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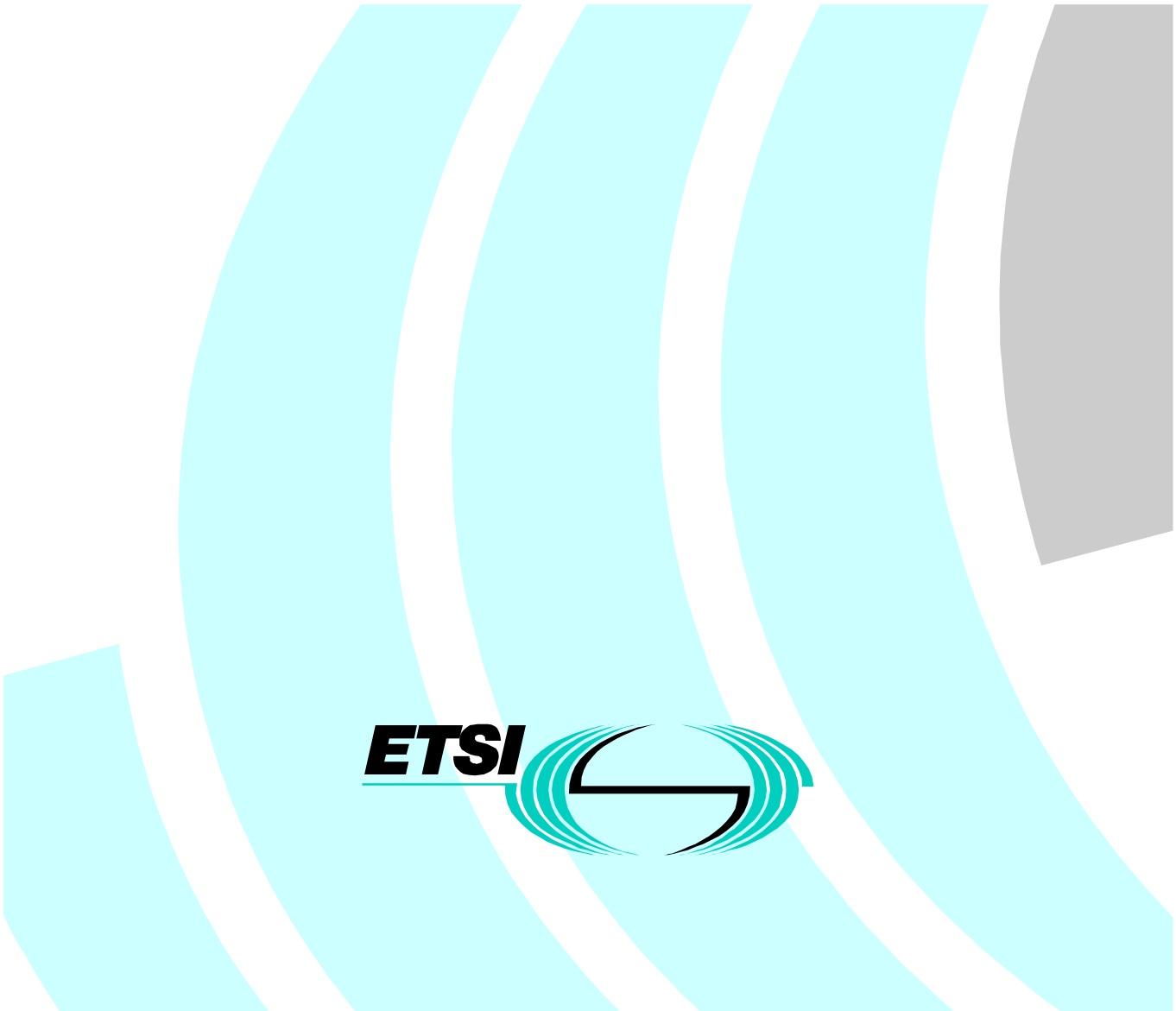
Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 4: Radio interface protocol specifications;
Sub-part 6: Mobile earth Station-Gateway Station Interface
Data Link Layer Specifications;
GMR-1 04.006



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Contents

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IPRs:

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Hughes Network Systems		US	Pending	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES modify the contents of the present document, it shall then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 1.m.n

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- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 4, sub-part 6 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Part 4: "Radio interface protocol specifications";

Sub-part 1: "Mobile Earth Station-Gateway Station System (MES-GSS) Interface; GMR-1 04.001";

Sub-part 2: "GMR-1 Satellite Network Access Reference Configuration; GMR-1 04.002";

Sub-part 3: "Channel Structures and Access Capabilities; GMR-1 04.003";

Sub-part 4: "Layer 1 General Requirements; GMR-1 04.004";

Sub-part 5: "Data Link Layer General Aspects; GMR-1 04.005";

Sub-part 6: "Mobile earth Station-Gateway Station Interface Data Link Layer Specifications; GMR-1 04.006";

Sub-part 7: "Mobile Radio Interface Signalling Layer 3 General Aspects; GMR-1 04.007";

Sub-part 8: "Mobile Radio Interface Layer 3 Specifications; GMR-1 04.008";

Sub-part 9: "Performance Requirements on the Mobile Radio Interface; GMR-1 04.013";

Sub-part 10: "Rate Adaptation on the Access Terminal-Gateway Station Subsystem (MES-GSS) Interface; GMR-1 04.021";

Sub-part 11: "Radio Link Protocol (RLP) for Data Services; GMR-1 04.022";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding specifications";

Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where:

- xx.0yy (z = 0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.
- xx.2yy (z = 2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.
- n denotes the first (n = 1) or second (n = 2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist, the corresponding GSM specification may or may not apply. The applicability of the GSM specifications is defined in GMR-1 01.201 [2].

1 Scope

The present document introduces the Link Access Procedures (LAP) for the Satellite Channel (LAPSat). LAPSat is the protocol for signalling transfer between an Access Terminal (MES) and a Gateway Station (GS) in the GeoMobile (GMR-1) network.

Most of the procedures defined for LAPSat closely follow those defined for the LAPs for the Mobile D Channel (LAPDm) used by Global System for Mobile (GSM). References are made throughout the present document to the corresponding GSM technical specifications (GSM 04.06 [9]). Only the significant differences between the LAPs for the Mobile D (Dm) and Satellite (Sat) channels are described here.

The present document is based on GSM 04.06 [9].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] GMR-1 01.004 (ETSI TS 101 376-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMR-1 01.004".

[2] GMR-1 01.201 (ETSI TS 101 376-1-2): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 Family; GMR-1 01.201".

[3] GMR-1 03.296 (ETSI TS 101 376-3-18): "GEO-Mobile Radio Interface Specifications; Part 3: Network specifications; Sub-part 18: Terminal-to-Terminal Call (TtT); GMR-1 03.296".

[4] GMR-1 04.003 (ETSI TS 101 376-4-3): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 3: Channel Structures and Access Capabilities; GMR-1 04.003".

[5] GMR-1 04.005 (ETSI TS 101 376-4-5): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 5: Data Link Layer General Aspects; GMR-1 04.005".

[6] GMR-1 04.008 (ETSI TS 101 376-4-8): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 8: Mobile Radio Interface Layer 3 Specifications; GMR-1 04.008".

[7] GMR-1 05.003 (ETSI TS 101 376-5-3): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-1 05.003".

[8] GMR-1 05.008 (ETSI TS 101 376-5-6): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 05.008".

[9] GSM 04.06 (ETSI ETS 300 555): "European digital cellular telecommunications system (Phase 2); Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification (GSM 04.06 (V4.4.0))".

[10] GSM 04.12 (ETSI ETS 300 560): "Digital cellular telecommunications system (Phase 2); Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface; (GSM 04.12 (V4.6.0))".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in GMR-1 01.004 [1] apply. A number of concepts and terms are borrowed from the GSM 04.06 [9]. The mapping shown in table 3.1 could be useful for proper association.

Table 3.1: Mapping of GSM terms to GMR-1

Usage in GSM	Usage in GMR
MS (Mobile Station)	MES (Mobile Earth Station)
BS (Base Station)	GS (Gateway Station)
Dm (D Channel for GSM)	Sat (Satellite Channel for GMR-1)

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in GMR-1 01.004 [1] apply.

4 General

The present document describes the deviations of the DL layer protocol for the GMR-1 system from that of the GSM system. This protocol shall be referred to as LAPSat throughout the document.

The frame formats and the link layer protocol defined for LAPSat are based on those defined for LAPD and LAPDm (Dm is the signalling channel for the GSM system). The primary difference between the LAPSat and the LAPDm are due to the round-trip delay for the satellite channel and the different burst sizes on the physical channels.

LAPSat is used for sending information on the control channels Broadcast Control Channel (BCCH), GPS Broadcast Control Channel (GBCH), Access Grant Channel (AGCH), Paging Channel (PCH), Broadcast Alerting Channel (BACH), Terminal-to-Terminal Associated Control Channel (TACCH), Fast Associated Control Channel (FACCH), Slow Associated Control Channel (SACCH), and Standalone Dedicated Control Channel (SDCCH), as defined in GMR-1 04.003 [4].

Terminal-to-Terminal (TtT) calls require an important deviation from the GSM system. For a TtT to be accomplished, a special Data Link (DL) connection is established using SAPI = 2, over the TtT channel. The two ends of the Data Link Layer (DLL) are the two MESs. One MES acts as a GS (or network) under the command of the network. The GS DL monitors all communication over this Service Access Point Identifier (SAPI); however, it never initiates nor responds to any transaction or exchange of messages over this link. It does send indications to the upper layer, as appropriate, about messages passing over this link. Throughout the present document when the role of the GS is mentioned it is referring to the MES acting as the GS (unless explicitly defined otherwise), with regard to the DL connection over SAPI = 2. The MES given the role of the terminal shall initiate the SAPI = 2 link establishment procedure.

5 Frame structure for peer-to-peer communication

5.1 General

All data link layer peer-to-peer exchanges are in frames conforming to one of the formats given below. The frame format for the GMR-1 system is significantly different from that for the GSM system. (See also clause 10.)

Format A is used for the point-to-point connection to exchange information (via I, S, and U frames) on the FACCH, SACCH, TACCH, and SDCCH channels. The Type A DL frame format is shown in figure 5.1.

Bit # /Octet	8	7	6	5	4	3	2	1
1	Address Field							
2	Control Field (bit#12 … bit#5)							
3	Control Field(bit#4 … bit#1)				Last Octet (bit#8…bit#5) (note 2)			
4	Length Field (note 1)							
5								
•	Information/Fill bits							
•								
•								
N201+3					Last Octet (bit#4..bit#1) (note 2)			

NOTE 1: The length field shall be present only if the size of the information field is less than N201 allowed for the frame.
NOTE 2: The last octet of the frame is split into two nibbles. The two nibbles are placed in the frame as shown in the figure. Repositioning the nibbles results in octet alignment of the rest of the information octets throughout the DL frame of Format Type A.

Figure 5.1: DL frame format type A

Format Type B is used to carry information on the BCCH, GBCH, PCH, AGCH, RACH, and BACH channels. The Type B DL frame format is shown in figure 5.2.

Bit # /Octet	8	7	6	5	4	3	2	1
1								
2								
•	Information Field							
•								
N201								

Figure 5.2: DL frame format type B

The parameter N201 takes a fixed value for each type of channel (see clause 8.8.3) and determines the maximum number of octets in the information field of a frame.

5.2 Frame delimitation and fill bits

Frame delimitation is provided by the physical layer in the following positions:

- at the beginning of the frame to determine the first bit of the frame, i.e., at the start of the first octet in the address field for the frames of Format Type A;
- at the beginning of the frame to determine the first bit of the frame, i.e., at the start of the first octet of the information field for the frame of Format Type B;
- at the end of the frame to determine the last bit of the frame.

The fill bits are used for the frame of Format Type A and are only necessary if the number of information octets is less than N201-1 (1 octet is used by the length field L). The fill bits pattern shall always be set to the binary value "00000000".

5.3 Address field

The address field consists of one octet. The address field identifies the Service Access Point (SAP) for which a command frame is intended and the SAP transmitting a response frame. The format of the address field is defined in clause 6.2.

5.4 Control field

The control field identifies the type of frame (see clause 6.4 for frame formats) and shall be 12 bits in length. The format of the control field is defined in clause 6.4.

5.5 Length field

The length of the information field in the DL frame shall be encoded conditionally in the length field using an 8-bit value (see clause 6.3.6). The length field L is present only if the length of the information field is less than the maximum number of information octets, i.e., N201 (see clause 8.8.3) for the frame. The length field shall not be present if the length of the information field is equal to N201.

5.6 Information field

The information field of a frame, when present, follows the length field L (if encoded) or the control field (if the length field is not encoded) in Format Type A frames. In Format Type B frames, the frame begins with the information field. The maximum number of octets in the information field (N201) is defined in clause 8.8.3.

5.7 Transparency

There are no special flags for frame delimitation. The frame can contain any random bit sequence without additional transparency mechanisms.

5.8 Format convention

The convention for mapping the bits is the same as given in clause 2.8 of GSM 04.06 [9].

6 Elements of procedures and formats of fields for DL layer

6.1 General

The elements of procedures define the commands and responses that are used on the data link connections. Procedures are derived from these elements of procedures and are described in clause 8.

6.2 Address field format

The address field consists of:

- the SACCH status bit (SST);
- the Command/Response (C/R) bit;
- the SAPI;
- the Segmentation Indicator (SI);
- the Link Protocol Discriminator (LPD);
- the Length Field Indicator (LFI).

The format of the address field for control channels is shown in table 6.1.

Table 6.1: DL address fields

Address Fields	Bit #	Definition
SST	1	SACCH status bit
C/R	2	Command Response
SAPI	3,4	Service Access Point Identifier
SI	5	Segment Indicator
LPD	6,7	DL for LAPSat or SMS-CB (Short Message Service-Cell Broadcast)
LFI	8	Length Field Indicator

6.3 Address field variables

6.3.1 Address field extension bit

The Extended Address (EA) as defined in GSM 04.06 [9] does not exist in the LAPSat.

6.3.2 Command/Response field bit

The C/R bit identifies a frame as either a command or a response. The MES side shall send commands with the C/R bit set to "0", and responses are sent with the C/R bit set to "1". The GS side shall do the opposite, i.e., commands are sent with C/R set to "1", and responses are sent with the C/R bit set to "0". The combinations for the GS side and MES side are shown in table 6.2.

NOTE: In case of TtT signalling for a single-hop call (see GMR-1 03.296 [3]), the MES and the GS imply the acting MES and acting GS (or network), respectively (see GMR-1 04.008 [6]). The MES is informed about its role during the TtT channel assignment procedure (see GMR-1 04.008 [6]). The DL entity at the MES that is given the role of the terminal shall work as a DL entity at the acting MES end. Similarly the DL entity at the MES that is given the role of the GS shall work as a DL entity at the acting GS end.

Table 6.2: C/R Bit

C/R Value	Direction	Type
1	GS – MES	Command
0	MES – GS	Command
0	GS – MES	Response
1	MES – GS	Response

6.3.3 Service Access Point Identifier

The SAPI identifies a point at which DL layer services are provided by the DL layer to a Layer 3 entity (see GMR-1 04.005 [5]). The SAPI allows four service access points to be specified initially, where bit 3 of the address field octet containing the SAPI is the least significant binary digit and bit 4 is the most significant bit.

The SAPI values are allocated as shown in table 6.3.

Table 6.3: SAPI values

SAPI Value	Name of Application(s)
0	Call Control (CC), Mobility Management (MM), Radio Resource (RR), Supplementary Services (SS) management
1	Reserved for future use
2	TtT signalling for a single-hop call
3	Short Message Service (SMS)

6.3.4 Segmentation indicator bit

The Segmentation Indicator (SI) bit indicates the segmentation of a Layer 3 message into multiple DL frames. The information field of the frame contains only a segment of the Layer 3 message unit when the SI bit is set to "1".

The SI bit set to "0" indicates:

- that the information field contains a complete Layer 3 message unit provided that the SI bit of the previous frame was set to "0";
- that the information field contains the last segment of the Layer 3 message unit if the SI bit of the previous frame was set to "1".

When the SI bit is set to "1", the information field shall contain the maximum number of octets N201 that an information frame can contain. The description of the SI bit is given in table 6.4.

In frames other than Information (I) frames the SI bit shall be set to "0".

Table 6.4: Segment Indication Bit

SI bit of current frame (b5)	SI bit of previous frame (b5)	Meaning
0	0	Complete L3 message
0	1	Last segment of the L3 message
1	x (don't care)	Segment only

6.3.5 Link protocol discriminator

The LPD corresponding to the use of the GMR-1 Air Interface shall take the value "00"; the LPD value of "01" corresponds to the data link protocol used for Short Message Service Cell Broadcast (SMS-CB) (see GSM 04.12 [10]). All other values are reserved.

6.3.6 Length field indicator

The LFI shows the presence or absence of the length field L (see clause 8.5) in the DL frame. It shall be assigned the binary value "1" only if the length field L is encoded in the frame.

6.3.7 SST (SACCH status) bit

The SST bit is used by the DL to determine the DLCI being used for the transfer of SACCH or FACCH information. This is particularly useful when SACCH information is transferred over the FACCH channel in the case of a TCH3 without a separate SACCH channel.

Table 6.5: SST Bit Indicator

SST Bit	Message Type
1	SACCH message
0	FACCH and all other messages

6.4 Control field formats

There are three types of control field formats specified. They are the numbered Information Transfer (I format), the Supervisory Functions (S format), and the Unnumbered Information Transfer and control functions (U format). The control field formats for LAPSat are shown in table 6.6.

Table 6.6: Control field format – A

Bit No.	12	11	10	9	8	7	6	5	4	3	2	1
I Format	N(R)					P	N(S)					0
S Format (note 1)	N(R)					P/F	Spare (note 2)		S	S	0	1
U Format	Spare (note 2)		MII/U	U	U	P/F	Spare (note 2)		U	U	1	1

N(S) Transmitter Send Sequence Number
N(R) Transmitter Receive Sequence Number
S Supervisory Function Bit (see table 6.7)
U Unnumbered Function Bit (see table 6.7)
MII Mobile-ID Indicator Bit (see table 6.7) (defined only for the SABM frame)
P/F Poll Bit, when issued as command
Final Bit, when issued as a response

NOTE 1: The GMR-1 DL Layer S frame GREJ uses two more octets for the information field, in addition to the 12 bits for the control field. This frame also includes the additional information Na(R) and Nb(R) (see table 6.7 and clause 10.3).

NOTE 2: The spare bits shall be coded as zero ("0") while transmitting. The receiver shall ignore these bits.

6.4.1 Information transfer format

The I transfer format is identical to that discussed in clause 3.4.1 of GSM 04.06 [9].

6.4.2 Supervisory format

The S format is identical to that discussed in clause 3.4.2 of GSM 04.06 [9].

6.4.3 Unnumbered format

The U format is identical to that discussed in clause 3.4.3 of GSM 04.06 [9].

6.5 Control field parameters and associated state variables

The parameters associated with the control field formats for LAPSat are similar to those for LAPDm as defined in clause 3.5 of GSM 04.06 [9]. The only differences are the range of values (0-31) and the modulus for the arithmetic operations (32).

6.5.1 Poll/Final bit

The poll/final bit is identical to that described in clause 3.5.1 of GSM 04.06 [9].

6.5.2 Multiple frame operation – variables and sequence numbers

6.5.2.1 Modulus

Each I frame is sequentially numbered by a sequence number that can have the values 0 through 31.

Arithmetic performed on variables related to such sequence numbers (i.e., N(S), N(R), V(S), V(R), V(A); see following clauses) operates modulo 32.

NOTE: Modulo 32 operation on negative numbers is performed by first adding multiples of 32 to the negative number until the result becomes nonnegative.

6.5.2.2 Send state variable V(S)

Each point-to-point data link connection endpoint shall have an associated Send State Variable (V(S)) when using I frame commands. The send state variable denotes the sequence number of the next in-sequence I frame to be transmitted.

The send state variable can take on the value 0 through 31.

The value of the send state variable shall be incremented by 1 with each successive I frame transmission, and shall not exceed V(A) by more than the maximum number of outstanding I frames k (the window size k is defined in clause 8.8.4).

6.5.2.3 Acknowledge state variable V(A)

Each point-to-point data link connection endpoint shall have 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) – 1 equals the N(S) of the last acknowledged I frame). The acknowledge state variable can take on the value 0 through 31. The value of the acknowledge state variable shall be updated by the valid N(R) values received from its peer (see clause 6.5.2.6). A valid N(R) value is in the range of V(A) < = N(R) < = V(S).

These inequalities shall be interpreted as follows: N(R) is valid if and only if (N(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32. Furthermore, (V(S) – V(A)) mod 32 < = k. (See clause 6.5.2.2).

6.5.2.4 Send sequence number

The Send Sequence Number (N(S)) is identical to that described in clause 3.5.2.4 of GSM 04.06 [9].

6.5.2.5 Receive state variable

Each point-to-point data link connection endpoint shall have 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 expected to be received. The receive state variable can take on the value 0 through 31.

The value of the receive state variable shall be incremented by one with the receipt of an error-free, in-sequence I frame whose send sequence number N(S) equals the Receive State Variable V(R). When the data link entity recovers from the GREJ exception condition (see clause 6.8.10) upon receipt of an in-sequence I frame, the value of V(R) shall be set to the sequence number of the next in-sequence I frame expected to be received.

6.5.2.6 Receive sequence number

The receive sequence number N(R) is identical to that described in clause 3.5.2.6 of GSM 04.06 [9].

6.5.2.7 Other parameters and variables

Other parameters and variables are identical to those described in clause 3.5.2.7 of GSM 04.06 [9].

6.5.2.8 Rejected frames sequence numbers Na(R) and Nb(R)

Only GREJ frames shall contain the start (Na(R)) and end (Nb(R)) sequence numbers of the rejected group of consecutive I frames. Na(R) and Nb(R) indicate the data link layer has not received the I frames from Na(R) to Nb(R) correctly.

6.5.3 Unacknowledged operation and parameters

The unacknowledged operation and parameters are identical to those discussed in clause 3.5.3 of GSM 04.06 [9].

6.6 Length field format

The length field L shall take an 8-bit binary value. The presence of this field is shown by the LFI bit in the address field (see clause 6.3.6). The L field, if present, indicates the length of the information field. The absence of the L field indicates that the length of the information field is N201 octets.

6.7 Length indicator field variables

The length indicator field variables defined for LAPDm in clause 3.7 of GSM 04.06 [9] are not relevant to the present document.

6.8 Commands and responses

The following commands and responses are used by either the MES or the GS data link layer entities and are represented in table 6.7. LAPSat uses the command/response GREJ instead of the REJ defined in GSM 04.06 [9]. LAPSat does not use the command/response RNR defined in GSM 04.06 [9].

Table 6.7: DL messages

Format	Command	Response	12	11	10	9	8	7	6	5	4	3	2	1
Information frame	I (Information)		N (R)					P	N (S)					0
Supervisory Frame	RR	RR	N (R)					P/F	0	0	0	0	0	1
	GREJ	GREJ	N (R)					P/F	0	0	1	0	0	1
Unnumbered Frame	SABM		0	0	MII	0	1	P	0	0	1	1	1	1
		DM	0	0	0	0	0	F	0	0	1	1	1	1
	DISC		0	0	0	1	0	P	0	0	0	0	1	1
		UA	0	0	0	1	1	F	0	0	0	0	1	1
	UI		0	0	0	0	0	P	0	0	0	0	1	1

For GREJ frame, format octet 5 and octet 6 of the frame are used to encode Na(R) and Nb(R) (i.e., start and end frame number of the rejected group). See clause 10.3. For the SABM frame, the MII is the Mobile-ID Indicator bit. It shall be set to "1" when the Con-Restaurant parameter (derived from the Mobile-ID) is present in the information field of the SABM.

6.8.1 Information commands

The Information (I) commands are identical to those discussed in GSM 04.06 [9].

6.8.2 Set Asynchronous Balanced Mode (SABM) Command

The Set Asynchronous Balanced Mode (SABM) unnumbered command is used to place the addressed user or network side into the modulo 32 multiple frame acknowledge operation.

An information field is permitted with the SABM command only if it is used in the MES to GS direction to establish a SAPI = 0 data link (for contention resolution) after having transmitted a random access frame on the RACH. Layer 3 shall indicate when an information field is to be included (see clause 8.4.1 for procedures).

A DL layer entity confirms acceptance of a SABM command by the transmission at the first opportunity of a UA response. Transmission of an SABM command indicates the clearance of any exception condition.

Previously transmitted I frames that are unacknowledged when this command is activated remain unacknowledged and shall be discarded. It is the responsibility of a higher layer to recover from the possible loss of the contents of such I frames.

The information field of SABM, if present, shall either be the complete Layer 3 message unit or a unique Con-Restaurant parameter value (see clause 7.1.3.8).

6.8.3 Disconnect command

The Disconnect (DISC) command is identical to that described in GSM 04.06 [9].

6.8.4 Unnumbered information command

The Unnumbered Information (UI) command is identical to that described in GSM 04.06 [9].

6.8.5 Receiver ready command/response

The Receiver Ready (RR) command/response is identical to that described in GSM 04.06 [9].

6.8.6 Reject command/response

The Reject (REJ) command/response is not used in GMR-1. The GREJ frame is used instead (see clause 6.8.10).

6.8.7 Receiver not ready command/response

The RNR command/response is not used in GMR-1.

6.8.8 Unnumbered Acknowledgement Response

The Unnumbered Acknowledegment (UA) response is identical to that described in GSM 04.06 [9].

6.8.9 Disconnect mode response

The disconnect mode DM response is identical to that described in GSM 04.06 [9].

6.8.10 Group Reject Command/Response

The Group Reject (GREJ) command/response is a supervisory frame that is used by a DL layer entity to request the retransmission of a group of sequentially numbered I frames, starting with the frame number specified by Na(R) up to and including the frame number specified by Nb(R). The first two octets of the information field of the GREJ frame contain the values of Na(R) and Nb(R), the start and end frame number respectively. The value of N(R) in the GREJ frame acknowledges all I frames numbered up to and including N(R)-1.

A DL layer entity shall transmit at least one GREJ frame upon detection of any missing I frame(s). If there are multiple missing I frames that are not sequentially numbered, the DL layer entity shall transmit at least one GREJ frame (each containing different values of Na(R) and Nb(R)) for each group of sequentially numbered frames (see clause 8.7.1). If more than one GREJ frame is issued for a single contiguous group of missing I frames, the combination of Na(R) and Nb(R) fields in them shall be mutually exclusive and logically equivalent to a single GREJ frame transmitted for the whole group.

The DLL shall transmit only one GREJ frame for each mutually exclusive group of sequentially numbered missing I frame(s). The following GREJ, if any, shall not indicate the missing I frames already reported in the previous GREJ frame(s).

A GREJ exception condition exists in a DL layer entity whenever there is one or more rejected or missing I frame or group(s) of I frames for which GREJ frame(s) have been transmitted and are waiting to be received by that DL layer entity. The GREJ exception condition is cleared upon the receipt of all the I frames from Na(R) to Nb(R) (including both Na(R) and Nb(R)) indicated by the GREJ frame(s).

The I frames for which retransmission has been requested using a GREJ frame shall be retransmitted before the I frames still to be transmitted for the first time. The I frames that may have been previously transmitted following the I frames indicated by a particular GREJ frame do not require retransmission after receiving the GREJ frame(s).

In addition to requesting the retransmission of I frames from its peer DL layer entity, a GREJ command with the P bit set to "1" may be used by the DL layer entity to ask for the status of its peer DL layer entity.

7 Elements for layer-to-layer communication

7.1 Definition of primitives and parameters

The primitives and parameters are the same as those defined in GSM 04.06 [9]. Data link service primitives are summarized in table 7.1. The physical service primitives are summarized in table 7.2.

7.1.1 Generic names

The generic names are identical to those identified in GSM 04.06 [9]. The following additional primitive is needed between DL and RR for the cipher mode setting command.

DL-BEGIN-CIPHERING: This primitive is used in the GS by the DL entity to inform the RR entity that the L3 message with an associated CiSyncFlag (see clause 7.1.3.7) has been transmitted.

7.1.2 Primitives types

The primitives types are identical to those discussed in GSM 04.06 [9].

7.1.3 Parameter definition

7.1.3.1 Message unit

The message unit is identical to that discussed in GSM 04.06 [9].

7.1.3.2 Channel type

Since the Sat channel procedures are distributed on several types of channels (CCCH, BCCH, GBCH, TACCH, and DCCH), a parameter is required to distribute the Layer 3 message units correctly on the various channel types. The control channel types to be used are defined in GMR-1 04.003 [4].

7.1.3.3 Service access point

The SAP point is identical to that discussed in GSM 04.06 [9].

7.1.3.4 Release mode

The release mode is identical to that discussed in GSM 04.06 [9].

7.1.3.5 Error cause

The error cause parameter is used by the DL layer to report a procedure error to Layer 3. The following causes may be reported:

- Timer T200 expired (N200+1) times: perform abnormal release;
- Reestablishment request;
- Unsolicited UA response;
- Unsolicited DM response;
- Unsolicited DM response, multiple frame established state: perform abnormal release;
- Unsolicited supervisory response;
- Sequence error: perform abnormal release;
- U frame with incorrect parameters;
- S frame with incorrect parameters;
- I frame, S and U frame received with invalid SI bit value;
- I frame with incorrect length;
- Frame not implemented;
- SABM command, multiple frame established state;
- SABM command with information field not allowed in this state;
- Layer 3 message with incorrect length: perform abnormal release;
- Timer T204 expired: perform abnormal release.

7.1.3.6 Establish mode

The establish mode is identical to that described in GSM 04.06 [9].

7.1.3.7 Cipher mode indicator CiSyncFlag

The CiSyncFlag is associated with the DL-DATA-REQUEST primitive and is used in the GS only. This parameter is used by the DL layer to indicate to the RR sublayer to configure the Physical (PHY) layer into cipher receive mode. After all the segments of the L3 message with the associated CiSyncFlag set are passed to the PHY layer, the DL layer can instruct the RR sublayer to switch the receiver at the PHY layer to cipher receive mode.

7.1.3.8 Con-Restaurant parameter

The Con-Restaurant parameter shall be sent with the DL-ESTABLISH-REQUEST primitive during the link establishment with contention resolution procedure. It should be a unique value. If the size of this parameter exceeds the N201 value for the SABM frame, then only the first N201 octets of this parameter shall be sent in the information field of the SABM frame.

7.1.3.9 SubLayerFlag

The SubLayerFlag parameter shall be sent with the DL-DATA-REQUEST, DL-ESTABLISH-REQUEST, DL-RESUME-REQUEST, and DL-RECONNECT-REQUEST primitives and is used in MES only. This parameter is used to indicate Layer 2 of the Layer 3 message sublayer (CM/MM or RR) in the respective primitives. This flag is set to "1" by RR whenever these primitives contain a CM or MM sublayer message.

7.1.3.10 LinkStatusFlag

The LinkStatusFlag is associated with the PH-EMPTY-FRAME-REQUEST primitive, which indicates to Layer 1 the current status of the data link. This flag shall be set to "1" if the data link is established with the peer entity.

7.1.3.11 Service Grade

This parameter shall identify the service grade of the information transfer (see GMR-1 04.005 [5]) over SACCH on TCH3. This parameter shall be associated with the DL-UNIT-DATA-REQUEST and PH-DATA-REQUEST primitives. This parameter can take any of service grades defined for SACCH on TCH3. For other logical channels the service grade is not used.

7.1.3.12 Time to Expiry

This parameter indicates the time still left for the message unit while waiting for the speech inactivity before it is either transmitted or discarded depending on the service grade (see annex C). This parameter shall be associated with the PH-DATA-REQUEST primitive for information transfer over SACCH on TCH3. For information transfer over other logical channels this parameter is set to 0 and is not used.

Table 7.1: Data Link service primitives

Generic Name and Types	Parameters					Message Unit Contents and Associated Parameters
	SAPI	Channel Type	Error Cause	Release Mode	Establish Mode	
DL-ESTABLISH-REQUEST	0	SDCCH, FACCH			Contention Resolution	Layer 3 message, SubLayerFlag and Con-Restaurant parameter or Con-Restaurant parameter only
	0	SDCCH, FACCH, TACCH/ FACCH			Normal	
	2	FACCH			Normal	
	3	SDCCH, SACCH			Normal	
DL-ESTABLISH-INDICATION	0	SDCCH, FACCH			Contention Resolution	Layer 3 message
	0	SDCCH, FACCH, TACCH/ FACCH			Normal	
	2	FACCH			Normal	
	3	SDCCH, SACCH			Normal	
DL-ESTABLISH-CONFIRM	0	SDCCH, FACCH			Contention Resolution	
	0	SDCCH, FACCH, TACCH/ FACCH			Normal	
	2	FACCH			Normal	
	3	SDCCH, SACCH			Normal	
DL-RELEASE-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH		Any		
	2	FACCH		Any		
	3	SDCCH, SACCH		Any		
DL-RELEASE-INDICATION	0	SDCCH, FACCH, TACCH/ FACCH		Any		
	2	FACCH		Any		
	3	SDCCH, SACCH		Any		
DL-RELEASE-CONFIRM	0	SDCCH, FACCH, TACCH/ FACCH		Any		
	2	FACCH		Any		
	3	SDCCH, SACCH		Any		
DL-SUSPEND-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH				
DL-SUSPEND-CONFIRM	0	SDCCH, FACCH, TACCH/ FACCH				

Table 7.1: Data Link service primitives

Generic Name and Types	Parameters					Message Unit Contents and Associated Parameters
	SAPI	Channel Type	Error Cause	Release Mode	Establish Mode	
DL-RESUME-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH				Layer 3 peer-to-peer message, SubLayerFlag
DL-RESUME-CONFIRM	0	SDCCH, FACCH, TACCH/ FACCH				
DL-RECONNECT-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH				Layer 3 peer-to-peer message, SubLayerFlag
DL-RECONNECT CONFIRM	0	SDCCH, FACCH, TACCH/ FACCH				
DL-DATA-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH				Layer 3 peer-to-peer message, CiSyncFlag, SubLayerFlag
	2	FACCH				Layer 3 peer-to-peer message
	3	SDCCH, SACCH				Layer 3 peer-to-peer message
DL-DATA-INDICATION	0	SDCCH, FACCH, TACCH/ FACCH				Layer 3 peer-to-peer message
	2	FACCH				Layer 3 peer-to-peer message
	3	SDCCH, SACCH				Layer 3 peer-to-peer message
DL-UNIT DATA-REQUEST	0	BCCH, PCH, AGCH, BACH, GBCH, SDCCH, FACCH, SACCH, TACCH				Layer 3 peer-to-peer message, service grade
	2	FACCH				Layer 3 peer-to-peer message
DL-UNIT DATA-INDICATION	0	BCCH, PCH, AGCH, BACH, GBCH, SDCCH, FACCH, TACCH, SACCH				Layer 3 peer-to-peer message
	2	FACCH				Layer 3 peer-to-peer message
MDL-RELEASE-REQUEST	0	SDCCH, FACCH, TACCH/ FACCH				
	2	FACCH				
	3	SDCCH, SACCH				
MDL-ERROR-INDICATION	0	SDCCH, FACCH, TACCH/ FACCH, SACCH	Any			

Table 7.1: Data Link service primitives

Generic Name and Types	Parameters					Message Unit Contents and Associated Parameters
	SAPI	Channel Type	Error Cause	Release Mode	Establish Mode	
	2	FACCH				
	3	SDCCH, SACCH	Any			
DL-RANDOM ACCESS-REQUEST	0	RACH				Channel request (see GMR-1 04.008 [6])
DL-RANDOM ACCESS-INDICATION	0	RACH				Request reference (see GMR-1 04.008 [6])
DL-RANDOM ACCESS-CONFIRM	0	RACH				Request reference (see GMR-1 04.008 [6])
DL-BEGIN-CIPHERING	0	SDCCH, FACCH,			Contention Resolution	

Table 7.2: Physical service primitives used

Generic Name and Types	Parameters				Message Unit Contents and Associated Parameters
	Channel Type	Error Cause	Release Mode	Establish Mode	
PH-DATA-REQUEST	Any (except RACH)				Data link peer-to-peer message, service grade, time to expiry
PH-DATA-INDICATION	Any (except RACH)				Data link peer-to-peer message
PH-RANDOM ACCESS-REQUEST	RACH				Random access data link message unit
PH-RANDOM ACCESS-INDICATION	RACH				Random access data link message unit and TDMA frame number
PH-RANDOM ACCESS-CONFIRM	RACH				TDMA frame number
PH-CONNECT-INDICATION	Any				
PH-READY-TO-SEND-INDICATION	Any				
PH-EMPTY-FRAME-REQUEST	Any (except RACH)				Empty frame and LinkStatus-Flag

Tables 7.1 and 7.2 do not contain a complete list of conditional dependencies of service primitive parameters. If a field is empty, the respective parameter shall not be used or is not applicable. Fields containing the word "any" indicate that the respective parameter shall be used and shall be set to a valid value according its specification.

In table 7.1, the term TACCH/FACCH means that the forward path (from the network to the MES) is via the TACCH. The reverse path (from the MES to the network) is via the FACCH. The information on the TACCH shall not be ciphered.

For acknowledged information transfer over SACCH on TCH3 the service grade shall be "Wait-then-Discard". For unacknowledged information transfer over SACCH on TCH3 the service grade shall be indicated by the higher layer. For information transfer on any other logical channel the service grade is not used.

The time to expiry parameter is applicable for the information transfer over SACCH on TCH3. For information transfer over other channels this parameter is set to 0.

7.2 Primitive procedures

The primitive procedures are identical to those discussed in GSM 04.06 [9].

8 Definition of the peer-to-peer protocol LAPSat

The peer-to-peer protocol borrows heavily from the GSM 04.06 [9]. The significant differences are explained in corresponding clauses. Refer to GSM 04.06 [9] for references to clauses not present in the present document.

8.1 General

The command used for unacknowledged information transfer is the UI command.

The commands and responses used for multiple frame acknowledged information transfer are:

- SABM command;
- UA response;
- DM response;
- DISC command;
- RR command/response;
- GREJ command/response;
- I command.

For various channel types the following applies:

- BCCH: unacknowledged operation only;
- CCCH: unacknowledged operation only;
- GBCH: unacknowledged operation only;
- SDCCH: unacknowledged operation and multiple frame acknowledged operation;
- FACCH: unacknowledged operation and multiple frame acknowledged operation;
- TACCH: unacknowledged operation and multiple frame acknowledged operation;
- SACCH: unacknowledged operation and multiple frame acknowledged operation.

8.2 General protocol procedures

The general protocol procedures are identical to those discussed in clause 5.2 of GSM 04.06 [9].

8.3 Procedures for unacknowledged information transfer

8.3.1 General

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

No DL layer error recovery procedures are defined for unacknowledged operation.

8.3.2 Transmission of unacknowledged information

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

Unacknowledged information is passed to the data link layer by Layer 3 using the primitive DL-UNIT-DATA-REQUEST along with a parameter indicating the service grade. The Layer 3 message unit shall be transmitted in a UI command frame. Layer 2 shall also note the time at which the message unit is given to it by Layer 3.

Layer 2 shall construct a Layer 2 message unit from the Layer 3 message unit and pass it to Layer 1 for transmission using the primitive PH-DATA-REQUEST along with the service grade and the time to expiry (see clause 8.8.9) parameters. The Layer 2 message unit uses the frame type as defined in clause 5.1.

If the Layer 2 message unit contains a control field, the P bit shall be set to "0".

NOTE: On a DCCH, UI frames with Length Field Indicator set to "1" and length field L set to "0" may be used as fill frames, see clause 8.4.2.3.

8.3.3 Receipt of unacknowledged information

Upon receipt of a UI frame with SAPI that is supported by the receiver, the contents of the information field shall be passed to the Layer 3 entity identified by the SAPI using the DL layer to Layer 3 primitive DL-UNIT-DATA-INDICATION. UI frames with invalid SAPI values shall be discarded. UI frames received with the length indicator set to "0" shall be ignored.

8.4 Procedures for establishment and release of multiple frame operation

8.4.1 Establishment of multiple frame operation

8.4.1.1 General

The general procedures for the establishment of multiple frame operation are identical to those described in clause 5.4.1.1 of GSM 04.06 [9].

8.4.1.2 Normal establishment procedures

The normal establishment procedure described in this clause shall be used for SAPI = 0 and SAPI = 2 links only. For SAPI = 3, the procedure in clause 5.4.1.2 of GSM 04.06 [9] shall be used. A DL layer entity shall initiate a request for the multiple frame operation to be set by transmitting N204 multiple SABM (set asynchronous balance mode) commands one after the other with the P bit for each set to "1" and shall enter the awaiting-establishment state. The SABM command is delivered to the physical layer at the receipt of PH-READY-TO-SEND-INDICATION during the establishment procedure. Since the DL-ESTABLISH-REQUEST primitive does not contain a Layer 3 message unit, the length, L, is set to "0". Also the MII bit in the control field of the SABM frame is set to "0".

All existing exception conditions shall be cleared, the retransmission counter shall be reset, and timer T204 shall be set right before transmitting the last SABM frame, when the PH-READY-TO-SEND primitive is received from the physical layer (timer T204 is defined in clause 8.8.8).

The establishment procedure implies the discard of any outstanding DL-DATA-REQUEST primitive that has been invoked prior to the DL-ESTABLISH-REQUEST. It also implies the discard of any segmented Layer 3 message unit for which the last segment has not been received (see clause 8.5.2 for the concatenation procedure).

All frames other than unnumbered frame formats received in the awaiting-establishment state shall be ignored.

A DL layer entity receiving a SABM, if it is able to enter the multiple-frame-establishment state and if the "establishment-in-progress" flag is not set, shall:

- set the "establishment-in-progress" flag;
- respond with a UA response, with the F bit set to the same binary value as the P bit in the received SABM command, the same SAPI value as in the received SABM command, and with the length indicator, L, set to "0";
- set the Send State Variable V(S), Receive State Variable V(R), and Acknowledge State Variable V(A) to "0";
- enter the multiple-frame-established state and inform the associated Layer 3 entity using the primitive DL-ESTABLISH-INDICATION;
- clear all existing exception conditions.

If the DL layer entity receives a SABM while the "establishment-in-progress" flag is set, it shall:

- respond with a UA response, with the F bit set to the same binary value as the P bit in the received SABM command, the same SAPI value as in the received SABM command, and with the length indicator, L, set to "0".

The DL layer entity shall reset the "establishment-in-progress" flag when:

- an I frame or S frame is received;
- a release request is received from a higher layer.

If the DL layer entity is unable to enter the multiple-frame-established state, it shall respond to the SABM command with a DM response with the F bit set to the same binary value as the P bit in the received SABM command. Upon reception of the UA response with the F bit set to "1" in the awaiting-establishment state, the originator of the SABM command shall:

- reset timer T204;
- set the V(S), the V(R) and the V(A) to 0;
- enter the multiple-frame-established state and inform the associated Layer 3 entity using the primitive DL-ESTABLISH-CONFIRM.

A UA response with the F bit set to "0" received in the awaiting-establishment shall be ignored.

A UA response with the F bit set to "1" received in the multiple-frame-established state shall be ignored.

Upon reception of a DM response with the F bit set to "1", the originator of the SABM command shall indicate this to the Layer 3 entity by means of the primitive DL-RELEASE-INDICATION and reset timer T204. DM responses with the F bit set to "0" shall be ignored.

8.4.1.3 Procedure on expiry of timer T204: normal establishment

The procedure in this clause shall be used for SAPI = 0 and SAPI = 2 links only. For SAPI = 3 the procedure in clause 5.4.1.3 of GSM 04.06 [9] shall be used.

If timer T204 expires before a UA response has been received, the DL layer entity shall enter the idle state and issue a DL-RELEASE-INDICATION primitive to the Layer 3 entity. Layer 3 shall also be notified by using the primitive MDL-ERROR-INDICATION with cause "timer T204 expired: perform abnormal release".

8.4.1.4 Contention resolution establishment procedure

The contention resolution establishment procedure is always initiated by the MES for establishing a data link to resolve contention after having accessed the GS on the RACH. Layer 3 decides when this establishment procedure is to be used and shall request the DL layer to initiate the procedure by a DL-ESTABLISH-REQUEST primitive, containing an optional Layer 3 message unit, a unique Con-Restaurant parameter, and the establishment mode set to contention resolution.

The DLL shall, however, ignore any such service request if it is not in the idle state when the request is received.

The DLL entity in the MES shall initiate the establishment by transmitting N204 SABM commands one after the other, with the P bit for each set to "1". The SABM frame is delivered to the physical layer on receiving the next PH-READY-TO-SEND-INDICATION. The DLL forms the SABM frame as follows:

- If the Layer 3 message is not available with the primitive, then:
  - the SABM command shall contain the unique Con-Restaurant parameter value;
  - the MII bit in the control field of the SABM shall be set to "1";
  - the LFI and L field (if present) shall be set to the appropriate values.
- If the complete Layer 3 message unit can be accommodated (i.e., if the size of the Layer 3 message unit < = N201 octets), then:
  - the SABM command shall contain the complete Layer 3 message unit;
  - the MII bit in the control field of the SABM frame shall be set to "0";
  - the LFI and L field (if present) shall be set to the appropriate value.
- If the complete Layer 3 message unit cannot be accommodated (i.e., if the size of the Layer 3 message unit > N201 octets), then:
  - the SABM command shall contain the unique Con-Restaurant parameter value;
  - the MII bit in the control field of the SABM shall be set to "1";
  - the LFI and L field (if present) shall be set to the appropriate value.

NOTE 1: The contention resolution procedure is only permitted with a SAPI value of "0" (see clause 6).

A Layer 3 message that cannot be accommodated in the SABM command shall be stored during the contention resolution procedure and shall be sent to the network after the link is established.

The information field of the SABM command shall be stored in the DLL entity of the MES. The information field is removed when the DL layer enters the multiple frame established state or the idle state.

All existing exception conditions shall be cleared, the retransmission counter shall be reset, and the timer T204 shall be set right, before transmitting the last SABM command frame, when the PH-READY-TO-SEND primitive is received from the physical layer.

The peer DL layer entity in the GS receiving the SABM shall, if the entity is in the idle state and an "establishment-in-progress" flag has not been set:

- set the "establishment-in-progress" flag;
- store the information field received in the SABM command;

- respond, at the earliest possible opportunity, with a UA response with:
  - the same SAPI value as received in the SABM command;
  - the F bit set to the same binary value as the P bit received in the SABM command;
  - the same information field as that contained in the SABM command;
  - the LFI and L field (if present) set to the appropriate values;
- set the V(S), the V(R), and the V(A) to "0";
- clear all existing exception conditions;
- enter the multiple-frame-established state;
- if the MII bit in the SABM command frame is set to "0" (indicating that the complete Layer 3 message is present in the information field), inform the Layer 3 entity using the DL-ESTABLISH-INDICATION primitive. The primitive shall contain the received Layer 3 message unit;
- if the MII bit in the SABM command frame is set to "1" (indicating that the Mobile-ID is present in the information field), do not inform Layer 3 of the link establishment under progress, instead expect the following Layer 3 message unit. The segments of the following Layer 3 message unit, if any, shall be received and assembled according to the procedure described in clause 8.5.2 and passed on to the higher layer using the DL-ESTABLISH-INDICATION primitive.

If an SABM command with an information field is received when the "establishment in progress" flag has been set, the DL layer entity in the GS shall compare the stored information field with the information field received in the SABM command. If they are not identical, the SABM command shall be ignored without any notification. If they are identical, the data link entity shall respond, at the earliest possible opportunity, with a UA response with:

- the same SAPI value as received in the SABM command;
- the F bit set to the same binary value as the P bit contained in the SABM command;
- the stored information field;
- the LFI and L field (if present) set to the appropriate values.

NOTE 2: The specification is very different from the normal establishment procedure; in the latter case the reception of a subsequent SABM frame triggers a re-establishment provided the establishment-in-progress flag is not set (see clause 8.6).

The DL layer entity in the GS shall remove the "establishment in progress" flag and delete the stored information field when:

- an I frame or supervisory frame is received. If the frame is in sequence, the DL layer entity shall process the frame, as specified, for operation in the multiple frame established state. If the frame is out of sequence, the GS shall initiate recovery using the procedure described in clause 8.7.1;
- a release request is received from Layer 3. In this case, the DL layer entity shall enter the idle state if the primitive received is DL-RELEASE-REQUEST or the null state if the primitive is MDL-RELEASE-REQUEST.

The procedure when awaiting an acknowledgment in the MES is as follows:

Upon reception of a UA response containing an information field and with the F bit set to "1", the DL layer entity in the MES shall compare the stored information field with the information field received in the UA response. If the two fields are identical, then the DL layer entity shall:

- reset timer T204;
- set the send state variable V(S), the receive state variable V(R), and the acknowledge state variable V(A) to 0;
- delete the stored information field;

- enter the multiple-frame-established state and inform the Layer 3 entity using the DL-ESTABLISH-CONFIRM primitive;
- if the Con-Restaurant parameter was used for contention resolution in the SABM frame and the L3 message is available for transmission, then start transmitting the segments of the Layer 3 message unit using the procedure described in clause 8.5.1.

If the two fields are different, then the DL layer entity shall:

- reset timer T204;
- delete the stored information field;
- enter the idle state and inform the Layer 3 entity using the DL-RELEASE-INDICATION primitive.

All frames other than unnumbered frame formats received for the SAPI in use during the establishment procedures shall be ignored.

The reception of unnumbered frames other than UA is treated, as specified, for the normal establishment case.

NOTE 3: There are no foreseen cases in which the network shall send SABM, DISC, or DM during the contention resolution procedure; but for the sake of completeness, these occurrences are specified and shall be treated as follows:

- the DL entity at the MES shall ignore the SABM with information field received from the network;
- the DL entity at the MES shall send DM with F bit set to "1" in response to DISC with P bit set to "1". The DL entity shall abort the link establishment and enter the idle state. The Layer 3 shall be informed with DL-RELEASE-INDICATION;
- the DL entity at the MES shall enter the idle state upon receiving the DM with F bit set to "1". The contention resolution procedure shall be aborted, and the Layer 3 shall be informed using the DL-RELEASE-INDICATION.

8.4.1.5 Procedure on expiry of timer T204: contention resolution (MES only)

If timer T204 expires before a UA response has been received, the DL layer entity shall enter the idle state and issue a DL-RELEASE-INDICATION primitive to the Layer 3 entity. Layer 3 shall also be notified by using the primitive MDL-ERROR-INDICATION with cause "timer T204 expired: perform abnormal release".

8.4.2 Information transfer

8.4.2.1 General requirements

The general requirements for information transfer are identical to those discussed in clause 5.4.2.1 of GSM 04.06 [9].

8.4.2.2 Error conditions

Error conditions requiring the abnormal release of the data link are discussed in clause 8.6.

Cases that do not lead to release but may cause the DL layer entity to issue an MDL-ERROR-INDICATION are summarized in table 8.1.

Table 8.1: Actions taken on response frames

Response frame	Multiple frame established	Timer recovery
UA F = 1	Normal	Normal
UA F = 0	MDL-ERROR-INDICATION (unsolicited UA response)	MDL-ERROR-INDICATION (unsolicited UA response)
DM F = 1	MDL-ERROR-INDICATION (unsolicited DM response)	Normal
DM F = 0	MDL-ERROR-INDICATION (unsolicited DM response, multiple frame established state: perform abnormal release)	MDL-ERROR-INDICATION (unsolicited DM response, multiple frame established state: perform abnormal release)
Supervisory response F = 1	Normal	Normal
Supervisory response F = 0	Normal	Normal

8.4.2.3 Fill frames

A fill frame (defined below) shall be sent on the radio path when there are no other frames scheduled for transmission and something must be sent. On the dedicated control channel (FACCH, SDCCH, TACCH and SACCH), a fill frame is a UI command frame for SAPI = 0, with P = 0, LFI = 1 and with the information field of length L = 0 (see table 8.2). Frame Format Type A shall be used. Fill pattern for the remaining octets shall be as defined in clause 5.2.

Fill frames are not needed for the Broadcast Channels (BCCH, GPS Broadcast Channel (GBCH), and Common Control Channel (CCCH)).

NOTE: The decision to actually send the fill frame on the air interface shall be made at the physical layer (see GMR-1 05.008 [8]).

Table 8.2: GMR-1 Data Link Layer fill frame format

b8	B7	b6	b5	b4	b3	b2	b1	bit #
1	0	0	0	0	0	C (note 1)	SST (note 2)	octet 1
0	0	0	0	0	0	0	0	octet 2
0	0	1	1	0	0	0	0	octet 3
0	0	0	0	0	0	0	0	octet 4
0	0	0	0	0	0	0	0	octet 5
0	0	0	0	0	0	0	0	octet 6
0	0	0	0	0	0	0	0	octet 7
…	…	…	…	…	…	…	…	…
				0	0	0	0	octet N201+3

NOTE 1: C = 0 if sent by the MES;
C = 1 if sent by the Network.

NOTE 2: SST = 1 for SACCH message;
SST = 0 for FACCH message;
SST = 0 for message on any other logical channel.

8.4.3 Suspension and resumption of multiple frame operation

8.4.3.1 General

These procedures shall be used in an MES entity to suspend the uplink multiple frame operation for SAPI = 0 during a change of dedicated channels (dedicated channel assignment on Layer 3) and to resume the 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.

The procedures may delay the actual channel change, so they shall only be used to protect Layer 3 messages pertaining to SAPI = 0. Applications using the multiple frame established service on SAPIs other than 0 are expected to cope with message loss or duplication autonomously, i.e., on layers above Layer 2.

The Layer 3 procedure, dedicated channel assignment, is initiated and controlled by a network entity. This entity therefore shall suspend the flow of Layer 3 messages towards the MES after the ASSIGNMENT COMMAND 1 or ASSIGNMENT COMMAND 2 message has been issued. The message flow may resume once the data link on the new channel has been established. No provisions in Layer 2 are needed on the network side to prevent message loss or duplication on the downlink during channel change.

The procedures in the MES are described below. For the description of the procedures, a conceptual configuration of a send queue, a send buffer, and a transmit buffer are assumed.

In order to ease the description of the procedures in the MES, it is assumed that any Layer 3 message passed to Layer 2 via SAPI = 0 in DL-DATA-REQUEST or DL-UNIT-DATA primitive is first placed in the send queue. The Layer 2 entity shall take out the messages on a "first-in first-out" basis and put them into a send buffer. The send buffer can hold multiple Layer 3 messages at a time. From the contents of the send buffer, an I frame or UI frame is constructed, only one at a time, and placed in a transmit buffer. (If the Layer 3 message needs to be segmented, then this last step shall be performed several times). The frame is then transmitted.

When a Layer 3 message in the send buffer has been transmitted and acknowledged, the Layer 3 message is cleared from the send buffer.

8.4.3.2 Suspension

A Layer 3 entity in the MES shall indicate a request for the suspension of multiple frame operation by use of the DL-SUSPEND-REQUEST primitive. Upon receipt of this primitive, the Layer 2 entity shall act as follows:

No further Layer 3 messages shall be taken from the send queue for SAPI = 0.

- Layer 3 messages in the send buffer that have not yet been transmitted and Layer 3 messages for which last segment has been transmitted but is not yet fully acknowledged shall be moved from the send buffer and put back to the send queue in the same order (Layer 3 message at the head of the send buffer shall be placed at the head of the send queue). The send and transmit buffers shall be 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 shall be transmitted on the new channel. Those segments already transmitted and received on the network side shall be discarded by the network upon release of the old channel because the Layer 3 message is not yet complete).

- The Layer 2 entity shall then return a DL-SUSPEND-CONFIRM primitive to Layer 3.

The DL layer entity is now in the suspended state. The only difference to the multiple frame established state is that no UI frames and no I frames are transmitted (all SAPIs).

The MES may now change to the new channel.

8.4.3.3 Resumption

8.4.3.3.1 Procedure after channel change

This procedure is initiated by the DL-RESUME-REQUEST primitive. A DLL entity shall initiate a request for the multiple frame operation by transmitting N204 SABM commands one after the other. The SABM command is delivered to the physical layer on receiving the next PH-READY-TO-SEND-INDICATION.

All existing exception conditions shall be cleared, and the timer T204 is started right before transmitting the last SABM command. All outstanding DL-DATA-REQUEST primitives and Layer 3 message units, which are not fully acknowledged, shall be saved. Any segmented Layer 3 message unit, for which the last segment has not been received, shall be discarded.

The send buffer is cleared.

The Layer 3 message included in the DL-RESUME-REQUEST primitive (in general, ASSIGNMENT COMPLETE) is put into the send buffer for transmission in acknowledged mode.

Upon reception of a UA response, the DL layer shall:

- reset T204;
- set send variable V(S), the receive state variable V(R) and the acknowledge state variable V(A) to 0;
- enter the multiple established state;
- confirm establishment to Layer 3 using DL-RESUME-CONFIRM;
- send the Layer 3 message unit passed together with the DL-RESUME-REQUEST primitive.

The DLL shall then continue normal operation.

8.4.3.3.2 Procedure after returning to the old channel (MES only)

This procedure is initiated by the DL-RECONNECT-REQUEST primitive. A DLL entity shall initiate a request for the multiple frame operation by transmitting N204 SABM commands one after the other. The SABM command is delivered to the physical layer on receiving the next PH-READY-TO-SEND-INDICATION.

All existing exception conditions shall be cleared, and the timer T204 is started right before sending the last SABM command. All outstanding DL-DATA-REQUEST primitives and Layer 3 message units that are not fully acknowledged shall be saved; this does not include a message carried by a possible previous DL-RESUME-REQUEST. Any segmented Layer 3 message units for which the last segment has not been received shall be discarded.

The send buffer is cleared.

A Layer 3 message included in the DL-RECONNECT-REQUEST primitive (in general ASSIGNMENT FAILURE) is put into the send buffer for transmission in acknowledge mode.

Upon reception of UA response the DLL shall:

- reset T204;
- set V(S), V(R) and V(A) to 0;
- enter the multiple frame established state;
- confirm establishment to Layer 3 using DL-RECONNECT-CONFIRM;
- send the Layer 3 message unit, passed with the DL-RECONNECT-REQUEST primitive.

The DLL shall then continue normal operation.

8.4.4 Termination of multiple frame operation

This procedure is identical to that described in clause 5.4.4 of GSM 04.06 [9].

8.4.5 Idle state

This procedure is identical to that described in clause 5.4.5 of GSM 04.06 [9].

8.4.6 Collision of unnumbered commands

This procedure is identical to that described in clause 5.4.6 of GSM 04.06 [9].

8.5 Procedure for information transfer in multiple frame operation

The procedure that applies to the transmission of I frames is defined below.

NOTE: The term "transmission of an I frame" refers to the delivery of an I frame by the DL layer to the physical layer.

8.5.1 Transmitting I frames

Layer 3 checks the duplication of the message by using 1 bit only. Layer 3 message duplication can only occur for SAPI = 0 messages from the MES to the network. Layer 2 can transmit multiple Layer 3 messages without waiting for acknowledgment of previous Layer 3 messages sent from the network to the MES for all SAPIs, and from the MES to the network for SAPI = 2 and SAPI = 3. To avoid the duplication of SAPI = 0 messages going in the MES-to-network direction, the GMR-1 DL layer shall transmit a maximum of two Layer 3 messages with the constraint that SubLayerFlag for two Layer 3 messages is not set. (If both of the Layer 3 messages have the SubLayerFlag set, then only one message is transmitted in the current Layer 2 window; otherwise, both are transmitted).

Information received by the DL from the Layer 3 entity using a DL-DATA-REQUEST primitive shall be transmitted in one or more I frames. If the Layer 3 message unit consists of N201 or fewer octets, the message unit is to be contained in one I frame. The SI value shall be set to "0" in such I frames. If the Layer 3 message exceeds N201 octets, the DL shall segment the message unit, so that all segments (with the possible exception of the last segment) consist of N201 octets. The SI shall be set to "1" for each segment with the only exception being the last segment. The SI bit of the last segment shall be set to "0".

The parameter N201 is defined in clause 8.8.3.

The control field parameters N(S) and N(R) shall be assigned the values of the send and receive state variables V(S) and V(R) when transmitting an I frame. The value of the send state variable V(S) shall be incremented by 1 at the end of the transmission of the I frame. The P bit is set to "0" for the initial transmission of I frames.

NOTE 1: If the I frames are transmitted upon receiving the GREJ frames, then the N(S) and N(R) shall be set to the next sequence number in the rejected group and current value of V(R), respectively. The P bit is set to "0" and the value of V(S) shall not be incremented during this retransmission in response to GREJ frame.

The DL (on the transmit side) segments the Layer 3 message into the size of the information field of the Layer 2 frame. It initializes the header, copies the Layer 3 information, fills the rest of the frame with fill bits (if needed), and delivers the frame to the Physical (PHY) layer (see figure 8.1).

NOTE 2: The CiSyncFlag parameter is associated with the L3 message in the GS. Layer 2 begins the transmission of a Layer 3 message with CiSyncFlag set only when all of the I frames sent by Layer 2 have been acknowledged. Once all of the I frames corresponding to the L3 message with an associated CiSyncFlag set have been passed to the PHY layer, the DL layer shall inform the RR sublayer with DL-BEGIN-CIPHERING.

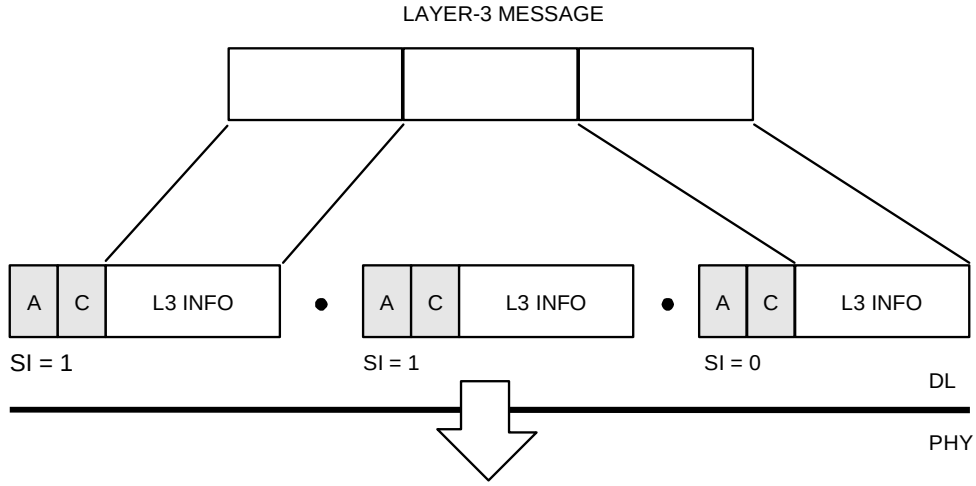

Figure 8.1: L3 message segmentation

Layer 3 messages are segmented and sent over traffic channels by selecting the size of the link layer frame based on the type of channel such as FACCH, SDCCH, TACCH, etc.

The frame is delivered to the physical layer upon completion of the DL header initialization.

If timer T200 is not running at the time right before transmitting a frame, when the PHY-READY-TO-SEND primitive is received from the PHY, it shall be set. If the timer T200 is already running, it shall not be set or reset. If the timer T200 expires, then the procedures defined in clause 8.5.7 shall be followed.

If the Send State Variable V(S) is equal to V(A) plus k, and k is the maximum number of the outstanding I frames (see clause 8.8.4), then the DL entity shall not transmit any new I frames, but shall retransmit an I frame as a result of the error-recovery procedures, as described in clauses 8.5.4 and 8.5.7.

If a DL-DATA-REQUEST primitive is received while in the timer recovery condition, then it shall be stored and serviced upon clearance of this condition.

8.5.2 Receiving I frames

When a DL:

- Receives a valid I frame having N(s) equal to the current Receive State Variable V(R), then the DL shall proceed as follows:

  - if the SI bit is set to "0" and its sequence number is in sequence with the current received frame sequence number, it shall be concatenated with previously received frames having the SI bit set to "1". Once all I frames of the L3 message (or messages) have been received, then the complete Layer 3 message unit (or message units if segments corresponding to multiple messages are available) is (are) passed to the Layer 3 entity using the primitive DL-DATA-INDICATION. See figure 8.2;

  - if the SI bit is set to "1" and its sequence number is in sequence with the current received frame sequence number, it shall be concatenated with previously received frames having the SI bit set to "1". No information is passed on to the Layer 3 entity;

  - update the value of V(R) and proceed as indicated in clauses 8.5.2.1 or 8.5.2.2, depending upon the value of the P bit.

NOTE: If the GREJ exception condition is cleared (see clause 8.7.1) upon receiving this I frame, then V(R) shall be set to the next in-sequence I frame expected; otherwise, V(R) shall be incremented by 1.

- If it receives an I frame having an N(S) that is less than the current receive state variable V(R), then the DL shall:
  - discard the information field in the I-frame and proceed as indicated in clause 8.5.2.1 or 8.5.2.2, depending upon the value of the P bit.
- If it receives an I frame having an N(S) that is not equal to the V(R) but within the current receive window, i.e., $0 < (N(S) - V(R)) \bmod 32 < k$, then the DL shall:
  - report the N(S) sequence error exception condition to the transmitting DL entity by indicating the missing I frame(s) in GREJ frame, if not already indicated, as given in clause 8.7.1;
  - retain the out of sequence I frame(s) and proceed as indicated in clause 8.5.2.1 or 8.5.2.2, depending upon the value of the P bit.

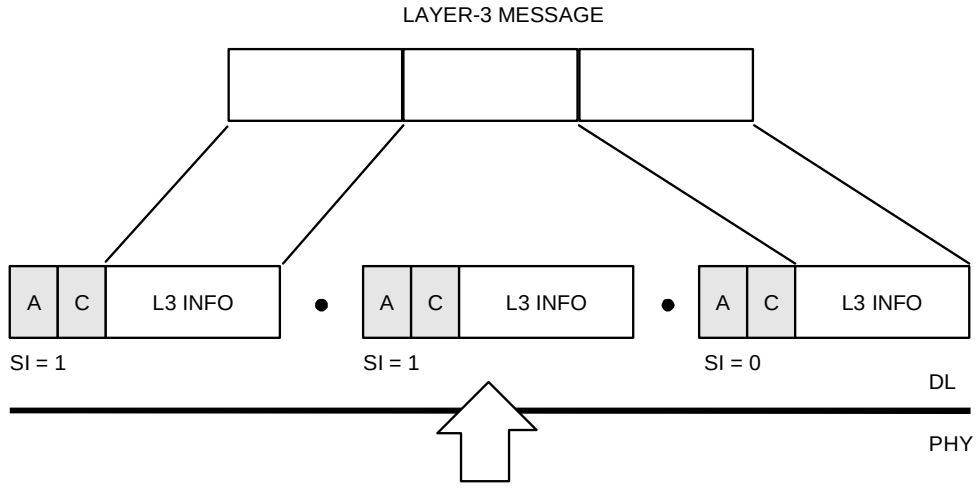

Figure 8.2: L3 message reassembling

8.5.2.1 I Frame received with P = 1

If the P bit of the received I frame was set to "1", the DL shall respond to its peer by sending an RR or GREJ (see clause 8.7.1) response with the F bit set to "1".

8.5.2.2 I Frame received with P = 0

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

- if no I frame is available for, then the DL shall transmit an RR or GREJ (see clause 8.7.1) response with the F bit set to "0"; or
- if an I frame is available for transmission and no peer receiver busy condition exists, then:
  - if the received I frame is out of sequence, the DL entity shall transmit a GREJ response (see clause 8.7.1). It shall then transmit the I frame with the value of N(R) set to the current value of V(R), as defined in clause 8.5.1 (this I frame then acknowledges the receipt of an I frame); or
  - if the received I frame is in sequence, the DL entity shall transmit the I frame with the value of N(R) set to the current value of V(R), as defined in clause 8.5.1 (this I frame then acknowledges the receipt of an I frame).

NOTE 1: The term "available for transmission" should be interpreted to mean available for transmission at the instant when the physical layer is ready to transmit the next frame. Making this decision as close as possible to that instant will ensure minimum delay in the transmission of I frames.

NOTE 2: Any I frame received in the timer recovery condition shall be handled as stated above.

8.5.2.3 Receiving frames for SAPI = 2 on the network end

The network shall snoop on the L-L channel and receive the messages transmitted by the MES on the SAPI = 2 link. This is a special mode of operation on the network side where, in the DL entity, it can only receive the SAPI = 2 frames and cannot transmit any frames.

When the DL entity receives an in-sequence I frame, it shall concatenate with the previously received I frames. Once the last segment of the message has been detected (I frame with SI bit set to "0"), the entire L3 message shall be passed to L3 using the DL-DATA-INDICATION primitive.

Out-of-sequence I frame(s) shall be retained and no attempt shall be made to initiate the N(S) sequence error recovery. When missing I frames are received, they are appropriately concatenated with the previously received frames. (This could be a result of retransmission on T200 timeout or GREJ exception recovery at the DL entity in the MESs engaged in a TtT call.).

The segments shall be retained until:

- all of the I frames corresponding to the L3 message are received and reassembled;
- the receive window has advanced to a frame number that indicates that the missing frames of a Layer 3 message cannot be retransmitted.

8.5.3 Receiving acknowledgment

8.5.3.1 Piggybacked acknowledgment

On receipt of a valid I frame or S frame (RR or GREJ), even in the timer recovery condition, the DL shall treat the N(R) contained in the frame as an acknowledgment for all the I frames it has transmitted with an N(S), up to, and including, the received N(R)-1. The value of the acknowledge state variable V(A) shall be set to the value of N(R) if the value of N(R) is valid (see clause 8.7.4). When not in the timer recovery condition, the DL shall reset the timer T200, on receipt of a valid I frame or supervisory frame (RR or GREJ), with N(R) higher than V(A) (actually acknowledging some I frames), or a GREJ with an N(R) equal to V(A).

NOTE: If an S frame command with the P bit set to "1" or an I frame command with the P bit set to "1" has been transmitted and not acknowledged by supervisory frame response with the F bit set to "1", timer T200 shall not be reset.

If timer T200 has been reset by the receipt of an Ior RR frame, and if there are outstanding I frames still unacknowledged, the DL shall set timer T200. If timer T200 expires, the DL shall follow the timer recovery procedure, as defined in clause 8.5.7, with respect to unacknowledged I frames.

If timer T200 has been reset by the receipt of a GREJ frame, the DL shall follow the retransmission procedures as described in clause 8.5.4.

8.5.3.2 Piggybacked acknowledgment with a command frame

If an S frame with P = 1 is received, the following responses with the F bit set to "1" shall be given:

- if the DL is not in an N(S) sequence error exception condition, then the appropriate response is the RR response;
- if the DL is in an N(S) sequence error exception condition (when a sequence error has been detected but a GREJ frame has not yet been transmitted), then the appropriate supervisory response is the GREJ response.

8.5.4 Receiving a GREJ frame

8.5.4.1 DL receives GREJ during timer recovery and normal conditions

Upon receipt of a valid GREJ frame, the DL shall:

- if it is not in the timer recovery condition, then:
  - set its Acknowledge State Variable V(A) to the value of the N(R) contained in the GREJ frame control field;
  - reset timer T200;
  - if it is a GREJ command frame with the P bit set to "1", then it will transmit an appropriate supervisory response frame with the F bit set to "1" (see clause 8.5.3.2);
  - transmit the requested I frame(s) as soon as possible as defined in clause 8.5.1 taking into account the condition given in clause 8.5.4.2;
- if the DL is in a timer recovery condition and a GREJ response frame is received with the F bit set to "1", then:
  - clear the timer recovery condition;
  - set its Acknowledge State Variable V(A) to the value of the N(R) contained in the GREJ frame control field;
  - reset timer T200;
  - transmit the requested I frame (or frames) as soon as possible, as defined in clause 8.5.1, taking into account the conditions given in clause 8.5.4.2;
- if the DL is in timer recovery condition and a GREJ frame is received (other than a GREJ response with the F bit set to "1"), then:
  - set the Acknowledge State Variable V(A) to the value of the N(R) contained in the GREJ frame control field;
  - if the received GREJ command frame had the P bit set to "1", transmit an appropriate supervisory response frame with the F bit set to "1" (see clause 8.5.3.2);
  - transmit the requested I frame (or frames) as soon as possible, as defined in clause 8.5.1, taking into account the conditions given in clause 8.5.4.2.

8.5.4.2 DL receives GREJ while transmitting a frame

When a GREJ is received while transmitting frames, the following conditions are to be observed:

- if the DL entity is transmitting an S frame when it receives a GREJ frame, it shall complete the transmission before commencing transmission of the requested I frame;
- if the DL is transmitting an SABM, a DISC command, a UA or DM response when it receives the GREJ frame, it shall ignore the request for retransmission;
- if the DL is not transmitting a frame when the GREJ is received, it shall immediately commence transmission of the requested frame(s).

The group of outstanding unacknowledged I frames identified in the received GREJ frame shall be transmitted. Other I frames not yet transmitted may be transmitted following the transmitted I frames.

8.5.5 Reception of RNR

The RNR frame described in GSM 04.06 [9] is not a valid LAPSat frame.

8.5.6 DL layer own receiver busy

The own receiver busy condition described in GSM 04.06 [9] is not applicable to LAPSat.

8.5.7 Waiting acknowledgment

The DL shall maintain an internal retransmission count variable.

If timer T200 expires, the DL shall:

- if it is not yet in the timer recovery condition, enter the timer recovery condition and set the retransmission count variable to 0; or
- if it is already in the timer recovery condition, add one to its retransmission count variable.

The DL shall then:

- if the value of the retransmission count variable is less than N200:
  - retransmit the unacknowledged I frame(s) starting from sequence number V(A) up to and including V(S)-1 with the P bit set to "1"; or
  - send the appropriate supervision frame, with the P bit set to "1" if no I frames are outstanding; or
  - set timer T200 right before transmitting the first frame (for the rest of the frames the timer is not restarted), when the PH-READY-TO-SEND primitive is received from the physical layer; or
- if the value of the retransmission count variable is equal to N200:
  - the DL shall indicate this by means of the primitive MDL-ERROR-INDICATION with cause "timer T200 expired N200+1 times: perform abnormal release" to Layer 3.

NOTE: It is then the responsibility of Layer 3 to release or reestablish the data link. The DL layer remains in the timer recovery state until further actions are taken by Layer 3.

The following paragraph applies only for DL layer in the timer recovery condition, as the case of receiving acknowledgment in multiframe established state is described in clause 8.5.3.1.

The timer recovery condition is only cleared if the DL entity receives a valid supervisory frame response with the F bit set to "1". The Timer T200 shall be reset if the received supervisory frame response is an RR or GREJ response with the F bit set to "1". The DL shall then resume with the I frame transmission or retransmission, as appropriate.

If timer T200 has been reset by the receipt of a valid supervisory frame, and if there are outstanding I frames still unacknowledged, the DL shall set timer T200.

8.6 Abnormal release and reestablishment of multiframe operation

8.6.1 Criteria for reestablishment

The criteria for reestablishment are identical to those described in clause 5.6.1 of GSM 04.06 [9].

8.6.2 Criteria for abnormal release

The procedure for abnormal release of multiple frame operation is initiated by:

- the receipt of a frame containing an invalid N(R), an invalid Na(R), or an invalid Nb(R) (see below).
- the receipt, while in the multiple-frame-established state, of an unsolicited DM response with the F bit set to "0".

A valid N(R) is one that is in the range V(A) < = N(R) < = V(S).

A valid Na(R) is one that is in the range V(A) < = Na(R) < = V(S).

A valid Nb(R) is one that is in the range V(A) < = Nb(R) < = V(S).

The Na(R) and Nb(R) pair is valid if (Nb(R) – Na(R)) mod 32 < k.

These inequalities shall be interpreted as follows:

N(R) is called valid, if and only if (N(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

Na(R) is called valid, if and only if (Na(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

Nb(R) is called valid, if and only if (Nb(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

8.6.3 Procedures for reestablishment

The procedures for reestablishment are identical to those described in clause 5.6.3 of GSM 04.06 [9]. Read SABM with L = 0 as SABM with an information field of 0 octets.

8.6.4 Procedures for abnormal release

The procedures for abnormal release are identical to those described in clause 5.6.4 of GSM 04.06 [9].

8.7 Exception condition reporting and recovery for multiple frame operation

Exception conditions can be caused by physical layer errors or DL layer procedural errors.

The error recovery procedures available to effect recovery following the detection of an exception condition at the DL layer are defined in this clause.

8.7.1 N(S) sequence error

An N(S) sequence error exception condition occurs in the receiver when a valid I frame is received that contains an N(S) value that is not equal to the Receive State Variable V(R) at the receiver. The information field of all I frames whose N(S) precedes the Receive State Variable V(R) shall be discarded. If an otherwise valid I frame is received with an N(S) that follows V(R) but is within the receive window and furthermore indicates the loss of a single frame or loss of multiple frames, the receiver shall retain the I frame and transmit a GREJ response frame.

The receiver shall not acknowledge (nor increment its receive state variable) the I frame causing the sequence error, nor any I frames that may follow, until an I frame with the correct expected Send Sequence Number, N(S) is received. The Receive State Variable, V(R), is updated on receipt of an I frame with the correct expected Send Sequence Number N(S). The I frame is not acknowledged if any of the previous frames is not received. If all sequence errors have been cleared, the DL acknowledges all I frames up to and including the last in-sequence I frame.

A DL receiving either one or more I frames having sequence errors but otherwise error-free, or subsequent supervisory frames (RR and GREJ), shall use the control field information contained in the N(R) field and the P or F bit to perform DL control functions; for example, receiving acknowledgment of the previously transmitted I frames may cause the DL to respond if the P bit is set to "1". Therefore, a retransmitted I frame may contain an N(R) field value and P bit that are updated from, and therefore different from, the ones contained in the originally transmitted I frame.

The GREJ frame is used by a receiving DL to initiate an exception condition recovery (retransmission) following the detection of an N(S) sequence error. One or more GREJ frames may be transmitted depending upon the groups of I frames that are missing and need retransmission, when the valid I frames that are within the receive window are retained.

NOTE: The DLL shall transmit at least one GREJ frame for each mutually exclusive group of sequentially numbered missing I frame(s). The following GREJ, if any, shall not indicate the missing I frames already reported in previous GREJ frame(s).

A DL receiving a GREJ command or response shall initiate sequential transmission (retransmission) of all the I frames starting with the I frame indicated by the Na(R) up to and including I frame indicated by the Nb(R) contained in the frame.

A GREJ exception condition is cleared when all the requested I frames are received or when a SABM or DISC command is received. If more than one GREJ frame has been transmitted for multiple sequence errors, the GREJ exception condition is cleared when all outstanding I-frames corresponding to all transmitted separate GREJ frames have been received.

8.7.2 Timer recovery

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

The DL that transmitted the unacknowledged I frame(s) shall, on the expiration of the timer T200, take appropriate recovery action as defined in clause 8.5.7 to determine at which I frame retransmission shall begin.

8.7.3 Invalid frame condition

Any frame received that satisfies one of more of the following conditions shall be discarded after notification to Layer 3 by means of the primitive MDL-ERROR-INDICATION (with cause as indicated):

- a supervisory or unnumbered frame with incorrect parameters (e.g., frames where the information field is not permitted and the length field indicates user information with the frame) (causes "S frame with incorrect parameters" and "U frame with incorrect parameters", respectively);
- an I frame received with SI set to "1" and LFI is set to "1" in the received frame (cause "I" frame with incorrect use of SI bit);
- a command or response frame with a control field that is not implemented (cause "frame not implemented").

No other action shall be taken as a result of such frames. The information fields shall be discarded and the N(S), N(R), Na(R), and Nb(R) fields, as well as the P/F bits (if applicable), shall be ignored.

8.7.4 N(R) sequence error

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

A valid N(R) is one that is in the range V(A) < =N(R) < = V(S).

These inequalities shall be interpreted in the following way; N(R) is called valid, if and only if
(N(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

The information field contained in an I frame that is correct in sequence and format but contains an invalid N(R) shall be delivered to Layer 3 by means of the primitive DL-DATA-INDICATION (if it contains a complete Layer 3 message unit or the last segmented Layer 3 message unit that is concatenated with the previously received segments; otherwise the information field is discarded), and a P bit set to "1" shall be processed before taking subsequent actions.

The DL shall then inform Layer 3 of this exception condition by means of the primitive MDL-ERROR-INDICATION with the cause "sequence error: perform abnormal release", as defined in clause 8.6.4. The DL shall remain in the current state until it is released by Layer 3.

8.7.5 Na(R) or Nb(R) sequence error

An Na(R) or Nb(R) sequence error exception condition occurs in the transmitter when a valid GREJ frame is received that contains an invalid Na(R) or Nb(R) value.

A valid Na(R) is one that is in the range V(A) < = Na(R) < = V(S).

A valid Nb(R) is one that is in the range V(A) < = Nb(R) < = V(S).

Also the Na(R) and Nb(R) pair is valid if (Nb(R) – Na(R)) mod 32 < k.

These inequalities shall be interpreted as follows:

Na(R) is called valid, if and only if (Na(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

Nb(R) is called valid, if and only if (Nb(R) – V(A)) mod 32 < = (V(S) – V(A)) mod 32.

The DL shall inform Layer 3 of this exception condition by using the primitive MDL-ERROR-INDICATION with the cause "sequence error: perform abnormal release" (as defined in clause 8.6.4). The DL shall remain in the current state until it is released by Layer 3.

8.7.6 Layer 3 message with incorrect length

The received Layer 3 message shall be discarded if the length of the received Layer 3 message exceeds the maximum number allowed (see clause 8.8.5). The DL shall inform Layer 3 of this exceptional condition by using the primitive MDL-ERROR-INDICATION with the cause "Layer 3 message with incorrect length; perform abnormal release". The data link shall remain in the current state until it is released by Layer 3.

8.8 List of system parameters

The parameters listed below are associated with each individual service access point and apply to both unacknowledged and multiple frame operations.

The only parameter required for unacknowledged operation is the maximum number of octets in the information field (clause 8.8.3).

The values given below for the parameters may be changed to optimize the system performance.

8.8.1 Timer T200

8.8.1.1 For SAPI = 0, SAPI = 2 and SAPI = 3

The value of timer T200 for data links with SAPI = 0, SAPI = 2 and SAPI = 3 depends on synchronization mechanisms and processing delays in both the Layer 1 and Layer 2 entities. The value is chosen to guarantee a predictable behaviour. The satellite round-trip delay should also be considered when choosing the value of timer T200. (Also see clause 5.8.1.1 of GSM 04.06 [9]).

The recommended values of the T200 (Retransmission timer) for the following call types are shown in figures 8.3, 8.4, and 8.5 and are listed in table 8.1.

- TtG call via one GS only

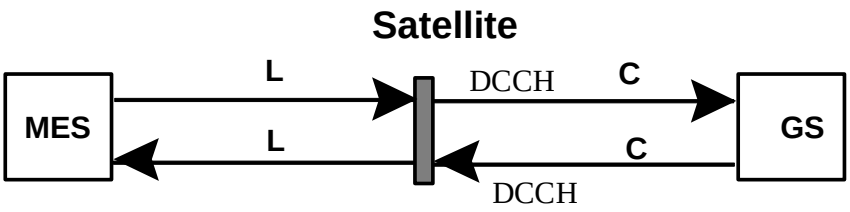

Figure 8.3: TtG call

- TtT call via one GS only (single-hop call)

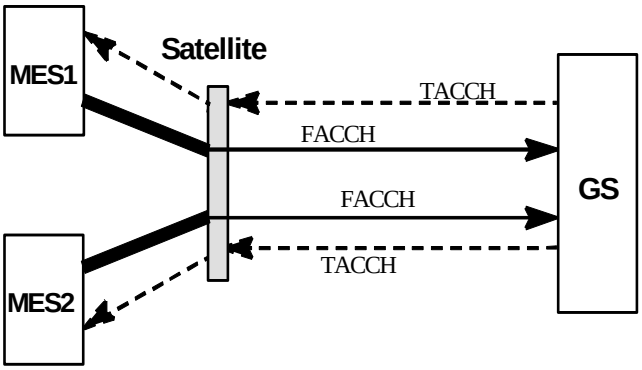

Figure 8.4: TtT call via one GS only

- TtT Call via two GSs (single-hop call)

NOTE: The FACCH (on TCH) assigned to the AT2 for the TtT call is used for reverse signalling from AT2 to GS1. The GS1 can listen to the FACCH assigned to the AT2. The TACCH is a common control channel for the spot beam under the control of GS2. AT2 listens to the TACCH for the signalling information. The signalling information from the GS1 to the AT2 uses the TACCH and is sent by GS1 via GS2 as GS2 controls the spot beam in which AT2 is located.

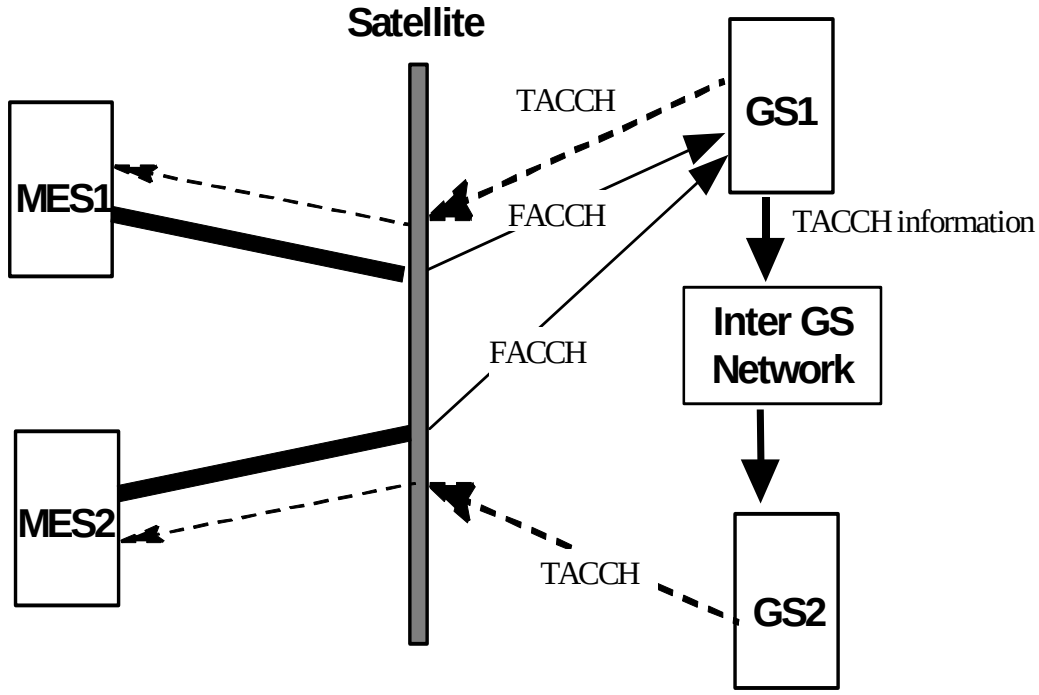

Figure 8.5: TtT call using two GSs

Table 8.3: Retransmission T200 value

GMR-1 Data Link Layer T200 Retransmission Timer Value									
		Available Response Delay (T_{resp})		Round Trip Delay	Queuing Delay (TDMA Frames)		T200 (msec) 1 TDMA Frame = 40 msec		Comments
SAPI	Type of Channel	MES	Network	(TDMA Frames)	MES	Net	MES	Net	
0	FACCH3	6 (note1)	4 (note 2)	14	4	8	1 440	1 440	See figure 8.3
0	FACCH6,9	6 (note1)	4 (note 2)	14	2	2	1 120	1 120	See figure 8.3
0,3	SDCCH/4	2 (note 1)	4 (note 2)	14	4	10	1 520	1 520	See figure 8.3
2	FACCH3	6 (note1)	4 (note 2)	14	4	8	1 400	1 440	See figure 8.4, figure 8.5
0	TACCH/ FACCH	6 (note 1)	4 (note 2)	14	4	8	1 440+640	1 440+640	See figure 8.4 (note 3)
0	TACCH/ FACCH	26 (note 1)	4 (note 2)	14	4	24	2 080	2 080	See figure 8.5 (note 3)
3	SACCH3	6	4	14	28	32	3 360	3 360	See note 4
3	SACCH6,9	6 (note 1)	4 (note 2)	14	22	22	2 720	2 720	

NOTE 1: The number of TDMA frames represents the average processing time in the MES.
NOTE 2: The number of TDMA frames represents the average processing time in the GS.
NOTE 3: The worst-case value of the retransmission timer for the TtT call using two GSs interconnected in a star topology.
NOTE 4: The value of T200 for SACCH3 should take into account the value of maximum waiting time for the frames using the acknowledge information transfer over SACCH on TCH3 (see clause 8.8.8 and annex C).

8.8.2 Maximum number of retransmissions (N200)

8.8.2.1 For SAPI = 0, 2, and 3

The maximum number of retransmissions N200 for SAPI = 0, 2, or 3 depends on the state and channel used. The recommended values of N200 are summarized in table 8.4.

Table 8.4: Retransmission number N200

Parameter	SAPI	DL State	Channel Type	Value	Comments
N200	0	Release states	FACCH3,6,9	5	
	2	Release states	FACCH3,6,9	5	
	3	Link establishment/release states	SACCH	5	
	0	Release states	TACCH/FACCH	5	
	0	Release states	SDCCH/4	5	
N200	0	In timer-recovery state	FACCH3,6,9	5	During signalling procedure
	2	In timer-recovery state	FACCH3,6,9	5	During signalling procedure
	3	In timer-recovery state	SACCH3,6,9	3	During signalling procedure
	0	In timer-recovery state	TACCH/FACCH	4	During signalling procedure
	0	In timer-recovery state	SDCCH/4	5	During signalling procedure

8.8.3 Maximum number of octets in an I, UI, SABM, and UA frame information field (N201)

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

- For the FACCH3: N201 = 07
- For the FACCH6: N201 = 21
- For the FACCH9: N201 = 35
- For the SACCH with TCH3: N201 = 07
- For the SACCH with TCH6: N201 = 07
- For the SACCH with TCH9: N201 = 07
- For the TACCH: N201 = 10
- For the SDCCH: N201 = 08
- For BCCH: N201 = 24
- For GBCH: N201 = 108 bits
- For PCH: N201 = 24
- For BACH: N201 = 36 bits
- For AGCH: N201 = 24
- For RACH: N201 = 139 bits

8.8.4 Void

8.8.5 Maximum number of outstanding I frames (k)

The maximum number of sequentially numbered I frames (k) that may be outstanding (unacknowledged) at any given time shall not exceed 16.

The value of k shall be 16 for data links with SAPI = 0, 2 or 3.

8.8.6 Maximum number of octets in a layer 3 message

The number of octets in an L3 message passed to Layer 2 for transmission in acknowledged mode shall not exceed 251.

The number of octets in an L3 message passed to Layer 2 for transmission in unacknowledged mode is limited by the maximum number of octets in the information field of a UI frame (as defined in clause 8.8.3).

8.8.7 Maximum number of SABMs in a group (N204)

The value of N204 is 8 for SAPI = 0 and SAPI = 2.

8.8.8 Timer T204

The value of T204 = T200 for SAPI = 0 and SAPI = 2.

8.8.9 Time to expiry (T205)

The time to expiry depends upon the maximum waiting time and the waiting time at Layer 2. Waiting time at Layer 2 is defined as the time spent by the frame at Layer 2 before it is given to Layer 1.

- For acknowledged information transfer over SACCH on TCH3 the value of T205 is given as:

  time to expiry = maximum waiting time where the maximum waiting time = 2 seconds.

- For unacknowledged information transfer over SACCH on TCH3 the value of T205 is given as:

  time to expiry = maximum waiting time – waiting time at Layer 2 = 0 if waiting time at Layer 2 exceeds the maximum waiting time where the maximum waiting time = 4 seconds.

- For information transfer over other logical channels the value of T205 is set to 0.

9 Special protocol operation on SAPI = 0 and SAPI = 3

This clause summarizes the special features of the LAPSat protocol regarding the acknowledged mode operation on SAPI = 0 and SAPI = 3. The purpose is to adapt the multiple frame operation of LAPSat to the needs and the characteristics of the GMR-1 system.

The adaptations and simplifications specified in this clause shall be used by both mobile earth station and network, for SAPI = 0 and SAPI = 3.

As indicated in clause 8, the protocol operates on SAPI = 0 in the following way:

- Data link establishment for SAPI = 0 is always initiated by the mobile earth station.
- Data link establishment, according to the contention resolution procedure (see clause 8.4.1.4), is supported when initiated by the MES on the main DCCH immediately after "immediate assignment" of that radio channel. In other cases of link establishment contention resolution is not used.
- When changing the radio channel during assignment procedure (Layer 3 procedure), in acknowledged mode on SAPI = 0, the MES supports continuous transmission of Layer 3 messages without loss by offering the SUSPEND, RESUME, and RECONNECT primitives, as specified in clause 8.4.3.

10 DL layer FRAME formats

This clause provides the frame formats for the DL layer.

NOTE: The Last Octet (LO) of the frame is split into two nibbles in all of the frame formats. (The last octet may belong to the information field or to the fill bit pattern.) The position of bits LO8 through LO1 is shown in all the frame formats.

10.1 Data link layer I-frame

Figure 10.1 shows the format of a DL I-frame.

Bit #/Octet #	8	7	6	5	4	3	2	1
1	LFI	LPD		SI	SAPI		C/R	SST
2	$N(R)_5$ • • • $N(R)_1$					P	$N(S)_5$	$N(S)_4$
3	$N(S)_3$	$N(S)_2$	$N(S)_1$	0	LO8	LO7	LO6	LO5
4	Value of L (if LFI = "1") or first octet of information/fill							
5	Information field/Fill bits							
6								
7								
•								
•								
•								
N201+3					LO4	LO3	LO2	LO1

Figure 10.1: Data Link Layer I – frame format

10.2 Data link layer S frame format (except GREJ)

Figure 10.2 shows the format of a DL S-frame.

Bit #/Octet	8	7	6	5	4	3	2	1
1	LFI	LPD		SI	SAPI		C/R	SST
2	$N(R)_5$ • • • $N(R)_1$					P/F	Spare	
3	S	S	0	1	0	0	0	0
4	Value of L = "00000000"							
5	Fill bits pattern "00000000"							
6								
7								
•								
•								
•								
N201+3					0	0	0	0

Figure 10.2: Data Link Layer S–frame format

Refer to table 6.7 for different values of S bits. Spare bits shall be coded as "0" while transmitting. The receiver shall ignore these bits.

10.3 Data link layer GREJ frame

Figure 10.3 shows the format of a DL GREJ frame.

Bit #/Octet	8	7	6	5	4	3	2	1
1	LFI	LPD		SI	SAPI		C/R	SST
2	$N(R)_5$ • • • $N(R)_1$					P/F	0	0
3	1	0	0	1	0	0	0	0
4	Value of L = "00000010"							
5	0	0	0	$Na(R)_5$ • • • $Na(R)_1$				
6	0	0	0	$Nb(R)_5$ • • • $Nb(R)_1$				
7	Fill bits pattern = "00000000"							
•								
•								
•								
N201+3					0	0	0	0

Figure 10.3: Data Link Layer GREJ frame format

10.4 Data link layer U frames format

Figure 10.4 shows the format of a DL U-frame.

Bit #/Octet #	8	7	6	5	4	3	2	1
1	LFI	LPD		SI	SAPI		C/R	SST
2	Spare		MII/U	U	U	P/F	Spare	
3	U	U	1		1	LO8	LO7 LO6	LO5
4	Value of L (if LFI = "1") or first octet of information/fill							
5	Information field (In case of SABM this field is present only for contention resolution)/ Fill bits							
6								
7								
•								
•								
•								
N201+3					LO4	LO3	LO2	LO1

Figure 10.4:Data Link Layer U-frame format

Refer to table 6.7 for value of U in different U frames. Spare bits shall be coded as 0 while transmitting. The receiver shall ignore these bits. The MII bit is defined for a SABM frame and set to "1" when the Con-Restaurant parameter is present in the information field.

Annex A (normative): Random access procedure

This random access procedure is identical to the procedure described in GSM 04.06 [9] (annex A) except that the RACH burst is 139 bits (see GMR-1 05.003 [7]) instead of 8 bits.

Annex B (normative): Handling of frames with parameter errors

B.1 General

Frames received with parameter errors in the address, control, and length field shall be ignored and the information field shall be discarded.

An indication is given to the higher layer entity in an MDL-ERROR-INDICATION primitive for certain parameter errors.

B.2 Parameter error in the address field

B.2.1 Invalid SAPI

No action shall be taken on frames containing an unallocated SAPI.

B.2.2 Wrong value of the C/R bit

An MDL-ERROR-INDICATION primitive with the cause "frame not implemented" is sent to the upper layer if the following conditions occur:

- I frame, C/R bit indicates response;
- SABM frame, C/R bit indicates response;
- UI frame, C/R bit indicates response;
- UA frame, C/R bit indicates command;
- DISC frame, C/R bit indicates response;
- DM frame, C/R bit indicates command.

B.2.3 SI bit error

See clause B.4.

B.2.4 Length field indicator error

See clause B.4.

B.3 Parameters errors in the control field

The values not permitted for the control field are shown in table B.1. An MDL-ERROR-INDICATION primitive with the cause "frame not implemented" is sent to the upper layer.

Table B.1: Control field parameter errors

Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
$N(R)_5$	$N(R)_4$	$N(R)_3$	$N(R)_2$	$N(R)_1$	P/F	x	x	1	1	0	1
x	x	x	x	x	P/F	x	x	1	0	1	1
x	x	x	x	x	P/F	x	x	0	1	1	1
x	x	0	1	0	P/F	x	x	1	1	1	1
x	x	0	1	1	P/F	x	x	1	1	1	1
x	x	1	0	0	P/F	x	x	1	1	1	1
x	x	1	1	0	P/F	x	x	1	1	1	1
x	x	1	1	1	P/F	x	x	1	1	1	1
x	x	0	0	1	P/F	x	x	0	1	1	1
x	x	0	0	1	P/F	x	x	0	0	1	1
x	x	1	0	0	P/F	x	x	0	0	1	1
x	x	1	0	1	P/F	x	x	0	0	1	1
x	x	1	1	0	P/F	x	x	0	0	1	1
x	x	1	1	1	P/F	x	x	0	0	1	1

B.4 Parameters errors for length field

B.4.1 Supervisory frames

- When a supervisory frame is received with the SI bit set to "1" (indicating segmentation); or when the L (length field) indicates the length of the information field in the S frame is not "0" octet (for RR) and "2" octets (for GREJ), then an MDL-ERROR-INDICATION primitive with cause "S frame with incorrect parameters" is sent to the higher layer.

B.4.2 Unnumbered frames

- When a DISC or DM frame is received with the SI bit set to "1" (indicating segmentation); or when the LFI bit in the address field set is to "0", (indicating that there is no Length Field); or when the L (length field) indicates the length of the information field in the U frame is more than "0" octets, then an MDL-ERROR-INDICATION primitive with cause "U frame with incorrect parameters" is sent to the higher layer.

- When SABM, UA or UI frames are received with L > = N201 or the SI bit is set to "1", then an MDL-ERROR-INDICATION primitive with cause "U frame with incorrect parameters" is sent to the upper layer.

B.4.3 Information frames

- When the length field of an I frame is set to a numerical value of L > = N201 or L = 0, then an MDL-ERROR-INDICATION primitive with cause "I frame with incorrect length" is sent to the higher layer.

- When the LFI is set to "1" (i.e., the numerical value of L < N201 and the SI bit is set to "1"), then an MDL-ERROR-INDICATION primitive with cause "I frame with incorrect use of SI bit" is sent to the higher layer.

Annex C (normative): Transmission of voice, FACCH and SACCH frames on TCH3

The FACCH data, SACCH data, and coded voice data use the same bandwidth when transmitted on TCH3. Table C.1 lists the priority of the transmission of this data and the preemption criteria.

Table C.1: Priority of transmission

Priority of transmission (decreasing from top to bottom)	Preemption upon receipt of following
FACCH, Immediate SACCH, or Wait-then-Go SACCH after timeout (highest)	_
Voice	FACCH (FACCH shall preempt Voice transmission, except when voice preempts SACCH)
Wait-then-Discard SACCH or Wait-then-Go SACCH within timeout (lowest)	Voice (Voice shall preempt SACCH transmission)

FACCH frames shall be transmitted on TCH3 by stealing the bursts. SACCH frames shall be transmitted on TCH3 depending upon the service grades.

a) Immediate SACCH: The SACCH frame is transmitted on TCH3 at the earliest opportunity by stealing the bursts just like the FACCH frames. (These frames shall be called pseudo-FACCH frames in the following discussion).

b) Wait-then-Go SACCH: The SACCH frame shall wait for speech inactivity. If the speech inactivity is detected within the SACCH-GUARD-TIMER value, the SACCH frame shall be transmitted during the period the inactivity persists. If the speech inactivity is not detected within the SACCH-GUARD-TIMER value, the SACCH frame shall be transmitted at the earliest opportunity by stealing the burst just like the FACCH frames. (These frames shall be called pseudo-FACCH frames in the following discussion).

c) Wait-then-Discard SACCH: The SACCH frame shall wait for speech inactivity. If the speech inactivity is detected within the SACCH-GUARD-TIMER value, the SACCH frame shall be transmitted. If the speech inactivity is not detected within the SACCH-GUARD-TIMER value, the SACCH frame shall be discarded and is lost.

FACCH (or pseudo-FACCH) frames shall preempt active voice frames, unless those voice frames are themselves preempting SACCH frames. Active voice frames shall preempt SACCH frames in every case. If a SACCH has been preempted by voice and then the voice becomes inactive before the fourth frame of the SACCH, then the remaining frames of the SACCH shall be transmitted as though they had not been preempted.

The following examples show legal combinations of voice (V), SACCH (S), DKAB (D), and FACCH/pseudo-FACCH (F) frames. Each SACCH consists of exactly four frames.

1) …VVVVSSSSDDDVVV… (voice goes inactive, SACCH sent, no FACCH, DKABs sent until voice resumes).

2) …VVVVSVVV… (voice goes inactive, no FACCH, one frame of SACCH sent, voice becomes active again).

3) …VVVVSVVVFFFF… (voice goes inactive, no FACCH initially, one frame of SACCH sent, voice becomes active again. FACCH is received [L2 to physical layer] any time after the SACCH starts but before the fourth frame after SACCH is received. Note that the FACCH does not preempt voice until the fourth frame following the first SACCH frame).

4) …VVVVSVSSFFFF… (same as example 3, but voice goes active for exactly one frame during the SACCH. FACCH is still held off until the fourth frame after the start of SACCH).

The following examples are illegal:

1) …VVVVSFFFFDDDDVVV… (Illegal action: voice goes inactive, SACCH begins, SACCH preempted by FACCH. Reason: FACCH cannot preempt SACCH).

2) …VVVVSVFFFFVVVV… (Illegal action: voice goes inactive, SACCH begins, voice preempts SACCH, FACCH preempts voice before fourth frame after start of SACCH. Reason: FACCH cannot preempt voice if voice is already preempting SACCH).

3) …VVVVSVDDDDDVVV… (Illegal action: voice goes inactive, SACCH begins, voice preempts SACCH for one frame, then DKABs sent. Reason: If voice goes inactive before the fourth frame after the beginning of the SACCH, the remainder of the SACCH shall be sent).

If the service grade is not "Immediate" and the value of the "time to expiry" parameter is 0 then appropriate action depending upon the service grade shall be taken. For nonzero values of the "time to expiry" parameter, the SACCH-GUARD-TIMER (set to the value of "time to expiry" parameter) is started by the physical layer upon receipt of Layer 2 frame for transmission on SACCH. Once the voice inactivity is detected and no (pseudo-) FACCH frame is waiting for transmission, the physical layer transmits SACCH frame in the next available burst. The SACCH-GUARD-TIMER is reset when the transmission of the SACCH starts (i.e., transmission of at least one burst is ensured).

NOTE 1: The data transmitted on TCH3 consists of four bursts (see GMR-1 05.003 [7]). The coding scheme allows the receiver to decode the data upon receiving any of the bursts, so the transmitter can consider the frame to be transmitted even if only one of the bursts is transmitted.

If the SACCH-GUARD-TIMER expires before the transmission of the SACCH frame begins, appropriate action, depending upon the service grade, shall be taken.

The value of SACCH-GUARD-TIMER shall be set to the value of time to expiry parameter given by the Layer 2 with the PH-DATA-REQUEST primitive.

NOTE 2: This scheme is followed at the physical layer.

Annex D (informative): Bibliography

GMR-1 05.001 (ETSI TS 101 376-5-1): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 1: Physical Layer on the Radio Path: General Description; GMR-1 05.001".

GMR-1 05.002 (ETSI TS 101 376-5-2): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 2: Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 05.002".

History

Document history		
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