Technical Document

GSM PROTOCOL STACK

MESSAGE SEQUENCE CHARTS

DL

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1.2 Abbreviations

AGCH	Access Grant Channel
BCCH	Broadcast Control Channel
BS	Base Station
BSIC	Base Station Identification Code
CBCH	Cell Broadcast Channel
CBQ	Cell Bar Qualify
CC	Call Control
CCCH	Common Control Channel
CCD	Condat Coder Decoder
CKSN	Ciphering Key Sequence Number
C/R	Command / Response
C1	Path Loss Criterion
C2	Reselection Criterion
DCCH	Dedicated Control Channel
DISC	Disconnect Frame
DL	Data Link Layer
DM	Disconnected Mode Frame
EA	Extension Bit Address Field
EL	Extension Bit Length Field
EMMI	Electrical Man Machine Interface
F	Final Bit
FACCH	Fast Associated Control Channel
FHO	Forced Handover
GP	Guard Period
GSM	Global System for Mobile Communication
HPLMN	Home Public Land Mobile Network
I	Information Frame
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
Kc	Authentication Key
L	Length Indicator
LAI	Location Area Information
LPD	Link Protocol Discriminator
M	More Data Bit
MCC	Mobile Country Code
MM	Mobility Management
MMI	Man Machine Interface
MNC	Mobile Network Code
MS	Mobile Station
NCC	National Colour Code
NECI	New Establishment Causes Included
N(R)	Receive Number
N(S)	Send Number
OTD	Observed Time Difference

P	Poll Bit
PCH	Paging Channel
PDU	Protocol Description Unit
P/F	Poll / Final Bit
PL	Physical Layer
PLMN	Public Land Mobile Network
RACH	Random Access Channel
REJ	Reject Frame
RNR	Receive Not Ready Frame
RR	Radio Resource Management
RR	Receive Ready Frame
RTD	Real Time Difference
SABM	Set Asynchronous Balanced Mode
SACCH	Slow Associated Control Channel
SAP	Service Access Point
SAPI	Service Access Point Identifier
SDCCH	Slow Dedicated Control Channel
SIM	Subscriber Identity Module
SMS	Short Message Service
SMSCB	Short Message Service Cell Broadcast
SS	Supplementary Services
TCH	Traffic Channel
TCH/F	Traffic Channel Full Rate
TCH/H	Traffic Channel Half Rate
TDMA	Time Division Multiple Access
TMSI	Temporary Mobile Subscriber Identity
UA	Unnumbered Acknowledgement Frame
UI	Unnumbered Information Frame
VPLMN	Visiting Public Land Mobile Network
V(A)	Acknowledgement State Variable
V(R)	Receive State Variable
V(S)	Send State Variable

1.3 Terms

Entity:	An entity is a program which executes the functions of a layer.
Message:	A message is a data unit which is transferred between the entities of one layer (peer-to-peer) of one component (mobile station or infrastructure). Message is used as a synonym to Protocol Data Unit (PDU). A message may contain several information elements.
Primitive:	A primitive is a data unit which is transferred between layers of one component (mobile station or infrastructure). The primitive has an operation code which identifies the primitive and its parameters.
Service Access Point:	A Service Access Point is a data interface between two layers of one component (mobile station or infrastructure).

2 Overview

This section offers a brief description of the different layers which constitute the mobile station Protocol Stack. It is also intended to offer an overview of the intersystem interface. The Protocol Stacks are used to define the functionality of the GSM protocols for interfaces. The GSM specifications are normative when used to describe the functionality of interfaces, but the stacks and the subdivision of protocol layers do not imply or restrict any implementation.

The base of the Protocol Stack rests on the Physical Layer.

The Data Link Layer (DL) is used to handle an acknowledged connection between the mobile and base stations. The LAPDm protocol is used.

Radio Resource (RR) manages the resources of the air-interface, meaning the configuration of the Physical Layer, cell selection and reselection, data transfer, and RR-Connection handling.

Mobility Management (MM) handles registration aspects for the mobile station. It detects changes in location areas and updates a mobile station into the new location area.

Call Control (CC) provides the call functionality. This includes call establishment and call maintenance procedures like Hold, Retrieve, and Modify and call disconnection.

Supplementary Services (SS) handles all call-independent supplementary services like call forwarding or call barring.

Short Message Services (SMS) is used for sending and receiving point-to-point short messages. Additionally included in SMS, is the reception of Cell Broadcast Short Messages.

The Man Machine Interface (MMI) is the user interface. Normally, it is connected with a keypad as the input device and a display as the output device.

Data interfaces are defined between the several entities,. These data interfaces are called Service Access Points (SAPs), which indicate that an upper layer is using the services of a lower layer.

The GSM specifications do not set out any implementation of the Protocol Stack. The following diagrams show the implementation for the mobile station as described in all of these documents. All entities, except the Man Machine Interface and Physical Layer, are implemented as part of the Protocol Stack.

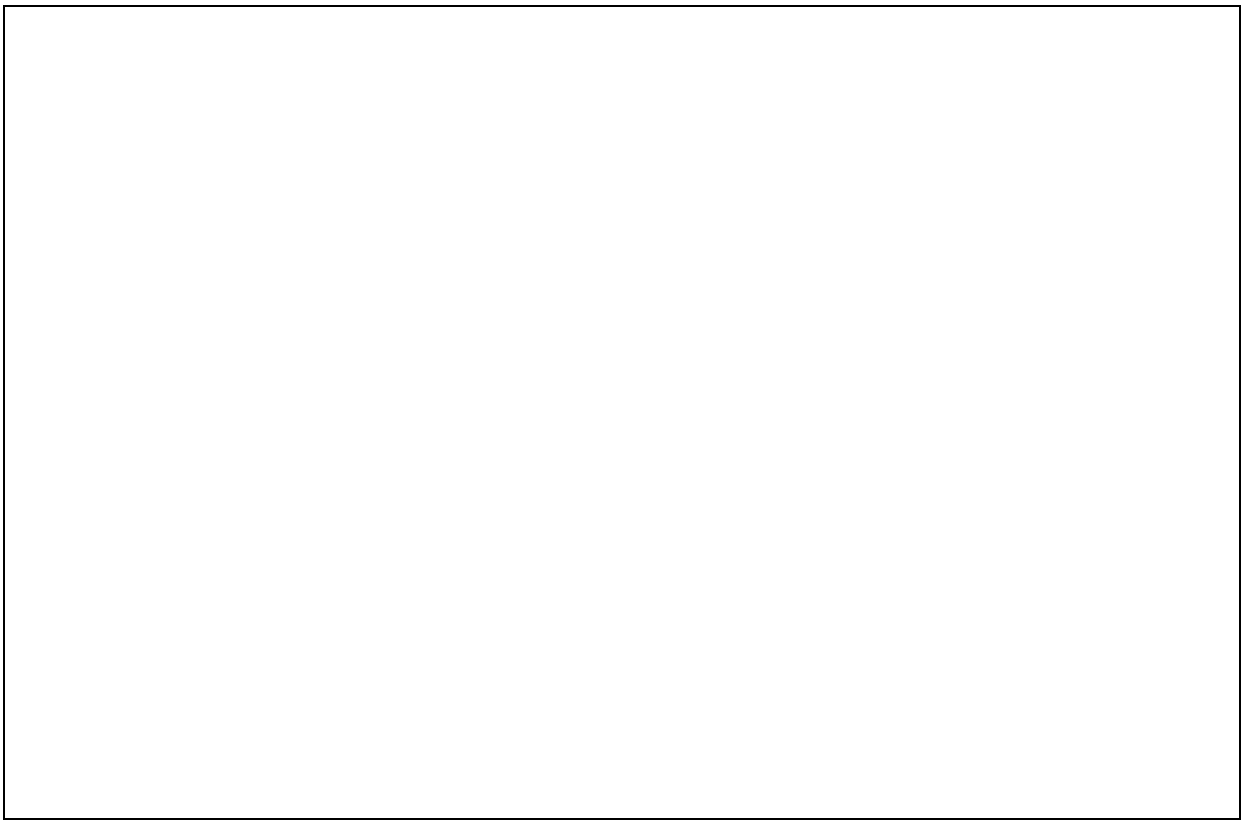


Figure 1: Mobile-station protocol architecture

This document describes the services offered by the Data Link Layer.

3 Introduction

3.1 Logical Channels

A number of Logical Channels are defined on the air-interface. These Logical Channels use timeslots on the Physical Channel, which are structured by a multiframe structure. The multiframe structure is defined by the channel combination and is repeated every 51 or 26 TDMA frames.
The Logical Channels are used in downlink (base station to mobile station) direction, uplink (mobile station to base station) direction, or in both directions.

3.1.1 Broadcast Control Channel (BCCH)

The Broadcast Control Channel (BCCH) is a downlink channel which transports the SYSTEM INFORMATION messages to the mobile station. These message are send-broadcast, not individually addressed, to the mobile station. The SYSTEM INFORMATION is used by the mobile station for cell selection and reselection.

3.1.2 Access Grant Channel (AGCH)

The Access Grant Channel (AGCH) is a downlink channel which transports the IMMEDIATE ASSIGNMENT messages to the mobile station. During connection establishment, these messages are used to define an SDCCH or FACCH channel for the following individual signalling, during the Connection Active phase.
These messages are send-broadcast to the mobile station. This message content is used by the mobile station to determine whether or not the assignment is addressed to the mobile station.

3.1.3 Paging Channel (PCH)

The Paging Channel (PCH) is a downlink channel which transports the PAGING messages to the mobile station. These message are send-broadcast to the mobile station to start connection establishment (mobile terminated call). This message content is used by the mobile station to determine whether or not the paging is addressed to the mobile station.

3.1.4 Fast Associated Control Channel (FACCH)

The Fast Associated Control Channel (FACCH) is the signalling channel for individual, acknowledged signalling information, during the Connection Active phase, with a Dedicated Traffic Channel (TCH). On the air-interface, the FACCH replaces a TCH timeslot.

3.1.5 Slow Dedicated Control Channel (SDCCH)

The Slow Dedicated Control Channel (SDCCH) is the signalling channel for individual acknowledged signalling information during the Connection Active phase, before having a Dedicated Traffic Channel (TCH). At this time, only signalling is possible.

3.1.6 Slow Associated Control Channel (SACCH)

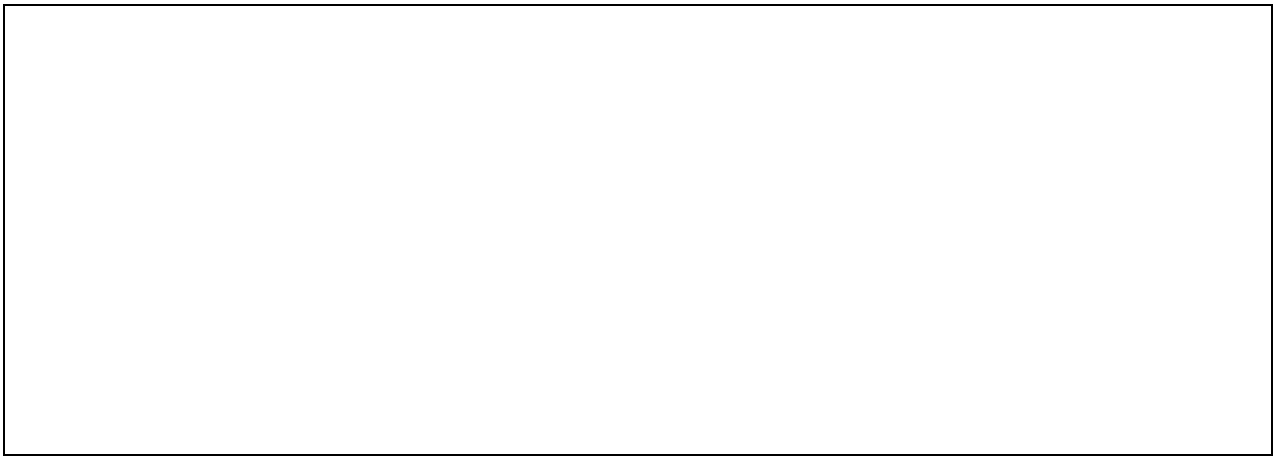
The Slow Associated Control Channel (SACCH) is the signalling channel associated with an FACCH or SDCCH with a low transmission rate. The channel is used for sending measurement reports to the base station or receiving SYSTEM INFORMATION messages from the mobile station during the Connection Active phase.

3.1.7 Cell Broadcast Channel (CBCH)

The Cell Broadcast Channel is used for the reception of Short Message Service Cell Broadcast (SMSCB) messages. On the air-interface, this channel is an SDCCH channel. The frame content is interpreted in a different way than in the upper layers. Each SMSBC message received on this channel is one page of the whole Short Message Cell Broadcast message.

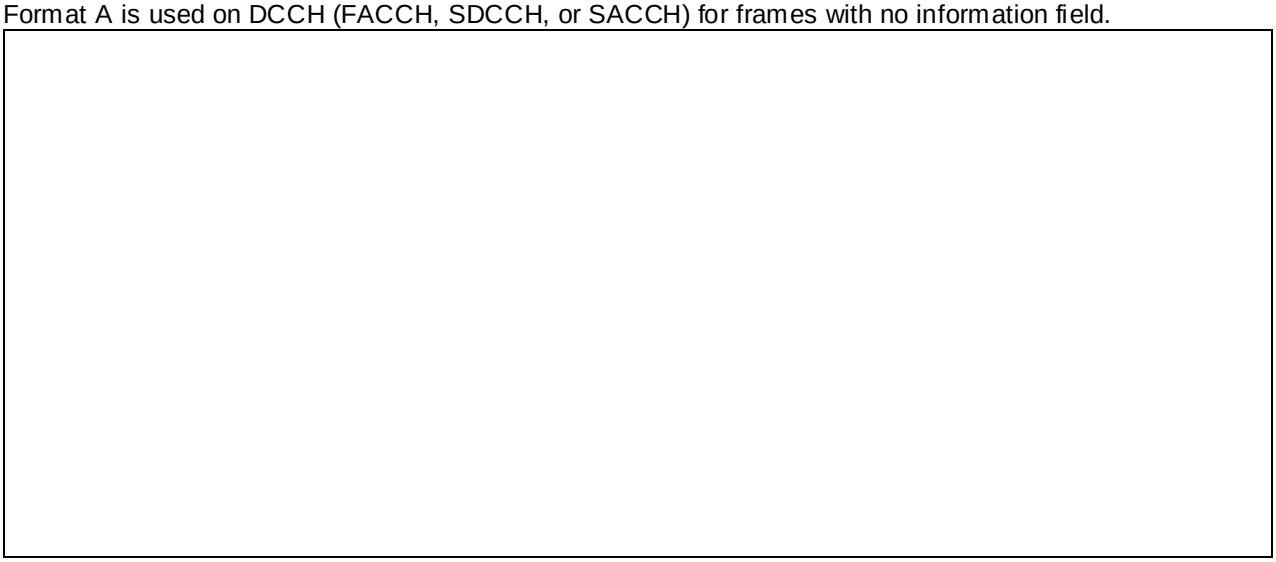
3.2 Frame Structure

Depending on the logical channel and whether or not information is included, one of the described frame structures is used. Distinction is made between Format A, Format B, Format Bbis, and Format C.



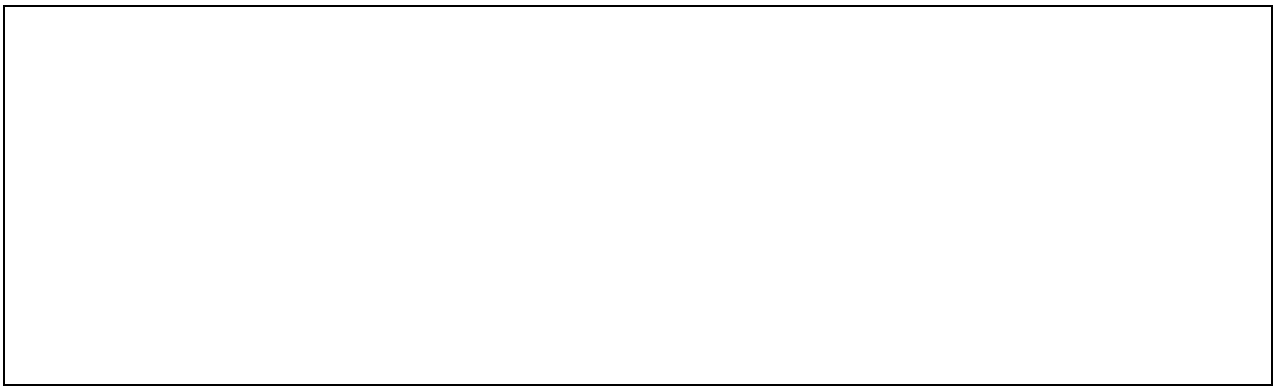
Format Type A

Format A is used on DCCH (FACCH, SDCCH, or SACCH) for frames with no information field.



Format Type B

Format B is used on DCCH (FACCH, SDCCH, or SACCH) for frames with an information field.

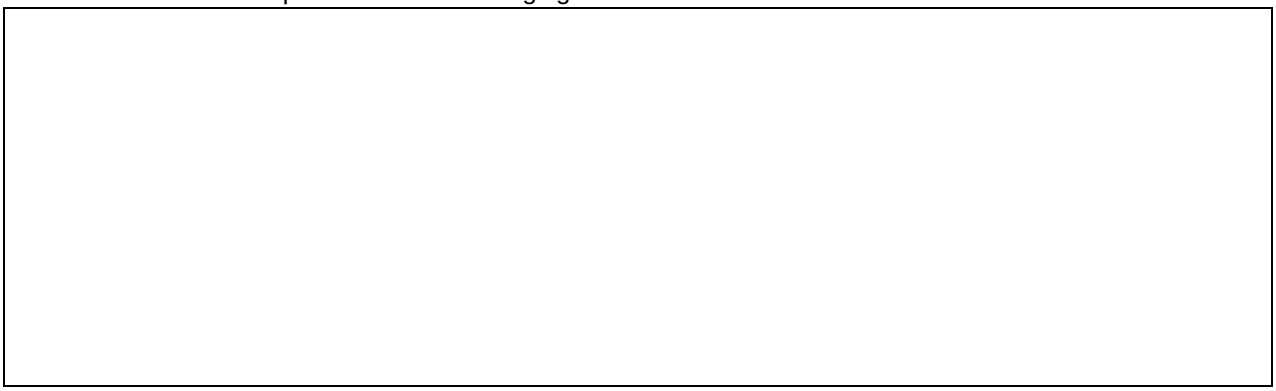


Format Type Bbis

Format Bbis is used on BCCH, PCH, and AGCH.
Format C is used for random bursts. The content is eight bits of information.

3.2.1 Address Field

The Address Field consists of one octet. It identifies the Service Access Point (SAP) for which a command frame is intended and the SAP transmitting a response frame.
The Address Field is depicted in the following figure:



Address Field Format

The field consists of :

- the Address Field Extension bit (EA),
- the Command / Response bit (C/R),
- the Service Access Point Identifier (SAPI), and
- the Link Protocol Discriminator (LPD).

Spare bits are set to zero.
The Address Field Extension (EA) enables an extension of the field to span more than one octet. The value one is used to indicate that the address field is not extended and consists of one octet.
The C/R bit identifies a frame as either a command or a response. The mobile station sends commands with the C/R bit set to zero, and responses with the C/R bit set to one. The base station does the opposite. The combinations for the mobile and base stations are shown in the next table:

Type	Direction	C/R value
Command	BS to MS	1
	MS to BS	0
Response	BS to MS	0
	MS to BS	1

The Service Access Point Identifier (SAPI) identifies the point at which Data Link Layer services are provided by the Data Link Layer to a Layer 3 three entity. The SAPI allows eight Service Access Points to be specified initially, where bit three of the Address Field octet containing the SAPI is the least significant binary digit and bit five is the most significant.
The SAPI values are allocated as shown in the next table:

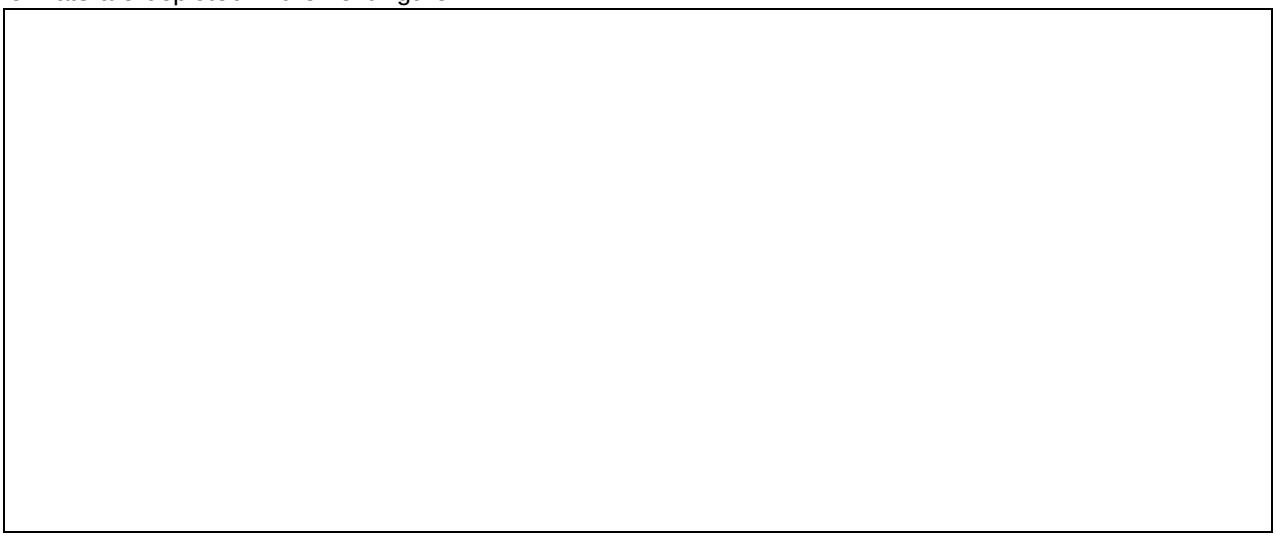
SAPI Value	Related Entity
0	CC, MM, RR
3	SMS
all others	reserved

The Link Protocol Discriminator (LPD) defines the protocol used on the air-interface. The LPD values are defined as shown in the next table:

LPD Value	Related Protocol
0	GSM Protocol
1	SMSCB Protocol
all others	reserved

3.2.2 Control Field

The Control Field identifies the frame type as either command or response. The Control Field will contain sequence numbering, where applicable.
Three types of Control Field formats are specified as: Numbered Information Transfer (I format), Supervisory Functions (S format), and Unnumbered Information Transfer (U format). The Control Field formats are depicted in the next figure:



Control Field Format

Information transfer format - I format
The I format is used to perform an information transfer between Layer 3 entities. The functions of N(S), N(R), and P are independent; that is, each I frame has an N(S) sequence number, an N(R) sequence number (which may or may not acknowledge additional I frames received by the Data Link Layer entity), and a P bit that may be set to zero or one.
Supervisory format - S format
The S format is used to perform Data Link supervisory control functions such as: acknowledging I frames, requesting the transmission of I frames, and requesting a temporary suspension of the transmission of I frames. The functions of N(R) and P are independent; that is, each supervisory frame has an N(R) sequence number (which may or may not acknowledge additional I frames received by the Data Link Layer entity), and a P/F bit that may be set to zero or one.
Unnumbered format - U format
The U format is used to provide additional Data Link control functions and unacknowledged information transfer. This format does not contain sequence numbers. It does include a P/F bit that may be set to zero or one.

All frames contain P/F, the poll/final bit. The poll/final (P/F) bit serves a function in both command and response frames. In command frames, the P/F bit is referred to as the P bit. In response frames, it is referred to as the F bit.
P bit set to one is used by the Data Link Layer entity to create (poll) a response frame from the peer Data Link Layer entity. F bit set to one is used by a Data Link Layer entity to indicate the response frame which is transmitted as a result of a soliciting (poll) command.

The following table shows the different commands and responses in unacknowledged and multiple frame acknowledged operation of a Data Link Layer entity.

Format	Commands	Responses	8	7	6	5	4	3	2	1
I - Format	I		N(R)			P	N(S)			0
	RR	RR	N(R)			P/F	0	0	0	1
S - Format	RNR	RNR	N(R)			P/F	0	1	0	1
	REJ	REJ	N(R)			P/F	1	0	0	1
	SABM		0	0	1	P	1	1	1	1
		DM	0	0	0	F	1	1	1	1
U - Format	UI		0	0	0	P	0	0	1	1
	DISC		0	1	0	P	0	0	1	1
		UA	0	1	1	F	0	0	1	1

Information (I) commands
The function of the Information (I) command is to transfer sequentially numbered frames, which contain information fields provided by Layer 3, across a Data Link connection. This command is used in the multiple frame operation.

Set Asynchronous Balanced Mode (SABM) command
The SABM unnumbered command is used to place the addressed user or network into the modulo eight multiple frame acknowledged operation.
An information field is permitted with the SABM command only if it is used in the mobile station to base station direction in order to establish an SAPI 0 Data Link for contention resolution, after having transmitted a random access frame on the RACH. Layer 3 will indicate when an information field is to be included.
A Data Link Layer entity confirms the acceptance of an SABM command by transmitting a UA response at first opportunity. Upon acceptance of this command, the Data Link Layer entity's Send State Variable V(S), Acknowledge State Variable V(A), and Receive State Variable V(R) are set to 0 (zero).
The transmission of an SABM command indicates the clearance of any exception condition, in particular a busy condition which was reported by an previous RNR frame transmission from that Data Link Layer entity.
Previously transmitted I frames that are unacknowledged when this command is initiated remain unacknowledged and are discarded. It is the responsibility of a higher layer, for example, Layer 3 to recover from the possible loss of the content of such I frames.
SABM frames cannot contain Layer 3 messages which have to be segmented.

Disconnect (DISC) command
The DISC unnumbered command is transmitted in order to terminate the multiple frame operation. Local end release is performed without sending a DISC command. No information field is permitted with the DISC command.
Prior to initiating the command, the Data Link Layer entity receiving the DISC command confirms the acceptance of a DISC command by the transmission of a UA response. The Data Link Layer entity sending the DISC command terminates the multiple frame operation when it receives the acknowledging UA or DM response.
Previously transmitted I frames, that are unacknowledged when this command is initiated, remain unacknowledged and are discarded. It is the responsibility of a higher layer, for example, Layer 3, to recover from the possible loss of the contents of such I frames.
Unnumbered Information (UI) command
When a Layer 3 entity requests unacknowledged information transfer, the UI unnumbered command is used to send information to its peer without affecting Data Link Layer variables. UI command frames do not carry a sequence number. Therefore, the UI frame may be lost without notification of the Layer 3 entity if a Data Link Layer exception occurs during the transmission of the command.
Receive ready (RR) command / response
The Receive Ready (RR) supervisory frame is used by a Data Link Layer entity to:

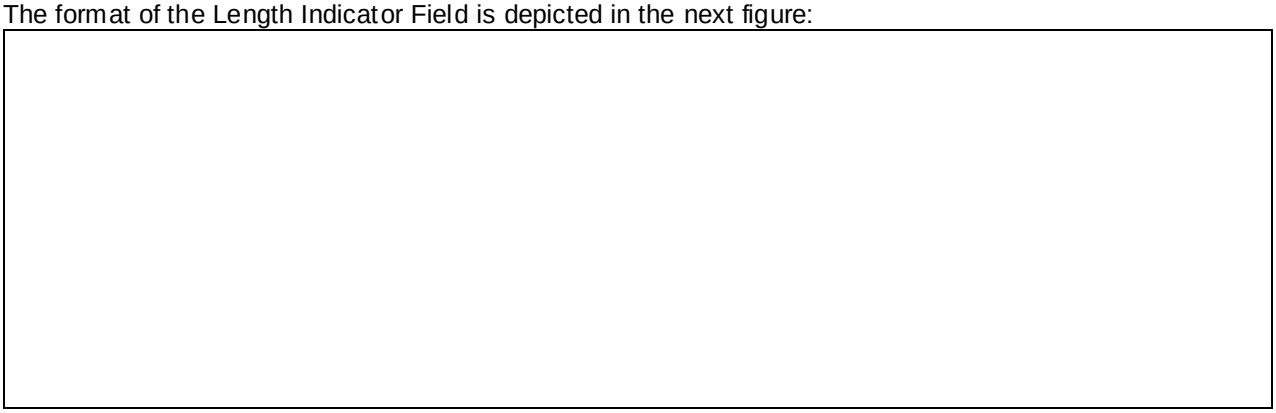
- indicate it is ready to receive an I frame.
- acknowledge previously received I frames numbered up to and including N(R)-1.
- clear a busy condition which had been indicated by the previous RNR frame transmission by that same Data Link Layer entity.

In addition to indicating the status of a Data Link Layer entity, the RR command with the P bit set to one may be used by the Data Link Layer entity to ask for the status of its peer Data Link Layer entity. No information field is permitted with the RR command / response.
Reject (REJ) command / response
The Reject (REJ) supervisory frame is used by a Data Link Layer entity to request the retransmission of I frames - starting with the frame numbered N(R). The value of N(R) in the REJ frame acknowledges I frames numbered up and including N(R)-1. New I frames pending initial transmission are transmitted following the retransmitted I frames.
Only one REJ exception condition for a given direction of information transfer is established at any given time. The REJ exception condition is cleared (reset) upon receiving an I frame with N(S) equal to N(R) of the REJ frame.
The transmission of an REJ frame also indicates the clearance of any busy condition within the sending Data Link Layer entity reported by the previous RNR frame transmission by that same Data Link Layer entity.
In addition to indicating the status of a Data Link Layer entity, the REJ command with the P bit set to one may be used by the Data Link Layer entity to ask for the status of its peer Data Link Layer entity. No information field is permitted with the REJ command/response.

Receive Not Ready (RNR) command/response
The Receive Not Ready (RNR) supervisory frame is used by a Data Link Layer entity to indicate a busy condition (a temporary inability to accept additional incoming I frames). The value of N(R) in the RNR frame acknowledges I frames numbered up to and including N(R)-1 (one).
Acknowledgement of subsequent I frames, transmitted before the indication of the peer receiver as being busy is received, will be made in subsequent exchanges if they arrive after the peer receiver busy condition has been cleared.
In addition to indicating the status of a Data Link Layer entity, the RNR command with the P bit set to one may be used by the Data Link Layer entity to ask for the status of its peer Data Link Layer entity.
No information field is permitted with the RNR command/response.
For the GSM procedures on SAPI 0 and 3, the RNR frame is not used and will be ignored.
Unnumbered Acknowledgement (UA) response
The UA unnumbered response is used by a Data Link Layer entity to acknowledge the reception and acceptance of the mode setting commands (SABM or DISC). Received mode setting commands are not activated until the UA response is transmitted.
An information field is permitted with the UA response. If an SABM command with an information field is received and the SABM is to be acknowledged, the UA response to that command will contain the same information field as received in the SABM command.
The transmission of the UA response indicates the clearance of any busy condition reported by the previous RNR frame transmission by that same Data Link Layer entity.
Disconnected mode (DM) response
The DM unnumbered response is used by a Data Link Layer entity to report to its peer that the Data Link Layer is in a state in which multiple frame operation cannot be performed. A Data Link Layer entity will transmit a DM response to any valid command it receives which it cannot activate.
No information field is permitted with the DM response.

3.2.3 Length Indicator Field

The format of the Length Indicator Field is depicted in the next figure:



Length Indicator Format

The field consists of

- the Length Indicator Field extension bit (EL),
- the More Data Bit (M), and
- the Length Indicator (L).

The Length Indicator Field Extension (EL) is used to extend the Length Indicator. In GSM, the Length Indicator Field has a fixed length of one octet and the Length Indicator Field Extension bit EL is set to one.
The More Data Bit (M) is used to indicate segmentation of Layer 3 messages on Data Link Layer frames. Layer 3 messages, which need to be segmented, are only transported by I frames.
When the M bit is set to one, it indicates that the information field of the frame contains only a segment of the Layer 3 message.
The M bit being set to zero indicates that the information field contains a complete Layer 3 message. Provided, that the M bit of the previous frame was set to zero, or that the information field contains the last segment of a Layer 3 message, if the M bit of the previous frame was set to one.
When the M bit is set to 1 one, the information field contains the maximum number of octets that an Information Frame can contain, N201.
In frames other than Information (I) frames, the M bit is set to zero.
The Length Indicator consists of six bits and is used to indicate the number of octets contained in the information field of UI, SABM, UA, or I frames. This number can be any value in the range zero to N201 inclusive.
The L=0 is used in frames containing no information field.

3.3 Variables and Sequence Numbers

3.3.1 Send State Variable V(S)

Each point-to-point Data Link connection endpoint has an associated Send State Variable V(S) when using I frame commands. The Send State Variable denotes the sequence number of the next to be transmitted I frame in sequence.
The Send State Variable can be any value zero through seven.
The value of the Send State Variable is incremented by one, with each successive I frame transmission, and may not exceed V(A) by more than the maximum number of outstanding I frames k. The window size k is set to one.

3.3.2 Acknowledge State Variable V(A)

Each point-to-point Data Link connection endpoint has an associated Acknowledge State Variable V(A), when using I frame commands and supervisory frame commands/responses.
The Acknowledge State Variable identifies the last frame that has been acknowledged by its peer V(A). The N(S) of the last acknowledged I frame is equal to one. The Acknowledge State Variable can be set between zero and seven. The value of the Acknowledge State Variable is updated by the valid N(R) values received from its peer. A valid N(R) is one that is in the range V(A) <= N(R) <= V(S).

3.3.3 Send Sequence Number N(S)

Only I frames contain N(S), the Send Sequence Number of transmitted I frames. The value of N(S) is set equal to the value of the sending state variable V(S) at the time that an I frame that is in sequence is designated for transmission.

3.3.4 Receive State Variable V(R)

Each point-to-point Data Link connection endpoint has an associated Receive State Variable V(R), when using I frame commands and supervisory frame commands/responses.
The Receive State Variable denotes the sequence number of the next-in-sequence I frame, that is expected to be received. The Receive State Variable can be any value between zero and seven.
The value of the Receive State Variable is incremented by one upon the reception of an error-free, in-sequence I frame in which the Send Sequence Number N(S) is equal to the Receive State Variable V(R).

3.3.5 Receive Sequence Number N(R)

All I frames and supervisory frames contain N(R), the expected Send Sequence Number of the next received I frame.
At the time that a frame is designated for transmission, the value of N(R) is set equal to the current value of the Receive State Variable V(R). N(R) indicates that the Data Link Layer entity transmitting the N(R) has received all I frames numbered up to and including N(R)-1 (one) correctly.

3.3.6 Timer T200

The exact value of Timer T200, for Data Links with SAPI 0 and SAPI 3, is implementation dependent. The timer is implemented as counter using the regular requests of layer 1.
The following table shows the minimum and maximum time for T200 depending on the channel type and the Service Access Point Identifier:

SAPI	Type of Channel	Minimum	Maximum
0	SDCCH	ca. 236 ms	ca. 236 ms
	FACCH	ca. 120 ms	ca. 179 ms
3	SDCCH	ca. 236 ms	ca. 236 ms
	SACCH	ca. 1440 ms	ca. 1732 ms

3.3.7 Maximum Number of Retransmissions (N200)

For SAPI equal to zero and three, the maximum number of retransmissions (N200) is dependent upon the state and the channel used. This ensures a common Layer 2 link failure time value on all channels - when multiple frame operation is established.
The N200 value for Layer 2 link establishment and release is five.
In the state, Timer Recovery, N200 is set in accordance with the next table:

Type of Channel	N200
SACCH	5
SDCCH	23
FACCH fullrate	34
FACCH halfrate	29

3.3.8 Maximum Number of Octets in one information field (N201)

The maximum number of octets in each information field (N201) is:

Type of Channel	N201
SACCH	18
SDCCH, FACCH	20
BCCH, AGCH, PCH	23

3.3.9 Maximum Number of Outstanding I frames (k)

The maximum number, k, of sequentially numbered I frames that may be outstanding (unacknowledged) at any given time is a system parameter in the range one to seven. For the air-interface, k is defined as one.

3.3.10 Maximum Number of Octets in a Layer 3 (three) message

The number of octets in a Layer 3 message, which are passed to Layer 2 for transmission in acknowledged mode, may not exceed 251 octets.
The number of octets in a Layer 3 message, which are passed to Layer 2 for transmission in unacknowledged mode, is limited by the number of octets in a UI-frame (N201) information field.

3.4 Dynamic Configuration

Many dynamic configurations are defined for the Data Link Layer (DL). That means, it is possible, at run-time, to change the behaviour of DL by sending to DL, a string from a test device.
DL uses a keyword table to interpret the strings. The strings have the following general format:
<keyword> = (parameter 1, parameter 2, ...)
Keywords without parameters are defined only by using the keyword. For keywords with one parameter, the parentheses are not necessary.
The following table is an overview of the possible configurations:

keyword	Parameter
N200	channel value
SEND_FRAME ADDR_FIELD CTRL_FIELD LEN_FIELD INFO_FIELD	channel value value value value
VS VR VA	channel value channel value channel value
UA_IGNORE RR_IGNORE I_IGNORE	channel value channel value channel value

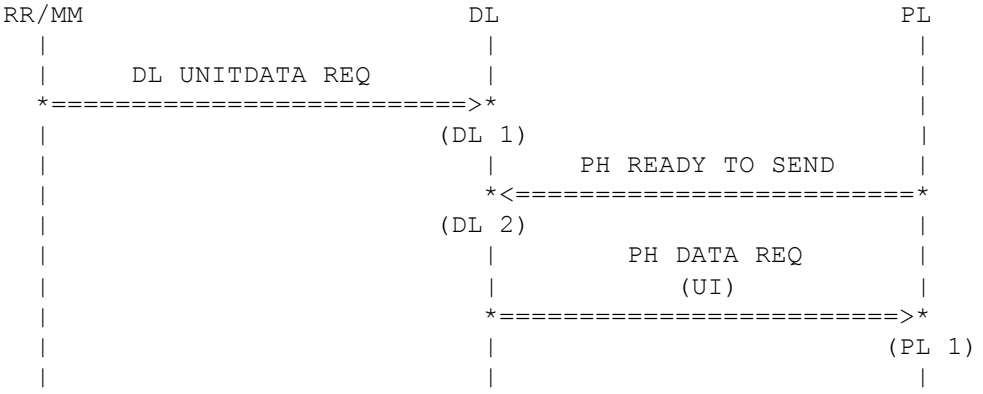
The configuration **N200** is used to redefine the retransmission counter N200. The default value depends on the channel used.
The keywords **SEND_FRAME**, **ADDR_FIELD**, **CTRL_FIELD**, **LEN_FIELD,** and **INFO_FIELD** are used to determine an erroneous frame. The configuration **ADDR_FIELD** determines the address field of this frame. The configuration **CRTL_FIELD** is used to determine the control field. The length field is set by **LEN_FIELD**. The information field is filled by the configuration **INFO_FIELD.** A frame like is sent once on the appropriate channel by the configuration **SEND_FRAME**. Normal operation of the Data Link Layer is not affected.
The variables V(S), V(R), and V(A) of a connection are manipulated by the configurations **VS**, **VR**, and **VA**. These may be used to force error situations on the Data Link Layer.
To force repetition of received frames, it is possible to ignore incoming UA, RR, or I frames. The configurations **UA_IGNORE**, **RR_IGNORE**, and **I_IGNORE** determine the number of ignored frames of this frame type.

4 Protocol

4.1 Layer 1 Access

There are two methods for access to DL by layer 1. In the PC-Simulation and in this specification layer 1 requests data with the primitive PH READY TO SEND.
This variant is used by the windows variant, and not by the target system. The second method is implemented and used by the ARM7 variant. Layer 1 uses function calls instead of the primitive. For more details see the generic target interface description (GTI23.DOC).

4.2 Transmission of unacknowledged information



(DL 1)

The Data Link Layer protocol defines unacknowledged data transmission, independent of channel or Service Access Point Identifier. Only transmission on SACCH with SAPI 0 is used by a GSM Protocol Stack to forward the measurement reports to the base station. Therefore, implementation supports unacknowledged data transmission only for SACCH with SAPI 0.

Unacknowledged information is passed to the Data Link Layer by Layer 3, using the primitive DL UNITDATA REQ on SACCH for SAPI 0. The Layer 3 message is stored. Previous stored messages are overwritten by the new one.

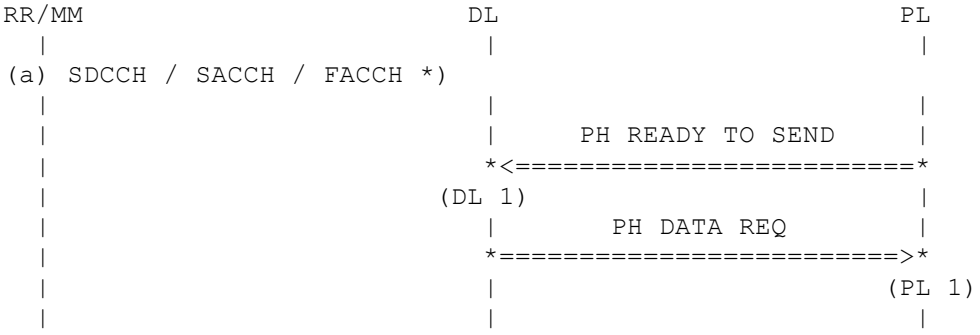
(DL 2)

PL notices that it is time to send on the channel. The Layer 3 message unit is transmitted in a UI command frame, with format type B. The Control Field P-Bit is set to zero. The maximum number of octets in an information field (N201) is eighteen Bytes for SACCH.

(PL 1)

The unnumbered information is given to the Physical Layer.

4.3 Fill Frame Transmission



(DL 1)

The Physical Layer informs the Data Link Layer that it expects data to be sent.

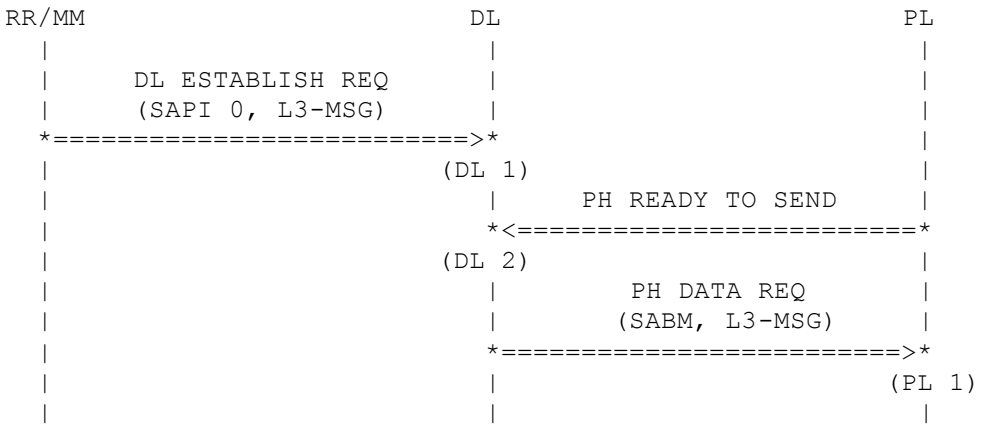
(PL 1)

If Data Link Layer has no data to be sent, a fill frame is sent. This is an unnumbered information command frame with the length zero. The P bit and SAPI are set to zero. The information field is filled with 0x2B.

On FACCH a fill frame is sent only if the channel mode is signalling only.

4.4 Contention Resolution from IDLE Mode (SAPI 0)

4.4.1 Initiation by Radio Resource



(DL 1)

The procedure for establishing a data link in order to resolve contention after having accessed the base station on the RACH is always initiated by the mobile station. Layer 3 decides when this establishment procedure is to be used and will request the Data Link Layer to initiate the procedure with a DL ESTABLISH REQ primitive which contains a Layer 3 message.

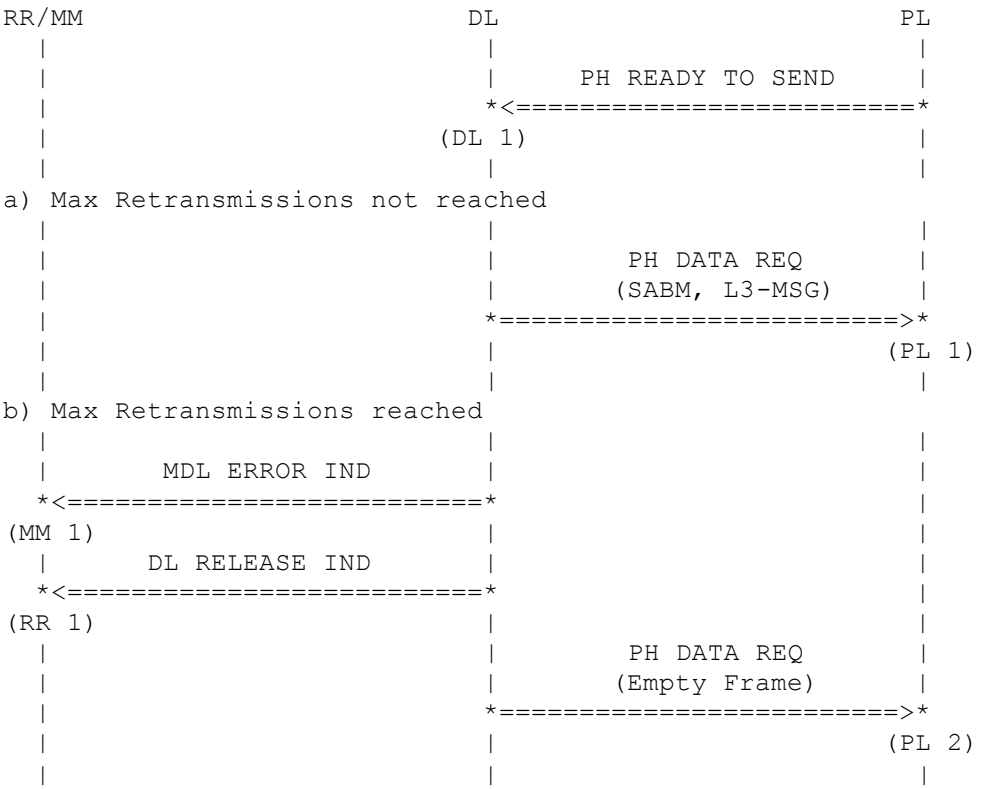
(DL 2)

DL waits for the PH READY TO SEND primitive from the Physical Layer which indicates the time for sending a frame.

(PL 1)

The Data Link Layer transmits an SABM frame with P equal to one. The Length Indicator L is set according to the length of the Layer 3 message. The Layer 3 message is stored in the Data Link Layer. All existing exception conditions are cleared, the retransmission counter is reset, and the counter for T200 is initialised.

4.4.2 T200 Timeout



(DL 1)

Layer 1 sents the PH READY TO SEND primitive. The counter for T200 is decremented. It indicates expiry of T200 before an UA response has been received.

(PL 1)

If the retransmissions counter is lower than N200, the Data Link Layer retransmits the SABM frame with the Layer 3 message. The retransmission counter is incremented by one and the counter for T200 is initialised.

(MM 1)

MM is informed with MDL ERROR IND, cause being - "Timer T200 expired N200 + 1 timer; perform abnormal release".

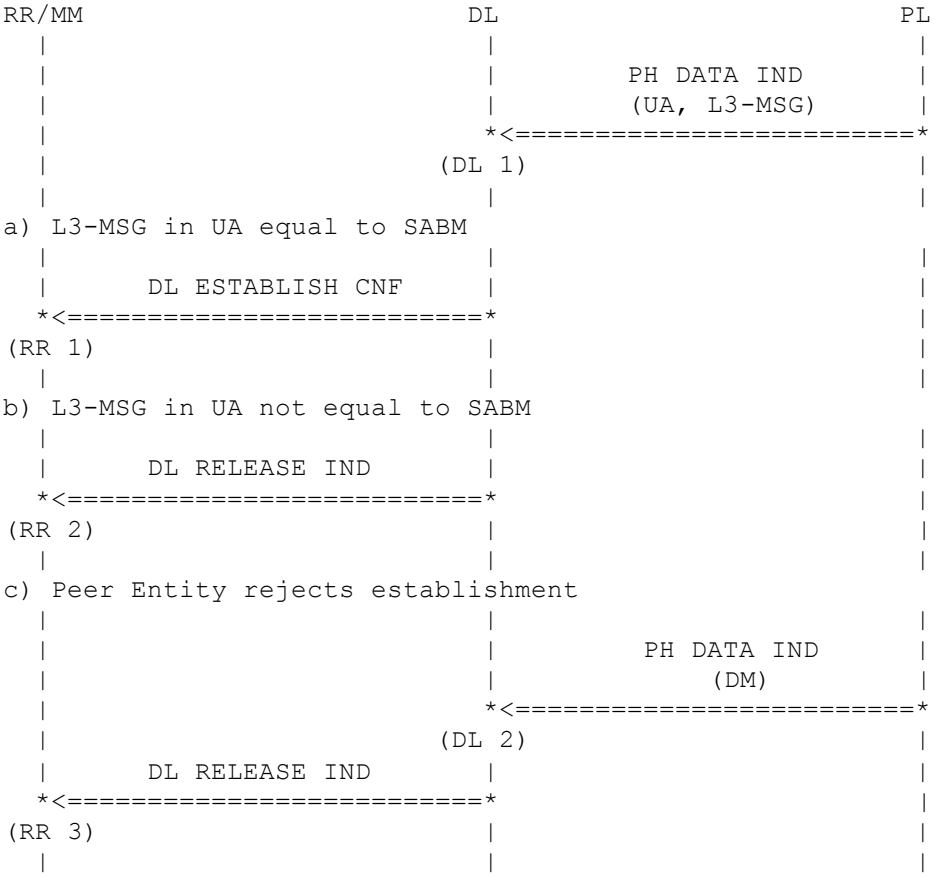
(RR 1)

If the retransmission counter is not lower than N200, the Data Link Layer enters state IDLE. Radio Resource is informed with the DL RELEASE IND primitive.

(PL 2)

An empty frame is forwarded to layer 1 if the channel mode is signalling only.

4.4.3 Response from Base Station



(DL 1)

Data Link Layer receives a UA response with F bit equal to one and an information field. UA responses with F bit equal to zero are ignored.

(RR 1)

The information field in the UA response is compared with the information field of the previous SABM command. If the two fields are identical, the Data Link Layer clears the counter for T200, sets the Send State Variable V(S)m, the Receive State Variable V(R), and the Acknowledge State Variable V(A) to zero, deletes the stored information field, enters the multiple frame established state, and informs Radio Resource with the DL ESTABLISH CNF primitive.

(RR 2)

If the two fields are different, the Data Link Layer clears the counter for T200, deletes the stored information field, enters the IDLE state, and informs Radio Resource with the DL RELEASE IND primitive.

(DL 2)

Data Link Layer receives a DM response with the F bit equal to one. DM responses with the F bit equal to zero are ignored. There is no foreseeable case in which the network will send a DM.

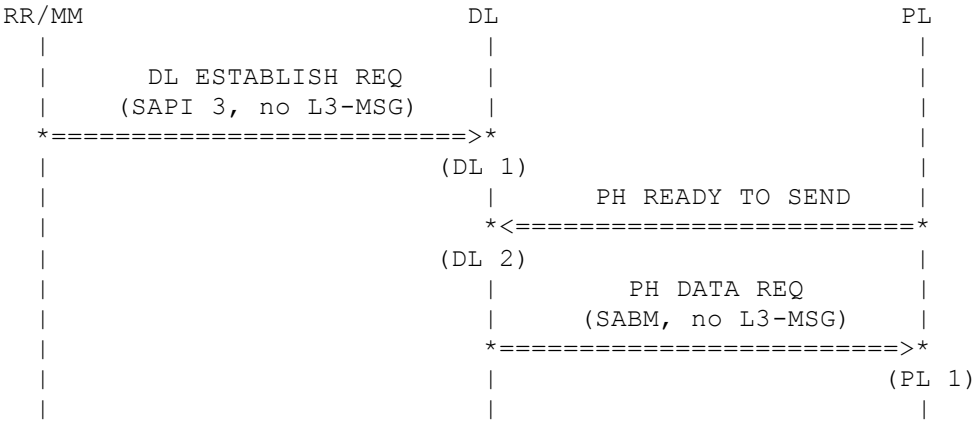
(RR 3)

Data Link Layer clears the counter for T200, deletes the stored information field, enters the IDLE state, and informs Radio Resource with the DL RELEASE IND primitive.

4.5 Normal Establishment (SAPI 3)

Normal Establishment is defined only for SAPI 3. It is performed on SDCCH or SACCH. An SAPI 0 connection must be established. The normal establishment procedure may established by the mobile station or by the base station. SAPI 3 Establishment is started on SDCCH, if the SAPI 0 connection is on SDCCH. It is started on SACCH if the SAPI 0 connection is on FACCH.

4.5.1 Initiation by Radio Resource



(DL 1)

The Data Link Layer receives the establish request from Radio Resource with a DL ESTABLISH REQ primitive and without a Layer 3 message for SAPI 3.

(DL 2)

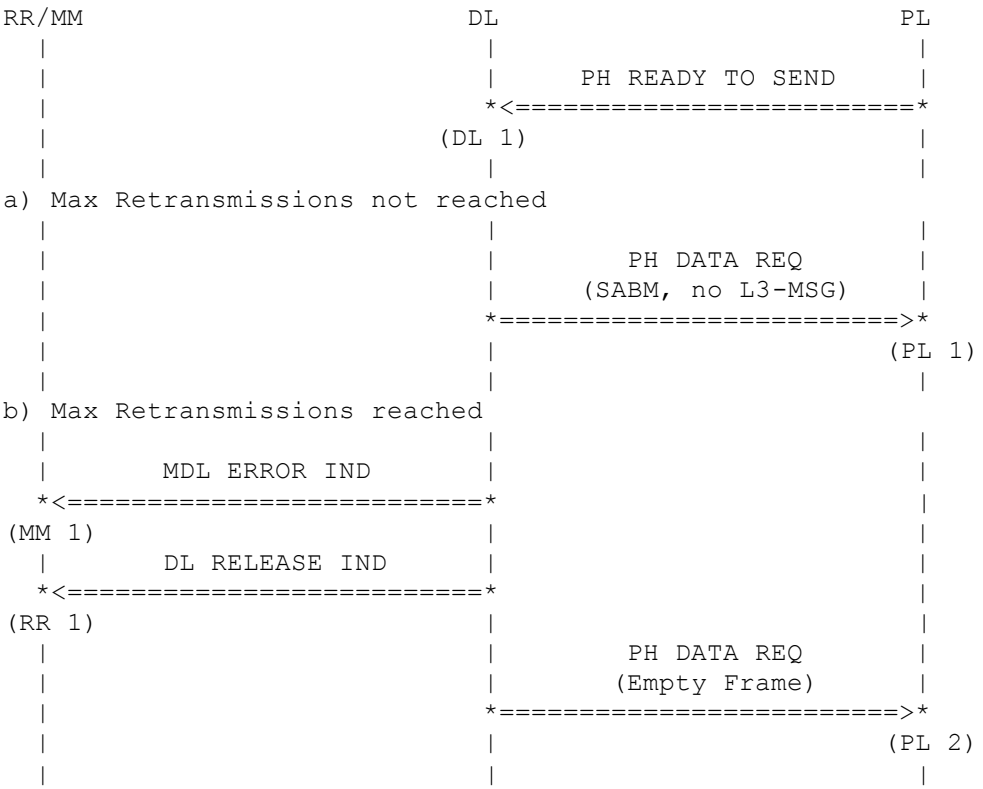
Data Link Layer waits for the PH READY TO SEND primitive, because this service is only for SDCCH and SACCH.

(PL 1)

The request for multiple frame operation is started by sending an SABM command with the P bit equal to one. The Length Indicator L is set to zero, because no Layer 3 message is to be transmitted.

All existing exception conditions are cleared. The retransmission counter is reset and counter T200 is initialized. The establishment procedure implies the discarding of any outstanding DL DATA REQ primitive which has been invoked prior to the DL ESTABLISH REQ. It also implies the discarding of any segmented Layer 3 message for which the last segment has not been received.

4.5.2 T200 Timeout



(DL 1)

Layer 1 requests data from data link layer. The counter for T200 indicates expiry of T200 expires before a UA or DM response is received.

(PL 1)

The retransmission counter is lower than N200 and a retransmission is started. The SABM command is retransmitted without a Layer 3 message, the retransmission counter is incremented by one, and the counter for T200 is initialised.

(MM 1)

Mobility Management is informed with MDL ERROR IND and "timer T200 expired N200 + 1 times; perform abnormal release".

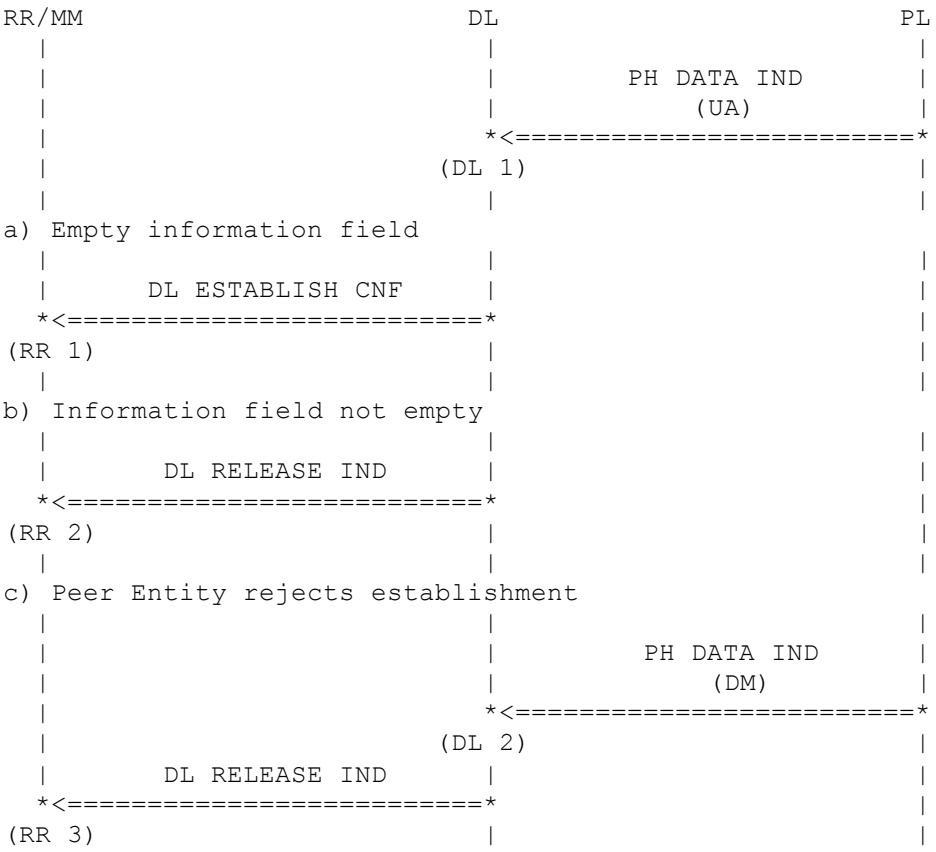
(RR 1)

After retransmission of the SABM command N200 times, the Data Link Layer indicates this to Radio Resource with DL RELEASE IND.

(PL 2)

An empty frame is send to layer 1 if the channel mode is signalling only.

4.5.3 Response from Base Station



(DL 1)

The base station sends a UA response with the F bit equal to one. UA responses with the F bit equal to zero are ignored.

(RR 1)

If the information field of the UA response is empty, Data Link Layer clears the counter for T200, sets the Send State Variable V(S), the Receive State Variable V(R), and the Acknowledge State Variable V(A) to zero, enters the multiple frame established state, and informs Radio Resource with DL ESTABLISH CNF.

(RR 2)

If the information field of the UA response is not empty, Data Link Layer clears the counter for T200, remains in IDLE state, and informs Radio Resource with DL RELEASE IND.

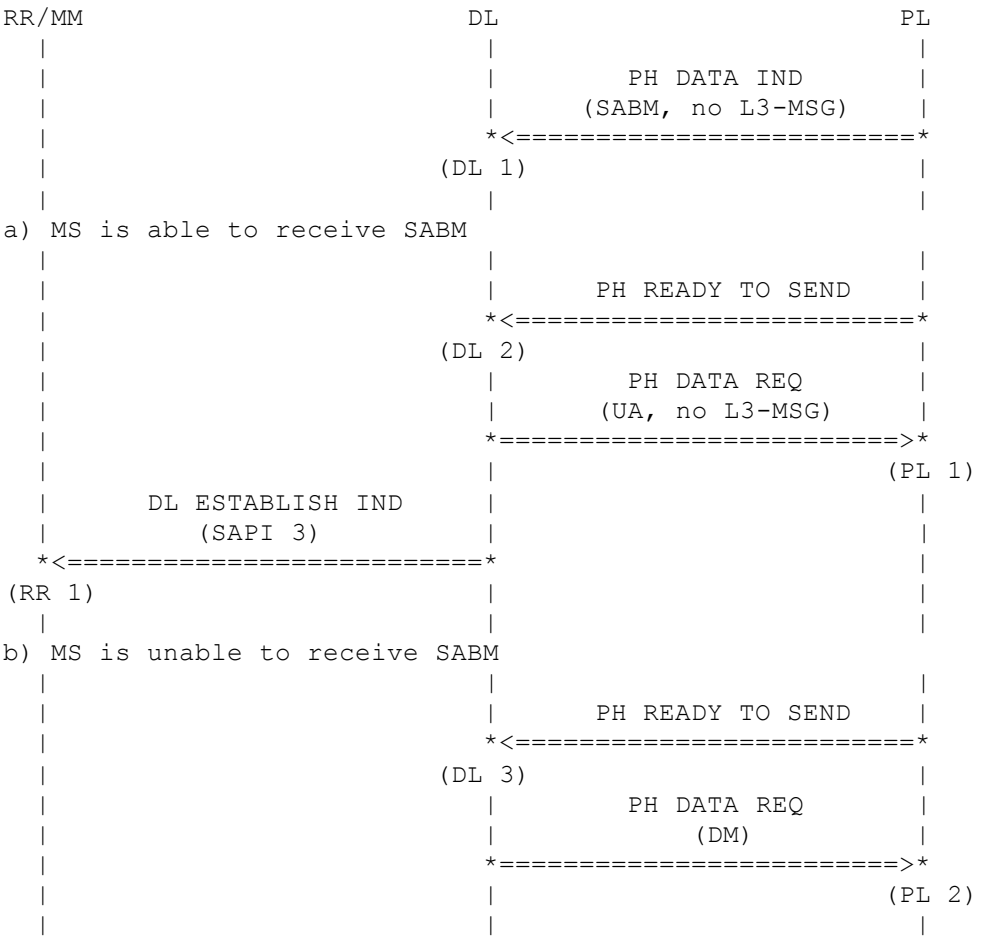
(DL 2)

If the base station is unable to enter the multiple-frame-established state, it responds with a DM response and the F bit set to one. DM responses with the F bit equal to zero are ignored.

(RR 3)

Data Link Layer clears the counter for T200, remains in IDLE state, and informs Radio Resource with DL RELEASE IND.

4.5.4 Initiation by the Base Station



(DL 1)

If the base station establishes the link for SAPI 3, Data Link Layer receives an SABM command without a Layer 3 message.

(DL 2)

Data Link Layer is able to accept the establishment, because the associated SAPI 0 connection is established. Data Link Layer waits for a PH READY TO SEND indicating the next time for sending a frame.

(PL 1)

Data Link Layer responds with a UA response with the F bit set to the same binary value as the P bit in the received SABM command, with SAPI equal to three and Length Indicator equal to zero. The Send State Variable V(S), the Receive State Variable V(R), and the Acknowledge State Variable V(A) are set to zero. Data Link Layer enters the state that multiple-frame has established.

(RR 1)

Radio Resource is informed with DL ESTABLISH IND. All existing exception conditions are cleared as well as any existing peer receiver busy condition.

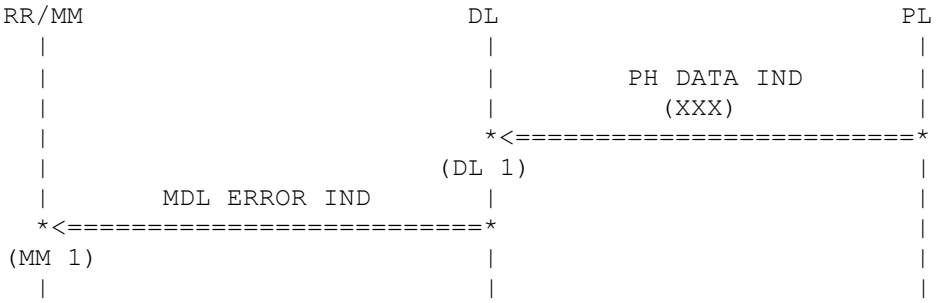
(DL 3)

Data Link Layer is unable to accept the establishment and waits for a PH READY TO SEND, indicating the next time for sending a frame.

(PL 2)

Data Link Layer responds with a DM response with the F bit set to the same binary value as the P bit in the received SABM command, with SAPI equal to three and Length Indicator equal to zero.

4.6 Error Conditions



(DL 1)

A frame is received in either the Multiple Frame Established or Timer Recovery state and one of the criteria depicted in the next table is matched.

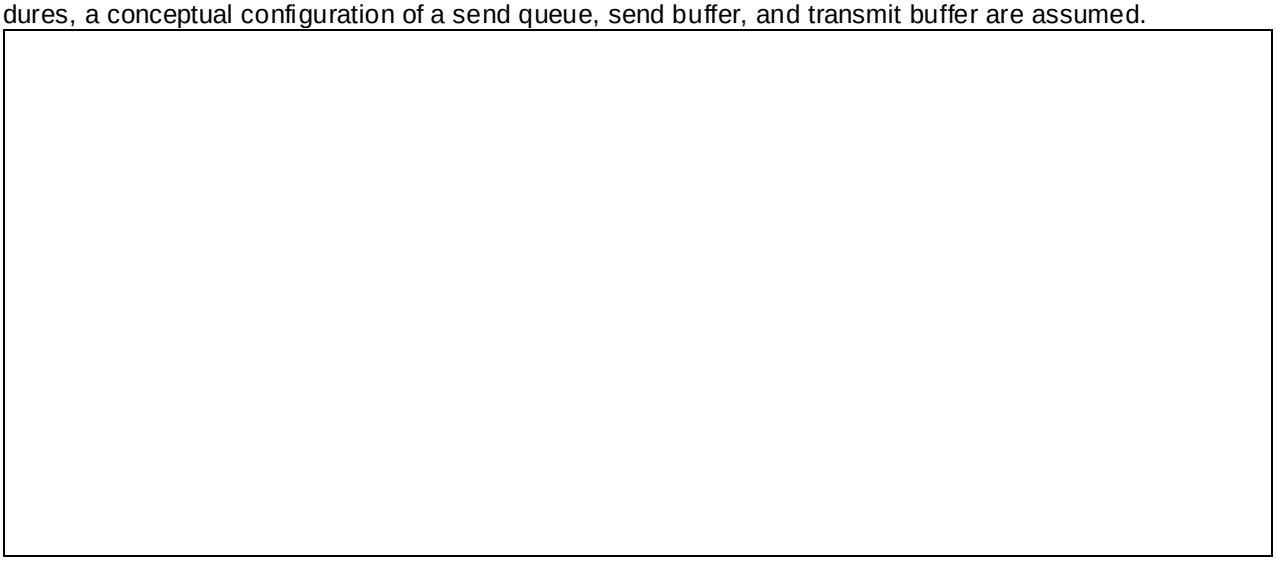
(MM 1)

A MDL ERROR IND is sent to MM.

Response Frame	Multiple Frame Established	Timer Recovery
UA, F=1	MDL ERROR IND (unsolicited UA response)	MDL ERROR IND (unsolicited UA response
UA, F=0	MDL ERROR IND (unsolicited UA response)	MDL ERROR IND (unsolicited UA response)
DM, F=1	MDL ERROR IND (unsolicited DM response)	OK
DM, F=0	MDL ERROR IND (unsolicited DM response, multiple frame established state, perform abnormal release)	MDL ERROR IND (unsolicited DM response, multiple frame established state, perform abnormal release)
Supervisory response, F=1	MDL ERROR IND (unsolicited supervisory response)	OK
Unallocated SAPI	ignore	ignore
I, SABM, UI, UA, DISC, DM, C/R indicates response	MDL ERROR IND (frame not implemented)	MDL ERROR IND (frame not implemented)
EA bit = 0	MDL ERROR IND (frame not implemented)	MDL ERROR IND (frame not implemented)
supervisory frame (N(R)-P/F-1 1 0 1)	MDL ERROR IND (frame not implemented)	MDL ERROR IND (frame not implemented)
unnumbered frame (x x x - P/F - 1 0 1 1 x x x - P/F - 0 1 1 1 0 1 0 - P/F - 1 1 1 1 0 1 1 - P/F - 1 1 1 1 1 0 0 - P/F - 1 1 1 1 1 0 1 - P/F - 1 1 1 1 1 1 0 - P/F - 1 1 1 1 1 1 1 - P/F - 1 1 1 1 0 0 1 - P/F - 0 1 1 1 0 0 1 - P/F - 0 0 1 1 1 0 0 - P/F - 0 0 1 1 1 0 1 - P/F - 0 0 1 1 1 1 0 - P/F - 0 0 1 1 1 1 1 - P/F - 0 0 1 1	MDL ERROR IND (frame not implemented)	MDL_ERROR_IND (frame not implemented)
EL bit = 0	MDL ERROR IND (frame not implemented)	MDL ERROR IND (frame not implemented)
I frame, L>201 or L=0	MDL ERROR IND (I frame with incorrect length)	MDL ERROR IND (I frame with incorrect length)
I frame, L<N201 and M=1	MDL ERROR IND (I frame with incorrect use of M bit)	MDL ERROR IND (I frame with incorrect use of M bit)
supervisory frame, L>0 or M=1	MDL ERROR IND (S frame with incorrect parameters)	MDL ERROR IND (S frame with incorrect parameters)
DISC, DM, L>0 or M=1	MDL ERROR IND (U frame with incorrect parameters)	MDL ERROR IND (U frame with incorrect parameters)
SABM, UA, UI, L>201 or M=1	MDL ERROR IND (U frame with incorrect parameters)	MDL ERROR IND (U frame with incorrect parameters)

4.7 Suspension and Resumption of Multiple Frame Operation

These procedures are used in the mobile station to suspend the uplink multiple frame operation for SAPI 0, during a change of dedicated channels (dedicated channel assignment or handover procedure in Radio Resource) and to resume operation after the new physical channel has been connected. The purpose of these procedures is to provide a mechanism for reliably avoiding message loss during a change of dedicated channels.
Applications using the multiple-frame-established service on SAPIs other than zero are expected to cope with message loss or duplication autonomously, i.e. on layers above Data Link Layer.
Radio Resource procedures, dedicated channel assignment, and handover are band controlled initiated by the network. The network will, therefore, suspend the flow of Layer 3 messages to the mobile station after the ASSIGNMENT or HANDOVER COMMAND message has been issued. When the Data Link on the new channel has been established, the message flow may resume.
In the following, the procedures in the mobile station are described. For the description of the procedures, a conceptual configuration of a send queue, send buffer, and transmit buffer are assumed.



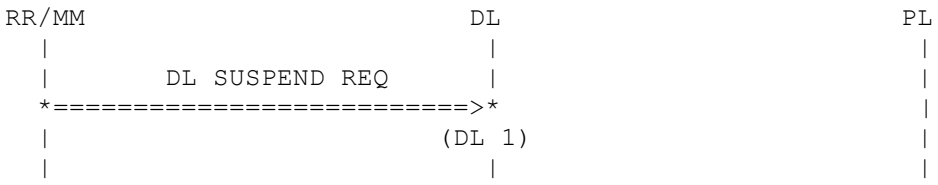
Layer 3 Storing in Data Link Layer

The send queue stores complete Layer 3 messages from Radio Resource. New messages from Radio Resource are stored in the send queue in the following order:

- acknowledged operation, SAPI 0
- acknowledged operation, SAPI 3
- unacknowledged operation, SAPI 0
- unacknowledged operation, SAPI 3

The send buffer contains the next complete Layer 3 message which is to be transmitted on a dedicated channel.
The transmit buffer contains the next segment of a Layer 3 message which is to be transmitted on a dedicated channel.

4.7.1 Suspension



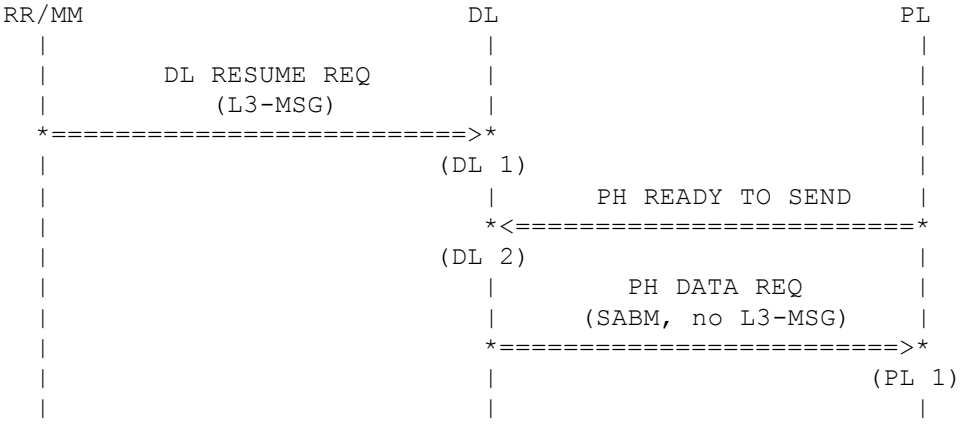
(DL 1)

Radio Resource indicates a request for the suspension of Multiple Frame Operation with the DL SUSPEND REQ primitive.

No further Layer 3 messages are taken from the send queue for SAPI 0. If there is a layer message in the send buffer which has not yet been transmitted, it will not be transmitted. The contents of the send buffer are put back to the first position of the send queue. The send and transmit buffers are cleared. A Layer 3 message is considered to be transmitted as soon as its final segment has been transmitted at least once; it need not yet have been acknowledged. This ensures that all segments of a segmented and possibly partly transmitted Layer 3 message will be transmitted on the new channel. Those segments that are already transmitted and received on the network will be discarded by the network upon the release of the old channel, because the Layer 3 message is not yet complete.

If there is a Layer 3 message in the send buffer, the last segment of which has been transmitted but is not yet fully acknowledged, i.e. the frame carrying the last segment of the message has been transmitted but is not yet acknowledged, then the contents of the send buffer are put back to the first position of the send queue and the send and transmit buffers are cleared.

4.7.2 Resumption, Initiation



(DL 1)

The Data Link Layer receives the resume request from Radio Resource with a DL RESUME REQ primitive and the Layer 3 message (ASSIGMENT or HANDOVER COMPLETE) included.

(DL 2)

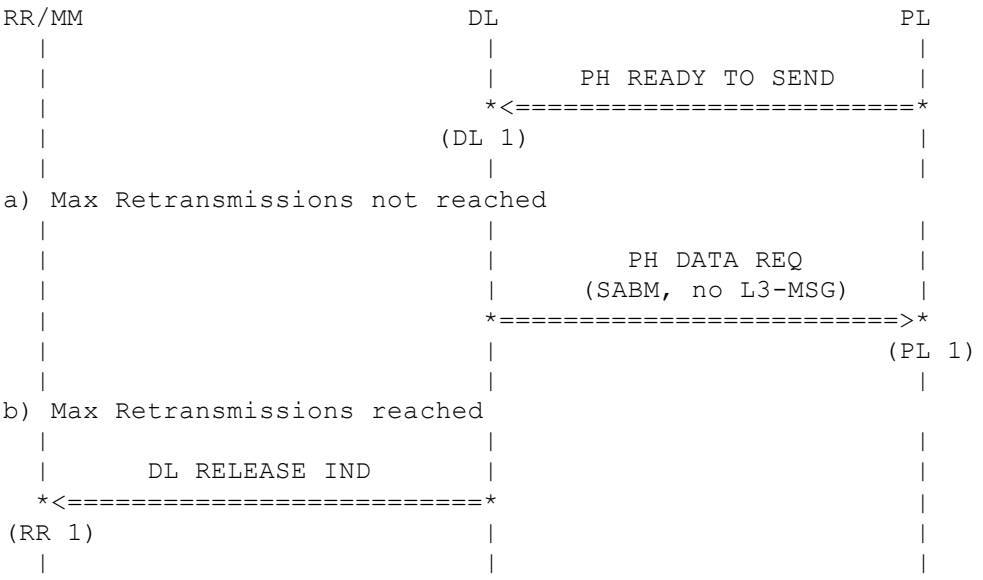
Data Link Layer waits for the PH READY TO SEND primitive.

(PL 1)

The resume request for Multiple Frame Operation is started by sending an SABM command with the P bit equal to one. The Length Indicator L is set to zero, because no Layer 3 message is to be transmitted.

All existing exception conditions are cleared. The retransmission counter is reset and the counter for T200 is initialised. This also implies the discarding of any segmented Layer 3 message for which the last segment has not been received. The send buffer is cleared. The Layer 3 message from the request is stored in the send buffer.

4.7.3 Resumption, T200 Timeout



(DL 1)

Layer 1 requests data from data link layer. The counter for T200 is decremented and indicates expiry of T200 before a UA or DM response is received.

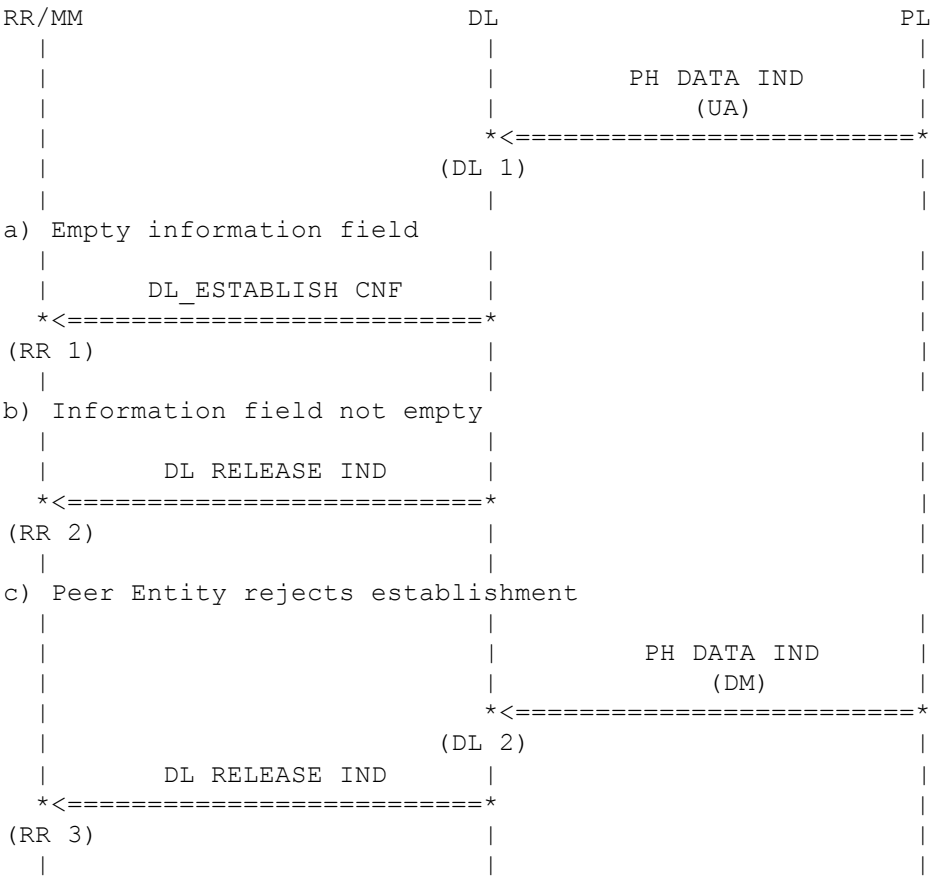
(PL 1)

The retransmission counter is lower than N200 and a retransmission is started. The SABM command without a Layer 3 message is retransmitted, the retransmission counter is incremented by one, and the counter for T200 is initialised.

(RR 1)

After retransmission of the SABM command N200 times, the Data Link Layer indicates this to Radio Resource with DL RELEASE IND.

4.7.4 Resumption, Response from Base Station



(DL 1)

The base station sends a UA response with the F bit equal to one. UA responses with the F bit equal to zero are ignored.

(RR 1)

If the information field of the UA response is empty, Data Link Layer clears the counter for T200, sets the Send State Variable V(S), the Receive State Variable V(R), and the Acknowledge State Variable V(A) to zero, enters the multiple frame established state, and informs Radio Resource with DL ESTABLISH CNF. The sending of the message stored in the send buffer is initiated.

(RR 2)

If the information field of the UA response is not empty, Data Link Layer clears the counter for T200, remains in suspended state, and informs Radio Resource with DL RELEASE IND.

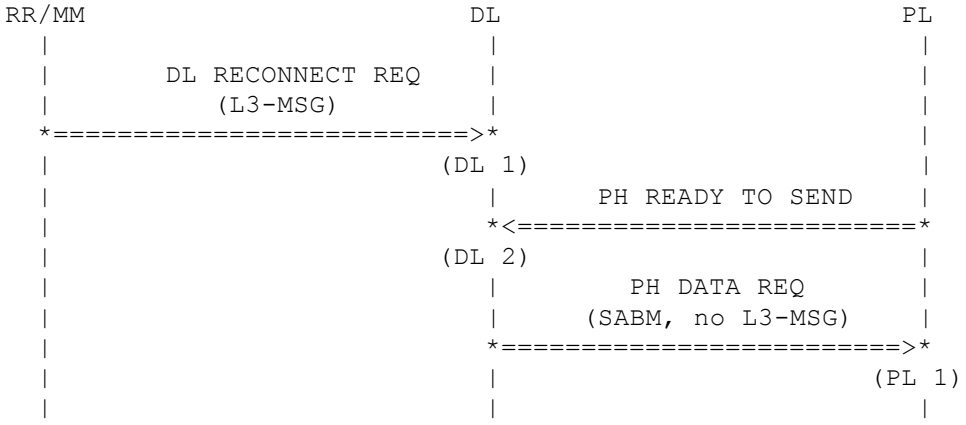
(DL 2)

If the base station is unable to resume, it responds with a DM response and the F bit set to one. DM responses with the F bit equal to zero are ignored.

(RR 3)

Data Link Layer clears the counter for T200, remains in suspended state, and informs Radio Resource with DL RELEASE IND.

4.7.5 Reconnection, Initiation



(DL 1)

The Data Link Layer receives the reconnect request from Radio Resource with a DL RECONNECT REQ primitive with a Layer 3 message (ASSIGMENT or HANDOVER FAILURE) included.

(DL 2)

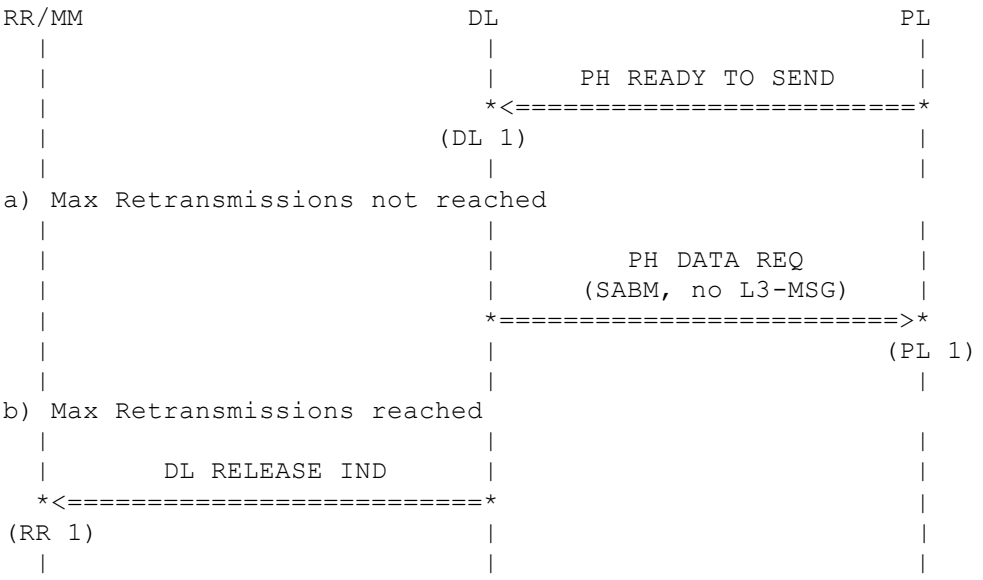
Data Link Layer waits for the PH READY TO SEND primitive.

(PL 1)

The reconnect request for Multiple Frame Operation is started by sending an SABM command with the P bit equal to one. The Length Indicator L is set to zero, because no Layer 3 message is to be transmitted.

All existing exception conditions are cleared. The retransmission counter is reset and the counter for T200 is started. This also implies the discarding of any segmented Layer 3 message for which the last segment has not been received. The send buffer is cleared. The Layer 3 message from the request is stored in the send buffer.

4.7.6 Reconnection, T200 Timeout



(DL 1)

Layer 1 requests data from data link layer. The counter for T200 is decremented. It indicates expiry of T200 before a UA or DM response is received.

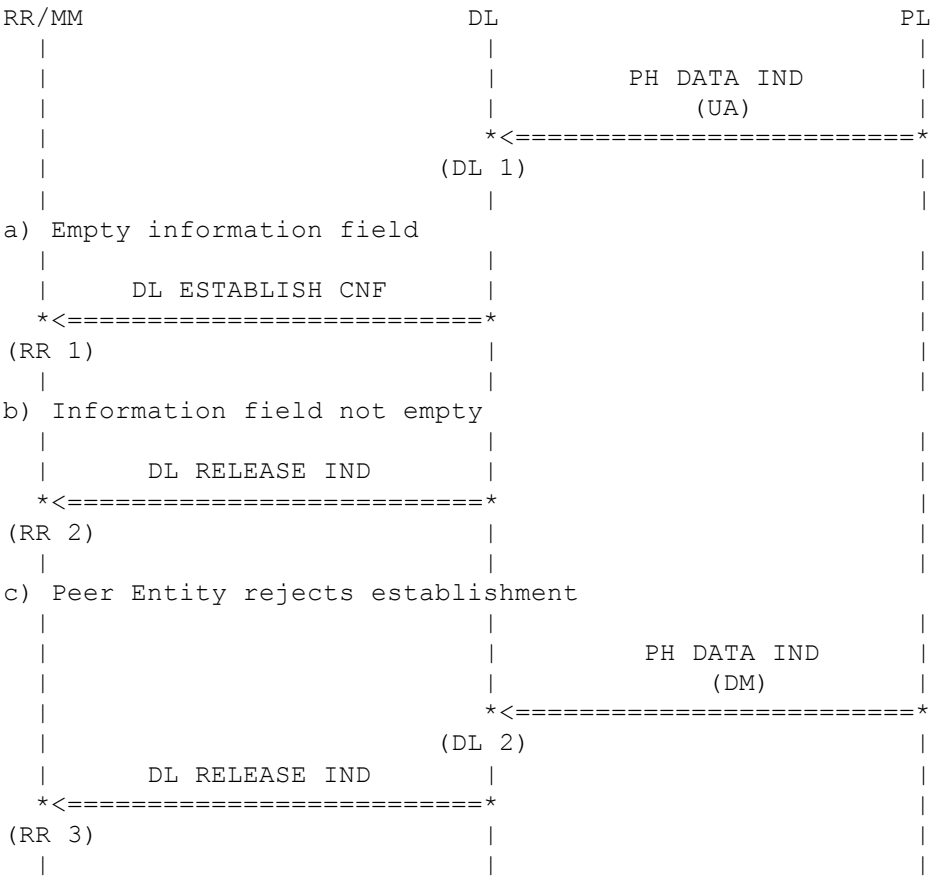
(PL 1)

The retransmission counter is lower than N200 and a retransmission is started. The SABM command without a Layer 3 message is retransmitted, the retransmission counter is incremented by one, and the counter for T200 is initialised.

(RR 1)

After retransmission of the SABM command N200 times, the Data Link Layer indicates this to Radio Resource with DL RELEASE IND.

4.7.7 Reconnection, Response from Base Station



(DL 1)

The base station sends a UA response with the F bit equal to one. UA responses with the F bit equal to zero are ignored.

(RR 1)

If the information field of the UA response is empty, Data Link Layer clears the counter for T200, sets the Send State Variable V(S), the Receive State Variable V(R), and the Acknowledge State Variable V(A) to zero, enters the multiple frame established state, and informs Radio Resource with DL ESTABLISH CNF. The sending of the message stored in the send buffer is initiated.

(RR 2)

If the information field of the UA response is not empty, Data Link Layer clears the counter for T200, enters the IDLE state, and informs Radio Resource with DL RELEASE IND.

(DL 2)

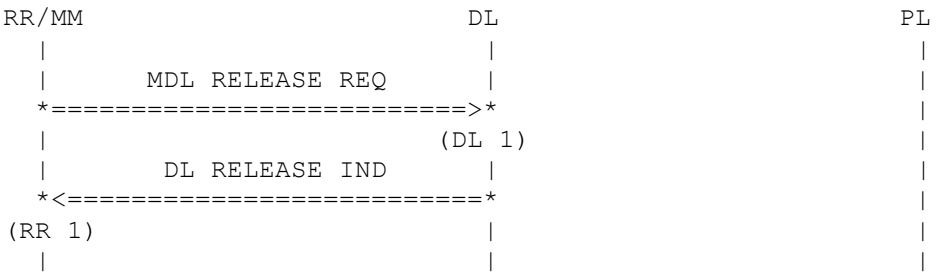
If the base station is unable to reconnect, it responds with a DM response and the F bit set to one. DM responses with F bit equal to zero are ignored.

(RR 3)

Data Link Layer clears the counter for T200, enters the IDLE state, and informs Radio Resource with DL RELEASE IND.

4.8 Release

4.8.1 Local End Release



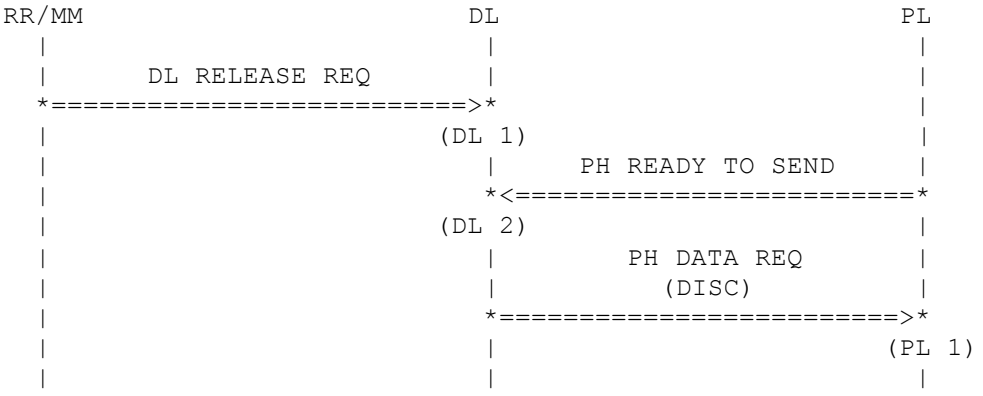
(DL 1)

When Data Link Layer is not in IDLE state and receives an MDL RELEASE REQ from Mobility Management, it performs a local end release.

(RR 1)

Data Link Layer enters state IDLE and sends a DL RELEASE IND primitive to Radio Resource.

4.8.2 Normal Release, Initiation by mobile station



(DL 1)

The procedure is initiated by the mobile station.

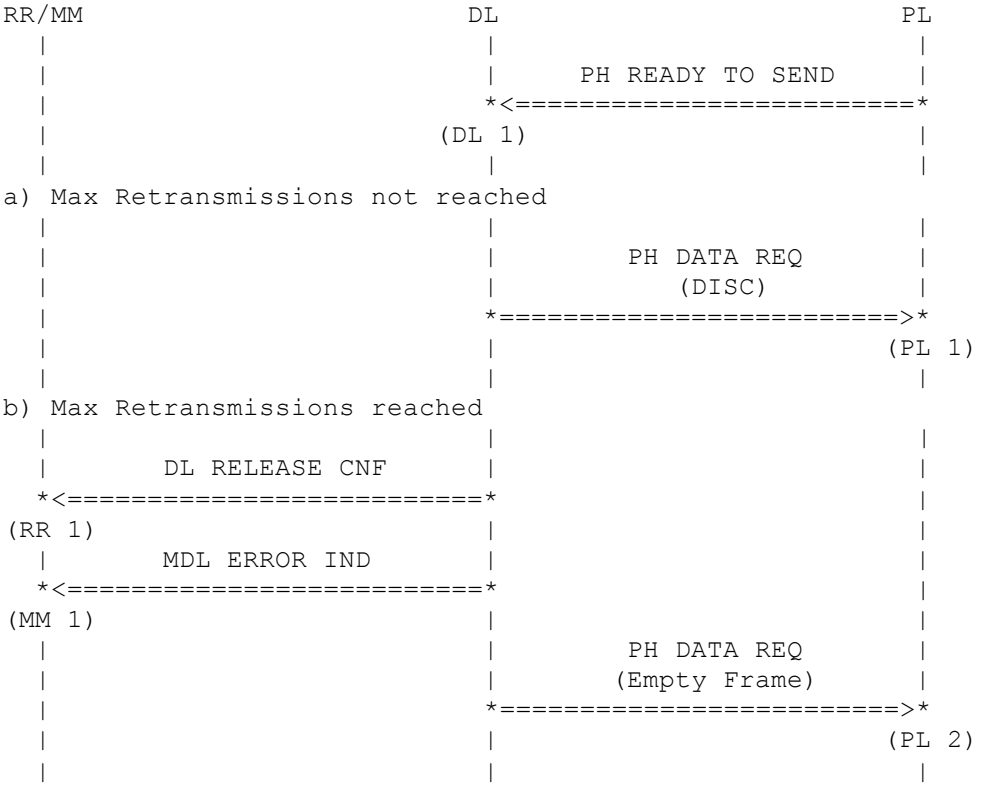
(DL 2)

DL waits for the PH READY TO SEND primitive from the Physical Layer which indicates the time for sending a frame.

(PL 1)

The Data Link Layer transmits a DISC frame with P equal to one. The Length Indicator L is set to 0 zero, because no Layer 3 message is sent. All existing exception conditions are cleared, the retransmission counter is reset, and the counter for T200 is initialised.

4.8.3 Normal Release, T200 Timeout



(DL 1)

Layer 1 requests data from data link layer. The counter for T200 is decreased. It indicates expiry of T200 before a UA or DM response has been received.

(PL 1)

If the retransmissions counter is lower than N200, the Data Link Layer retransmits the DISC frame. The retransmission counter is incremented by one and the counter for T200 is initialised.

(RR 1)

If the retransmission counter is not lower than N200, the Data Link Layer enters state IDLE. Radio Resource is informed with the DL RELEASE CNF primitive

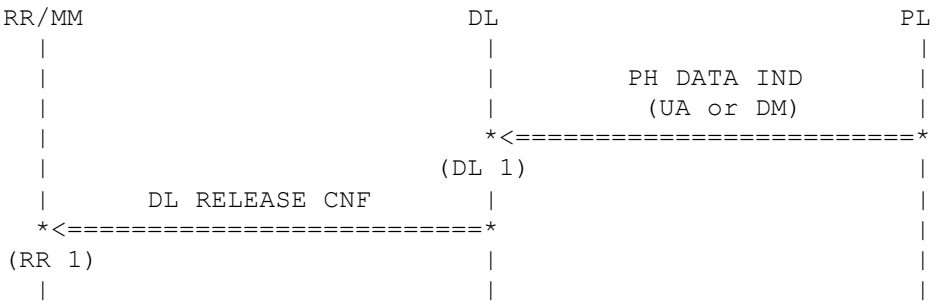
(MM 1)

MM is informed with an MDL ERROR IND and the cause "Timer T200 expired N200 + 1 timer; perform abnormal release".

(PL 2)

An empty frame is send to layer 1 if the channel mode is signalling only.

4.8.4 Normal Release, Response from Base Station



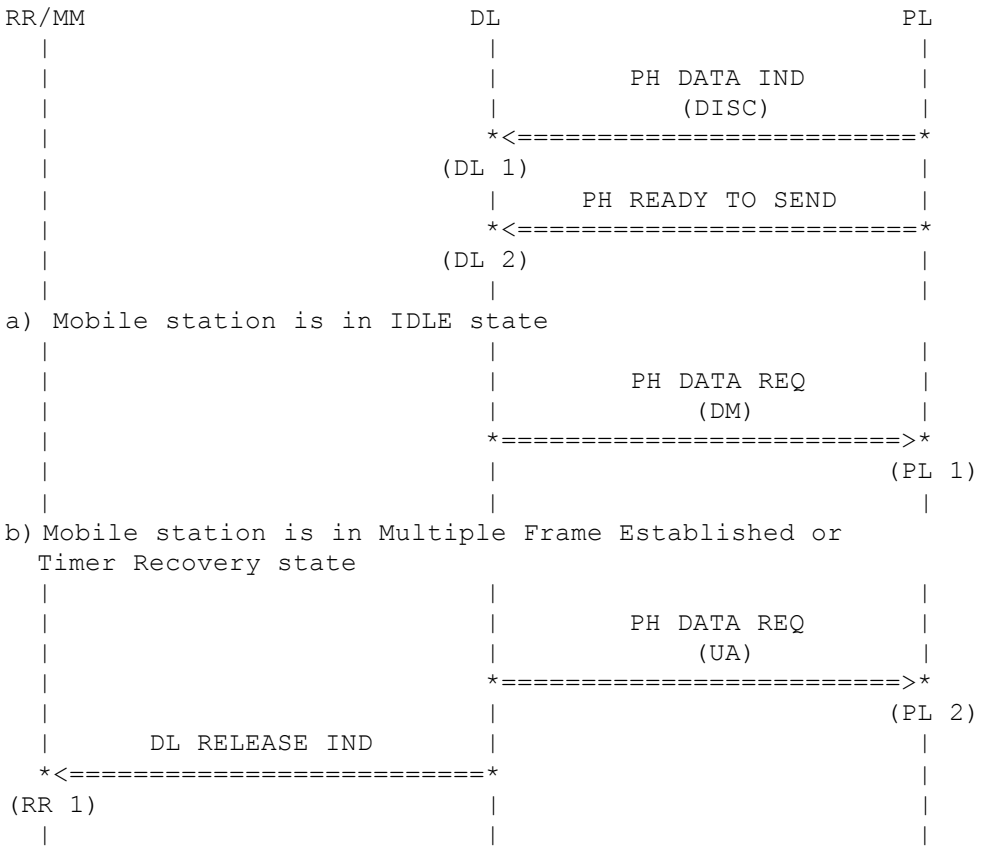
(DL 1)

Data Link Layer receives a UA or DM response with the F bit equal to one and an information field. A UA response with the F bit equal to zero is ignored.

(RR 1)

Data Link Layer clears the counter for T200, enters state IDLE, and informs Radio Resource with the DL RELEASE CNF primitive.

4.8.5 Normal Release, Initiation by base station



(DL 1)

The base station sends a DISC command.

(DL 2)

DL waits for the PH READY TO SEND primitive from the Physical Layer indicating the time for sending a frame.

(PL 1)

If Data Link Layer is in state IDLE, a DM response is sent to the base station. The F bit is set to the same value as the P bit in the previous DISC command.

(PL 2)

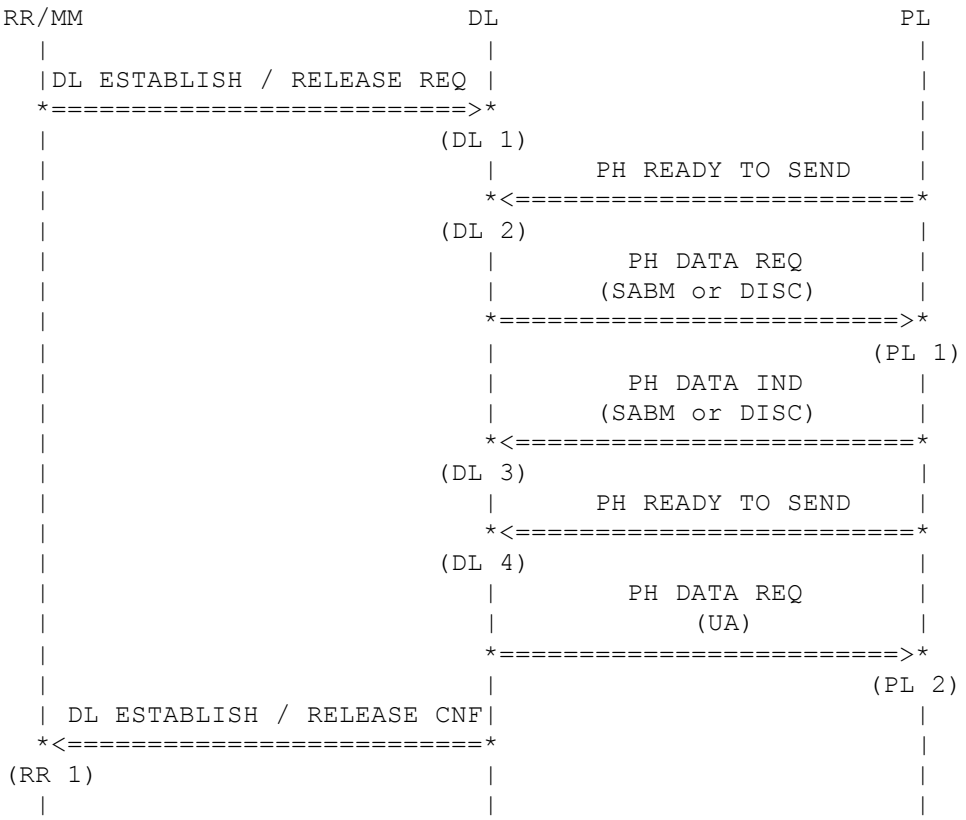
If Data Link Layer is in multiple-frame-established or timer recovery state a UA response is sent to the base station. The F bit is set to the same value as the P bit in the previous DISC command.

(RR 1)

A DL RELEASE IND is sent to Radio Resource. The counter for T200 is cleared and Data Link Layer enters state IDLE.

4.9 Collision of unnumbered commands and responses

4.9.1 Identical transmitted and received commands



(DL 1)

Radio Resource starts an establish or release request.

(DL 2)

Data Link Layer waits for PH READY TO SEND to send a frame .

(PL 1)

Depending on the procedure, an SABM or a DISC command is sent to the base station.

(DL 3)

The base station answers with the same unnumbered command (SABM or DISC).

(DL 4)

Data Link Layer waits for PH READY TO SEND to send a frame.

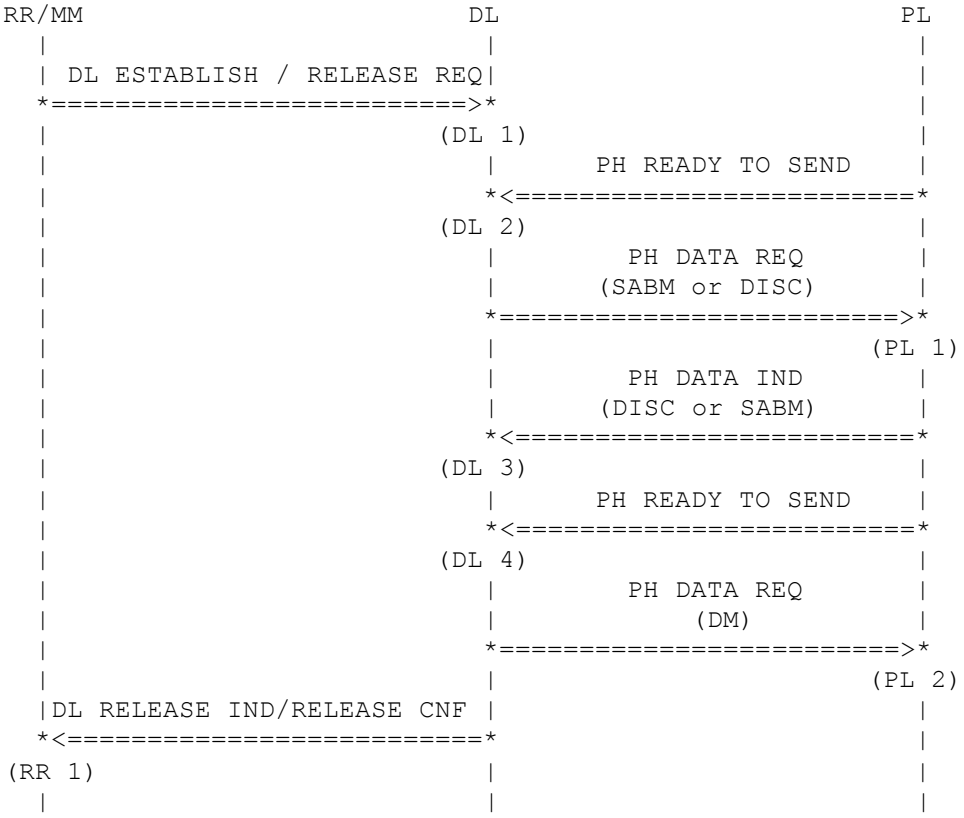
(PL 2)

Data Link Layer sends a UA response with the F bit set to the value of the P bit in the previous command.

(RR 1)

Radio Resource is informed about the successful end of procedure.

4.9.2 Different transmitted and received commands (SDCCH / SACCH)



(DL 1)

Radio Resource starts an establish or a release request.

(DL 2)

Data Link Layer waits for PH READY TO SEND to send a frame.

(PL 1)

Depending on the procedure, an SABM or a DISC command is sent to the base station.

(DL 3)

The base station answers with a different unnumbered command (DISC or SABM).

(DL 4)

Data Link Layer waits for PH READY TO SEND to send a frame.

(PL 2)

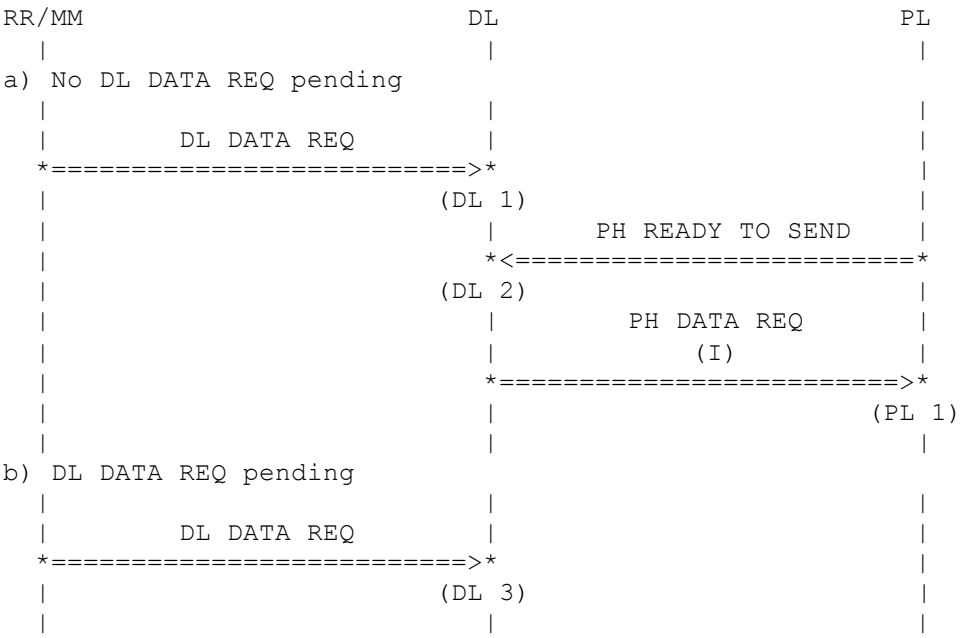
Data Link Layer sends a DM response with the F bit set to the value of the P bit in the previous command.

(RR 1)

Radio Resource is informed about the failed establishment or end of release procedure. The counter for T200 is cleared.

4.10 Information Transfer

4.10.1 Transmitting I Frames



(DL 1)

The Layer 3 message is stored in the send buffer.

(DL 2)

Data Link Layer waits for PH READY TO SEND to send a frame.

(PL 1)

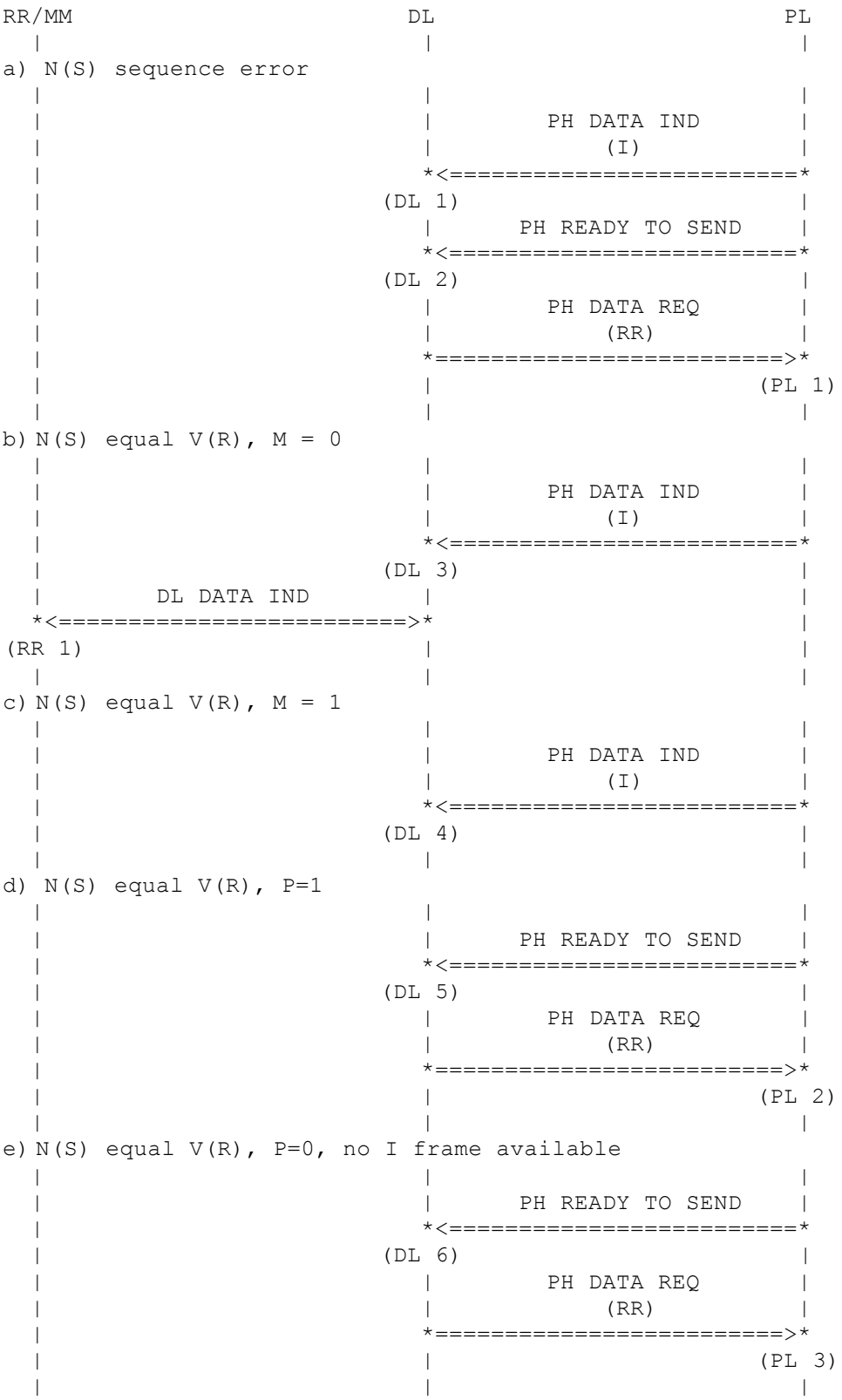
Information received by the Data Link Layer from Radio Resource is transmitted by one or more I frames. If the Layer 3 (three) message consists of N201 or fewer octets, the message is to be contained in one I frame. The M bit is set to zero. If the Layer 3 message exceeds N201 octets, the Data Link Layer segments the message in such a way that all segments, except the last, consist of N201 octets. The M bit is set to one for each segment except the last, in which the M bit is set to zero.

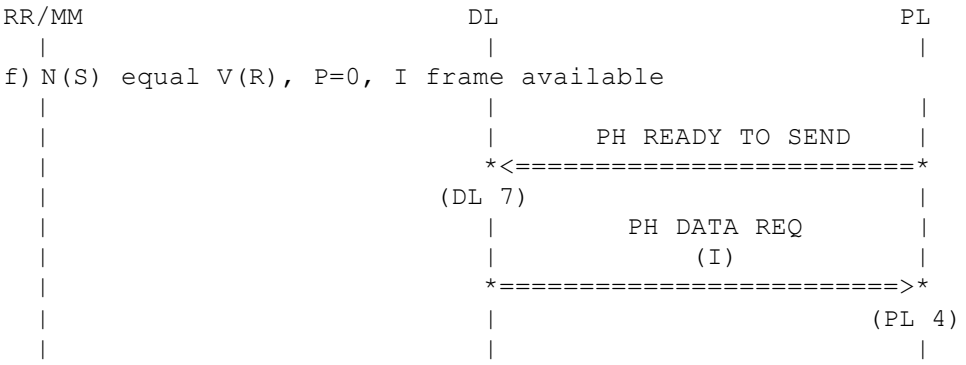
When transmitting an I frame, the Control Field parameters N(S) and N(R) are assigned the values of the Send and Receive State Variables V(S) and V(R), respectively. The value of the Send State Variable V(S) is incremented by one at the end of transmission of the I frame. The counter for T200 is cleared.

(DL 3)

If a DL DATA REQ is pending, the send buffer is not empty and an I frame is not acknowledged. The Layer 3 message is then stored in the send queue.

4.10.2 Receiving I Frames





(DL 1)

An N(S) sequence error occurs if a valid I frame is received containing an N(S) value which is not equal to the Receive State Variable V(R). The information is discarded.

(DL 2)

Data Link Layer awaits PH READY TO SEND from the Physical Layer to send a response.

(PL 1)

If this N(S) sequence error occurs the first time the exception condition recovery is set, the REJ frame is used by Data Link Layer to initiate this exception condition. Only one REJ exception condition for a given direction of information transfer is established at one time. The REJ exception is cleared when the requested I frame or an SABM or DISC command is received.

(DL 3)

A valid I frame is received with N(S) equal to the Receive State Variable V(R). The M bit is set to 0 zero. The content is a complete or the last segment of a Layer 3 message. If needed, the information field is concatenated to the previous segments.

(RR 1)

The complete Layer 3 message is forwarded to Radio Resource.

(DL 4)

A valid I frame is received with N(S) equal to the Receive State Variable V(R). The M bit is set to one. The content is only a segment of a Layer 3 message and is concatenated to the previous segments.

(DL 5)

Data Link Layer awaits PH READY TO SEND from Physical Layer to send a response.

(PL 2)

The P bit in the previous I frame was set to one. Therefore, an RR response with the F bit set to one is sent to the base station.

(DL 6)

Data Link Layer awaits PH READY TO SEND from the Physical Layer to send a response.

(PL 3)

The P bit in the previous I frame was set to zero and Data Link Layer has no I frames to send. Therefore, an RR response with the F bit set to zero is sent to the base station.

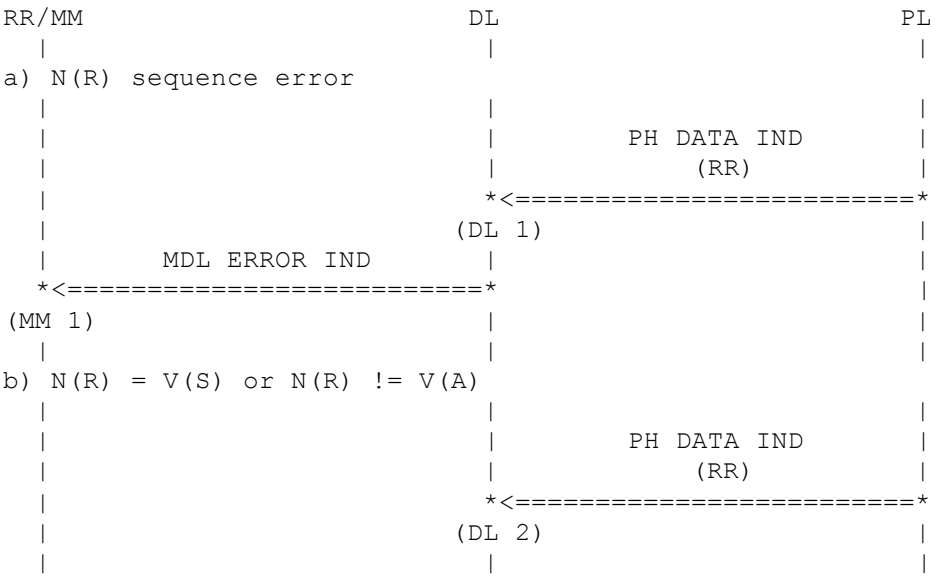
(DL 7)

Data Link Layer awaits PH READY TO SEND from the Physical Layer to send a response.

(PL 4)

The P bit in the previous I frame was set to zero and Data Link Layer has I frames to send. Therefore, an I frame with N(R) set to the current V(R) value is sent to the base station. This I frame acknowledges the reception of an I frame.

4.10.3 Receiving Acknowledgement



(DL 1)

Data Link Layer receives an RR response. An N(R) sequence error is detected by Data Link Layer. This occurs when a valid RR frame is received which contains an invalid N(R) value. A valid (N) is one that is in the range:

V(A) <= N(R) <= V(S).

The inequalities are interpreted in the following way: N(R) is call valid if and only if

(N(R) - V(A)) mod 8 <= (V(S)-V(A)) mod 8.

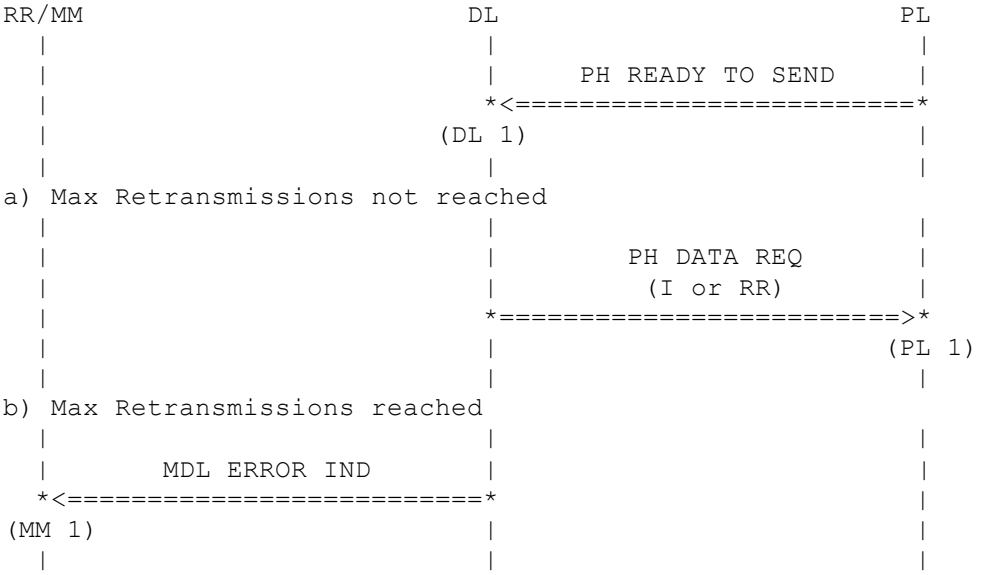
(MM 1)

An MDL ERROR IND is sent to Mobility Management with the cause stated as "sequence error; perform abnormal release".

(DL 2)

Data Link Layer receives the expected RR response. The counter for T200 is cleared and VA is set to N(R)

4.11 Timer Recovery, T200 Timeout



(DL 1)

Layer 1 requests data from data link layer. The counter for T200 is decremented. It indicates expiry of T200 before an RR response or I command has been received.

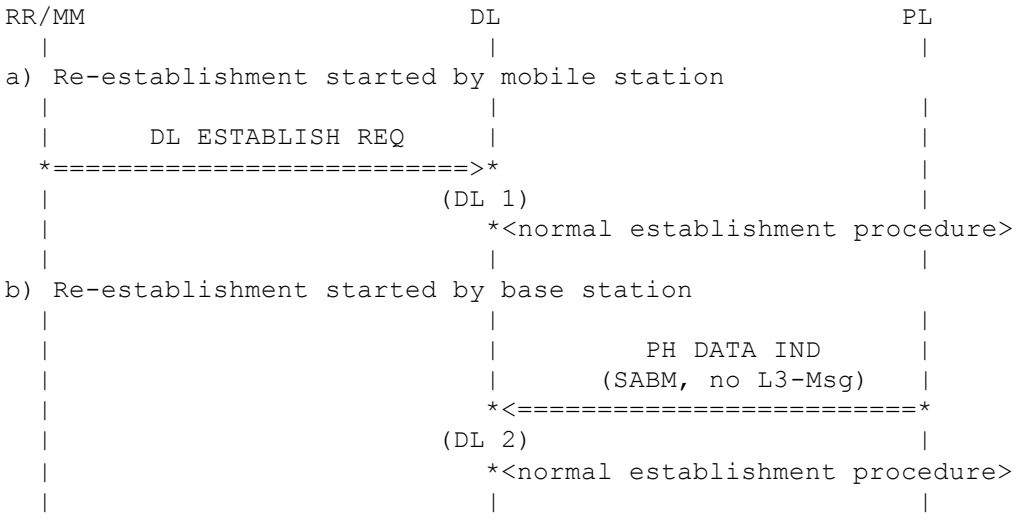
(PL 1)

If the retransmissions counter is lower than N200, the Data Link Layer retransmits the last transmitted I frame (V(S) - 1) or the appropriate supervision frame with the P bit set to one. The retransmission counter is incremented by one and the counter for T200 is initialised.

(MM 1)

If the retransmission counter is not lower than N200, Mobility Management is informed with an MDL ERROR IND and the cause "Timer T200 expired N200 + 1 timer; perform abnormal release".

4.12 Re-establishment



(DL 1)
When the Data Link Layer receives a DL ESTABLISH REQ from Radio Resource without a Layer 3 message for SAPI 0 in the multiple-frame-established state or timer recovery state, a mobile originated re-establishment is started. This results in the normal establishment procedure.

(DL 2)
When the Data Link Layer receives an SABM command from the base station without a Layer 3 message for SAPI 0 in the multiple-frame-established state or timer recovery state, a mobile terminated re-establishment is started. This results in the normal establishment procedure.

Appendices

A. Acronyms

DS-WCDMA	Direct Sequence/Spread Wideband Code Division Multiple Access

B. Glossary

International Mobile Telecommunication 2000 (IMT-2000/ITU-2000)	Formerly referred to as FPLMTS (Future Public Land-Mobile Telephone System), this is the ITU's specification/family of standards for 3G. This initiative provides a global infrastructure through both satellite and terrestrial systems, for fixed and mobile phone users. The family of standards is a framework comprising a mix/blend of systems providing global roaming. <URL: http://www.imt-2000.org/>