL switch interface is segmented to connect to multiple trunk groups or base stations, a different location registration area code is assigned to each segment.

(ii) The location registration area code consists of 8 bits as same as the main text. Code 255 is defined as dummy code and carries no significance as location information.

(2) Initialization of a mobile station

(i) After a mobile station is installed, it automatically memorizes the location registration area code according to the information from the WLL switch interface to which the mobile station is registered. To prepare for it, when the mobile station is used for the first time after installation, the mobile station shall initialize the location registration area code to 255. This means that the mobile station has not been informed its location registration area code yet.

(ii) After a mobile station is installed and starts operation, in the case that the registration to its network is changed to other WLL switch interface (base station) due to the system configuration change etc., the mobile station also needs to automatically memorize the new location area code. For this action, when the mobile station cannot be connected with the previous location registration area code, the mobile station shall set the location registration area code to 255 as same as the initialization.

(iii) When the location registration area code of a mobile station is set to 255, the mobile station scans the perch channel among all pre-programmed control channels and is fixed to the channel with the strongest reception level. The mobile station requests location registration to the WLL System interface on the channel (by mobility management program).

(3) Transfer of location registration message from a network to a mobile station

When a WLL switch interface receives a location registration request from a mobile station, it checks whether the ID (MSI) of the mobile station has been registered to the WLL switch interface. If the registration of the ID is confirmed, the WLL switch interface sends the Location Registration Acknowledge message to the mobile station. If the registration cannot be confirmed, the WLL switch interface sends the Location Registration Reject message.

F2. Method of location registration control

F2.1

The description in the main text should be applied as it is.

F2.2 Operation of a mobile station (should be changed as below)

[Location registration]

(4) and (6) among (1) through (7) should be changed as below.

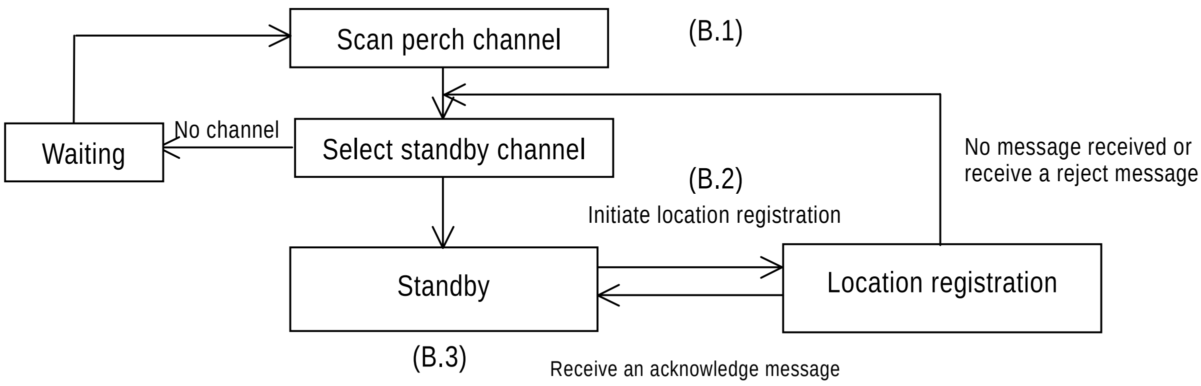
(4) The operation of the mobile station after the initialization of location registration is categorized into the following three cases.

(i) If the mobile station receives the Location Registration Acknowledge message from the WLL switch interface, it memorizes the location indentity (L_{g1} as L_0) and the network identity in the non-volatile memory and completes location registration.

(ii) If the mobile station receives the Location Registration Reject message or receives no response, it switches to the perch channel with the second strongest reception level and retries location registration. If it receives the Location Registration Acknowledge message as a response, it completes location registration in the same manner as (i).

(iii) If the mobile station fails to receive the Location Registration Acknowledge message even after switching to the last perch channel, the mobile station once switches to the Waiting state and then scans perch channels again and retries location registration.

(6) The relationship between the Standby state of the mobile station and the operation (4) above is illustrated in the following figure.



（B.＊） indicates the section number to be referred in the Appendix.

F3. Example of configuration

“The example of the operation of the MS in group 1” in the main text does not apply to the WLL System. Other descriptions in the main text apply to the WLL System as they are.

F4. Terminating service registration during standby

The descriptions in the main text should be applied as they are.

Attached document 1　Overview of WLL

1. Definition of WLL

(1) The concept of WLL (Wireless Local Loop) is to provide subscriber telephone service by replacing the subscriber line connected to the local switch (LS) partly or completely with the radio link. It aims cost reduction for installation and maintenance of the subscriber line and early introduction of the subscriber telephone service.

(2) The main purpose of WLL is to provide subscriber telephone service. It does not fully guarantee the capabilities of cellular system or PHS such as roaming, wide area handover, etc.

(3) Subscriber wireless system, cellular system, PHS, etc. can be applied to WLL as wireless technologies. The WLL specified in this standard utilizes the PDC system based on RCR STD-27; therefore, the specifications and explanations in this standard describes the WLL using the PDC system.

2. Configuration of WLL

Figure 1 illustrates a standard WLL configuration.

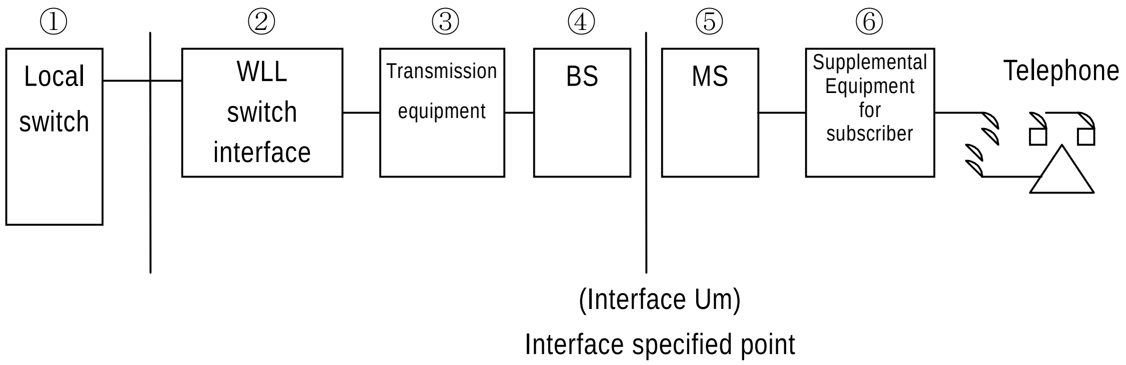


Figure 1 Configuration of WLL

(1) Local switch

A Local switch which interfaces to the public switched telephone network (PSTN). This is not an essential element of WLL.

(2) WLL switch interface

An interface between PSTN and WLL system which performs call connection control specific to the WLL system.

(3) Transmission equipment

Transmission equipment connects the WLL switch interface and the BS. Any of fiber optics, microwaves or wire can be used in order to extend the service area of WLL. However, there are cases where it is included or not included as an essential element of WLL.

(4) BS

A base station for the WLL system which provides a radio link to a subscriber station.

(5) MS

A mobile station for the WLL system. It is sometimes combined with the supplemental equipment for subscriber in (6) below.

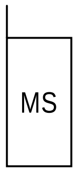
(6) Supplemental equipment for subscriber

A supplemental equipment to connect a telephone and MS with 2-wire interface, etc. In order to serve as a normal subscriber line when viewed from the telephone, it shall be capable of power supply, 4-wire/2-wire conversion, DP/DTMF transmission and reception, howler/ringer, and so on. This is not required when MS in (5) is used as a telephone.

Note: The above elements are given as examples to show the WLL capabilities clearly. It does not indicate the actual equipment structure of the system.

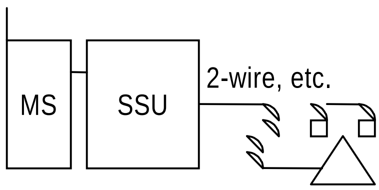
3. Examples of configuration in MS side

①



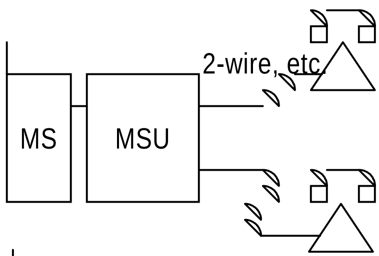
MS is used as a telephone (except for a public telephone.)

②



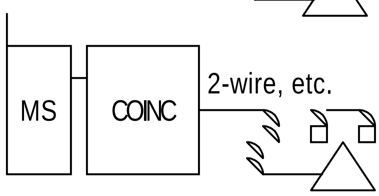
Telephone (except for a public telephone) is connected to the MS with 2-wire, etc.

③



Multiple telephones (except for a public telephone) are connected to one MS with 2-wire, etc.

④



Public phone is connected to the MS with 2-wire, etc.

Note:

SSU (Single Subscriber Unit):

One of the supplemental equipment for a subscriber. It has a capability to connect one telephone (except for a public telephone) to MS by 2-wire, etc.

MSU (Multiple Subscriber Unit):

One of the supplemental equipment for a subscriber. It has a capability to connect multiple telephones to MS by 2-wire, etc.

COINC (COIN Controller):

One of the supplemental equipment for a subscriber. It has a capability to connect a public telephone to MS by 2-wire etc. The practical functions of COINC are almost equivalent to those of SSU, however, it has additional capabilities regarding coin storage, etc.

Attachment Amendment History of RCR STD-27

Revision A

Appendix A Addition of SDL Diagrams

Addition of Appendices J to O

Appendix J	Paging Identification Number
Appendix K	Handling of Spare Bits
Appendix L	Operation of the Data Link Layer During Channel Handover Failure
Appendix M	Division of Messages During Partial Retransmission Control
Appendix N	Definition of Cause Indications
Appendix O	The Correspondence Between ITU-T I-interface Recommendation and Pertinent Sections of the Layer 2 and Layer 3 Interfaces in the RCR Standard

Revision B

Revision of 1500 MHz radio frequency bands

Addition of Appendices P and Q

Addition of Annex 2

Revision of Section 3.2.1 Radio frequency bands and related items

Appendix P	Control Method for Periodical Location Registration(provisionally)
Appendix Q	Layer 2 Frame Unit Structure When the Address and Control Field Spanning Over Multiple Units
Annex 2	Data Transmission Standard for the Personal Digital Cellular Tele-communication System (G3 facsimile and modem(V.42 ANNEX))

Revision C

Addition of Appendices P, R and S

Addition of Half-rate speech CODEC

Appendix P	Control Method for Periodical Location Registration
Appendix R	Reception Conditions for RT and MM Messages
Appendix S	User-User Information Transfer(UUS) Supplementary Services

5.2 Half-rate speech CODEC

Revision D

Addition of Annex 3

Annex 3 High Speed Data Transmission Standard for the Personal Digital Cellular Telecommunication System

Revision E

Revision of 800 MHz Radio frequency bands

Revision of Section 3.2.1 Radio frequency bands and related items are revised.

Revision F

Definition of Packet communication service

Addition of Appendices T and U

Addition of Annex 4

Addition of Section 4.1.4.3.3 Packet Physical Channel and 4.1.5.4 User Packet CHannel signals (UPCH) and revision and addition of related items

Appendix T Examples of operation of the MS for packet communications

Appendix U Restriction Control for Packet Communication Physical channel

Annex 4 Standard for Interface between Mobile Station and Subscriber Information Module

Revision G

Definition of Virtual Circuit Connection
Addition of Sections 4.3.7.2.3, 4.3.7.3.7 to 4.3.7.3.9, and 4.3.8.24 to 4.3.8.27

Definition of Voice Terminating Method 2 (for packet communication)
Addition of Sections 4.3.5.2.33 to 4.3.5.2.41 and 4.3.8.28 to 4.3.8.29

Addition to Channel selection algorithm 1
Addition of Reception group selection algorithm B to Section 4.1.10.4.2 (a) Channel selection algorithm 1

Definition of Half-duplex packet communication method
Addition of Annex 5 Half-duplex packet communications standard for the Personal Digital

Cellular Telecommunication System

Revision H

Revision of 800MHz Radio frequency band
Revision of Sections 3.2.1 Radio frequency bands and 3.4.1.1 800MHz Band 3

Definition of the Announce method of the Maximum power to mobile station (for packet communication)
Addition of Sections 4.3.5.3.55, 4.3.5.3.3.56 and 4.3.5.3.3.57

Definition of the Random Access Algorithm Packet communication
Addition of Sections 4.3.8.22 and 4.3.8.23

Addition of the Option Speech Codec
Addition of Sections 5.3 CS-ACELP speech Codec
Addition of Sections 5.4 ACELP speech Codec

Definition of the WLL Standard
Addition of Annex 6 Standard for the Radio Interface of the Wireless Local Loop System

Revision I

Addition of Radio Frequency band
Revision of Section 3.2.1 Radio frequency bands, 3.4.1.1 800MHz Band 3, 4.3.5.3.3.8 Frequency code and Section 4.3.5.3.3.30 Frequency band

Addition of the method for notifying the Channel number in Packet communication

Addition of Section4.3.5.2.42, Section4.3.3.3.58, Section4.3.3.3.59, Section4.3.3.3.60, Section4.3.3.3.61, Section 4.3.5.2.2, Section 4.3.6.3.3.35, Section 4.3.6.3.3.36, Section 4.3.6.3.3.37, Section 4.3.6.3.3.38, Section 4.3.6.3.3.39, Section4.3.8.30, Section4.3.8.31 and Appendix V

Revision of Section 4.1.10.3.2, Section 4.3.3.2, Section 4.3.5.1.2, Section 4.3.5.2.28, Section 4.3.5.3.2, Section 4.3.6.2.16, Section 4.3.6.2.19, Section 4.3.6.3.3.16, Appendix A and Appendix T.

Revision of the restriction
Revision of Section 4.3.5.3.3.39 and Appendix E

Addition of Operator specific information in RT messages

Revision of Section 4.3.5.2

Addition of MS Rev. code

Revision of Section 4.3.5.3.3.3 and Section 4.3.6.3.3.16

Revision I-1

Revision of Attachment 2 (IPR) of INTRODUCTION

Revision J

Addition of an information element to Location Registration Request message in order to support the dual mode operation
Revision of Section 4.3.6.2.3

New definition of an information element related to the above addition
Addition of Section 4.3.6.3.3.40

Addition of the operating procedure to Appendix F (method of location registration control)
Revision of Appendix F

Changes of the mobile station revision
Revision of Section 4.3.5.3.3.3 and Section 4.3.6.3.3.16

Addition of description referring to the ETSI SCP Standard
Revision of Annex 4

Error corrections
Revision of Section 4.2.1.3.3.2, Section 4.3.7.2.1.11, Appendix A and Annex 5, etc.

Revision K

Change of the condition of connection on the emergency calls (i.e. 110/118/119) under the restriction of accesses
Revision of Appendix E

Changes of Mobile station type information element to include the mobile station revision extended
Revision of Section 4.3.5.3.3.3 and Section 4.3.6.3.3.16

Addition of radio frequency band
(1) Base station transmit frequency : 1513 MHz to 1516 MHz
(2) Mobile station transmit frequency : 1465 MHz to 1468 MHz
(3) Frequency separation between transmit and receive carriers : 48 MHz
Revision of Section 3.2.1 and Section 3.4.1.1

Changes of Frequency code information element
Revision of Section 4.3.5.3.3.8

Change of Frequency band information element
Revision of Section 4.3.5.3.3.30 and Section 4.3.6.3.3.39

Revision L

Change of definition of spurious
Revision of Section 3.4.2.6

Change of measurement method
Revision of chapter 6, Section 6.1, Section 6.1.1, Section 6.1.2, Section 6.1.3, Section 6.1.4, Section 6.1.5, Section 6.1.8, Section 6.2, and Section 6.2.5

Change of the mobile station revision extended

Revision of Section 4.3.5.3.3.3 and Section 4.3.6.3.3.16

Error corrections

Revision of Section 1.1, Section 3.1, Section 3.2.17, Section 4.3.5.3.3.3, Section 4.3.6.3.3.16, Section 4.3.6.3.3.17, Section 4.3.6.3.3.19, Section 4.3.6.3.3.28, and Section 4.3.6.3.3.33

PERSONAL DIGITAL CELLULAR TELECOMMUNICATION SYSTEM

ARIB STANDARD

RCR STD-27L

Fascicle 3

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