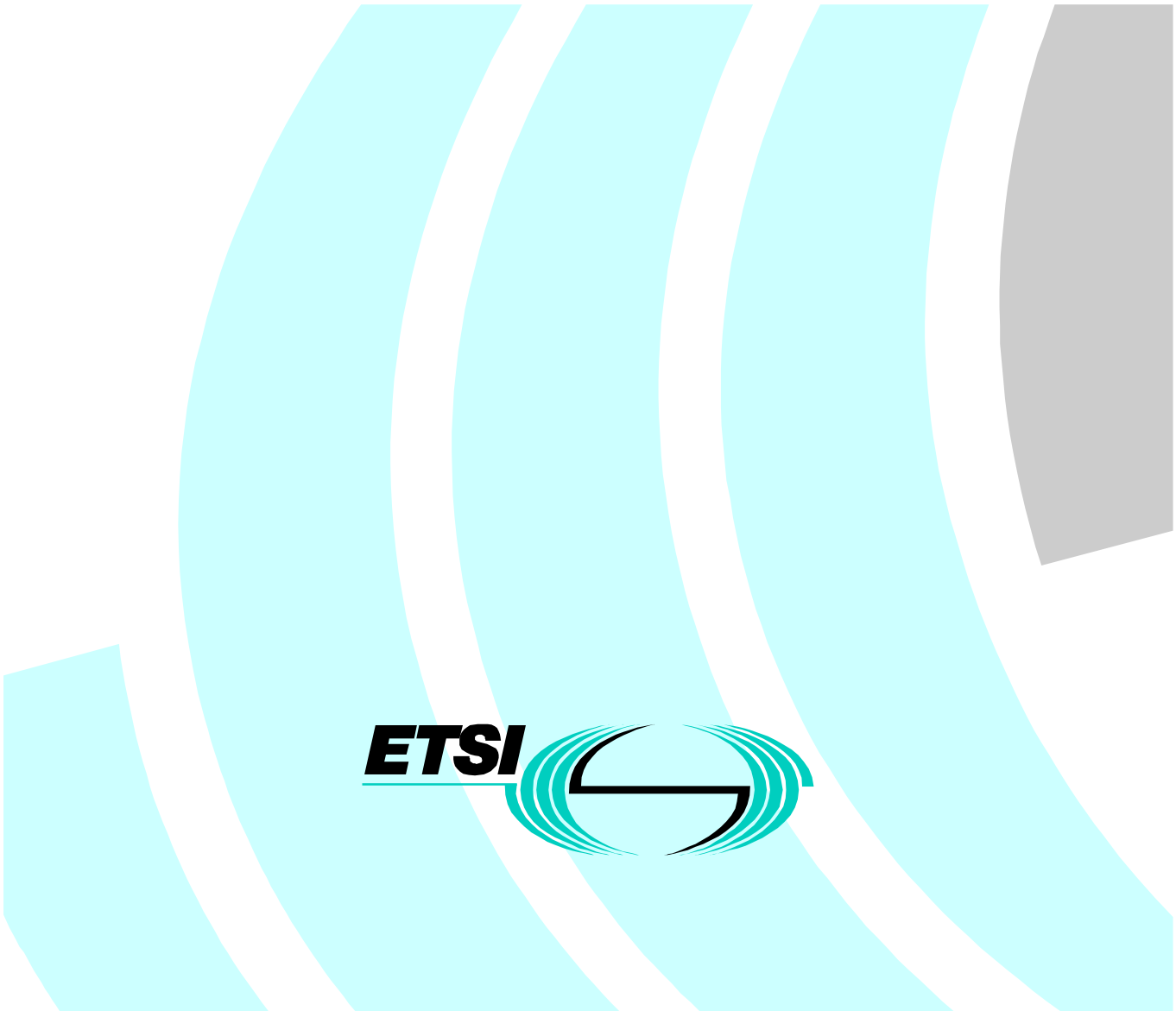
ETSI TS 101 377-4-4 V1.1.1 (2001-03)

Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 4: Radio interface protocol specifications;
Sub-part 4: Data Link Layer General Aspects;
GMR-2 04.005



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Contents

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IPRs:

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TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 377 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 101 377 V1.1.1	Hughes Network Systems		US	Pending	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 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 101 377 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 101 377 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 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 377 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 101 377 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 will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 1.m.n

where:

- 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 4 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: "GMR-2 Mobile Earth Station-Network Interface; General Aspects and Principles; GMR-2 04.001";

Sub-part 2: "GMR-2 Mobile Earth Station-Network Interface; Channel Structures and Access capabilities; GMR-2 04.003";

Sub-part 3: "Layer 1 General requirements; GMR-2 04.004";

Sub-part 4: "Data Link Layer General Aspects; GMR-2 04.005";

Sub-part 5: "GMR-2 Mobile Earth Station - Network Interface; Data Link (DL) layer Specifications; GMR-2 04.006";

Sub-part 6: "Mobile Radio Interface Signalling Layer 3; General Aspects; GMR-2 04.007";

Sub-part 7: "Mobile radio interface Layer 3 Specifications; GMR-2 04.008";

Sub-part 8: "Point-to-Point Short Message Services; GMR-2 04.011";

Sub-part 9: "Performance requirements on the mobile radio interface; GMR-2 04.013";

Sub-part 10: "Rate Adaptation on the Mobile Earth Station (MES) - Gateway System Interface; GMR-2 04.021";

Sub-part 11: "Call Waiting (CW) and Call Holding (HOLD) Supplementary Services; GMR-2 04.083";

Sub-part 12: "Multiparty Supplementary Services (MPTY); GMR-2 04.084";

Sub-part 13: "Technical Realisation of the Early Flag Technique; GMR-2 04.201";

Sub-part 14: "Call Barring Supplementary Services; GMR-2 02.088";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding 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 are defined in GMR-n 01.201.

1 Scope

The present document defines a technical specification which describes in general terms the Link Access Procedures on the Dm channel, LAPDm. The application of this protocol to other channel types is for further study. Details are provided in GMR-2 04.006 [5].

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.

[1] GMR-2 01.004 (ETSI TS 101 377-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and Acronyms; GMR-2 01.004".

[2] GMR-2 04.001 (ETSI TS 101 377-4-1): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 1: GMR-2 Mobile Earth Station-Network Interface; General Aspects and Principles; GMR-2 04.001".

[3] GMR-2 04.003 (ETSI TS 101 377-4-2): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 2: GMR-2 Mobile Earth Station-Network Interface; Channel Structures and Access capabilities; GMR-2 04.003".

[4] GMR-2 04.004 (ETSI TS 101 377-4-3): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 3: Layer 1 General requirements; GMR-2 04.004".

[5] GMR-2 04.006 (ETSI TS 101 377-4-5): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 5: GMR-2 Mobile Earth Station - Network Interface; Data Link (DL) layer Specifications; GMR-2 04.006".

[6] GMR-2 04.007 (ETSI TS 101 377-4-6): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 6: Mobile Radio Interface Signalling Layer 3; General Aspects; GMR-2 04.007".

[7] GMR-2 04.008 (ETSI TS 101 377-4-7): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 7: Mobile radio interface Layer 3 Specifications; GMR-2 04.008".

[8] GSM 04.10 (ETSI ETS 300 558 Edition 2): "Digital cellular telecommunications system (Phase 2); Mobile radio interface layer 3; Supplementary services specification; General aspects (GSM 04.10 version 4.10.0)".

[9] GSM 04.11 (ETSI ETS 300 559 Edition 4): "Digital cellular telecommunications system (Phase 2); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface (GSM 04.11 version 4.10.0)".

[10] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[11] ITU-T Recommendation X.200: "Information technology - Open Systems Interconnection - Basic reference model: The basic model".

[12] ITU-T Recommendation X.210: "Information technology - Open Systems Interconnection - Basic Reference Model: Conventions for the definition of OSI services".

[13] ITU-T Recommendation Q.920: "Digital Subscriber Signalling System No. 1 (DSS1) - ISDN user-network interface data link layer - General aspects".

[14] ITU-T Recommendation Q.921: "ISDN user-network interface - Data link layer specification".

[15] ISO/IEC 3309: "Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures -- Frame structure".

[16] ISO/IEC 4335: "Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Elements of procedures".

3 Abbreviations

Abbreviations used in the present document are listed in GMR-2 01.004 [1].

4 Concepts and terminology

The general layering principles used in the present document and other specifications in the GMR-2 04-series are given in GMR-2 04.001 [2].

The data link layer is the next to lowest layer of the OSI reference model. The data link layer receives services from the physical layer and provides services to layer 3.

The services provided by the data link layer are the combination of the services and functions provided by both the data link layer and the physical layer.

A data link layer Service Access Point (SAP) is the point at which the data link layer provides services to layer 3. The Service Access Point is identified by a Service Access Point Identifier (SAPI). One or more data link connection endpoints can be associated with each data link layer SAP as shown in figure 4.1. Data link connection endpoint is identified by a data link connection endpoint identifier (as seen from layer 3) and by a Data Link Connection Identifier (DLCI) (as seen from the data link layer).

SAPIs and DLCIs used by LAPDm are defined in clause 7.2.

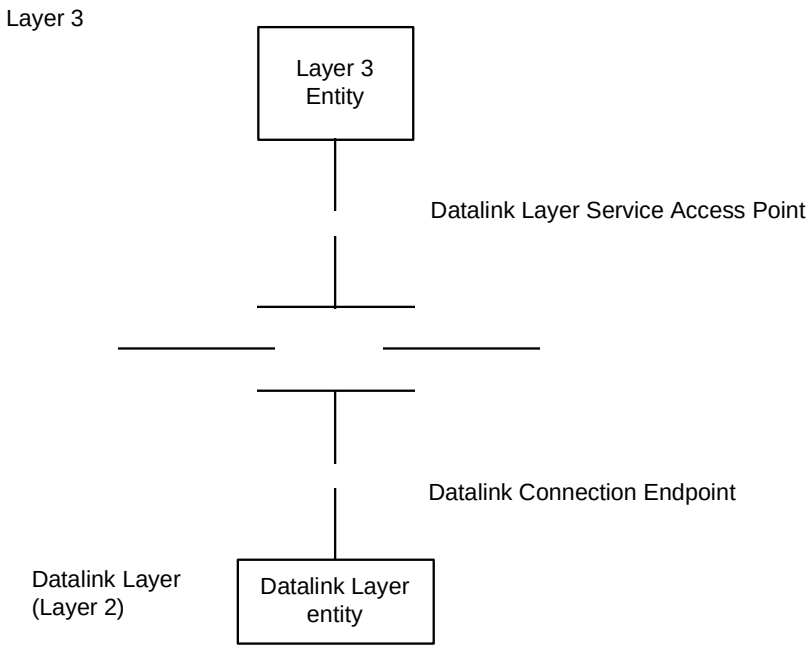


Figure 4.1: Entities, service access points and endpoints

Co-operation between data link layer entities is governed by a peer-to-peer protocol specific to the layer. For information exchange between two or more layer 3 entities, an association must be established between the layer 3 entities in the data link layer using a data link layer protocol. This association is called a data link connection. Data link connections are provided by the data link layer between two or more SAPs (see figure 4.2).

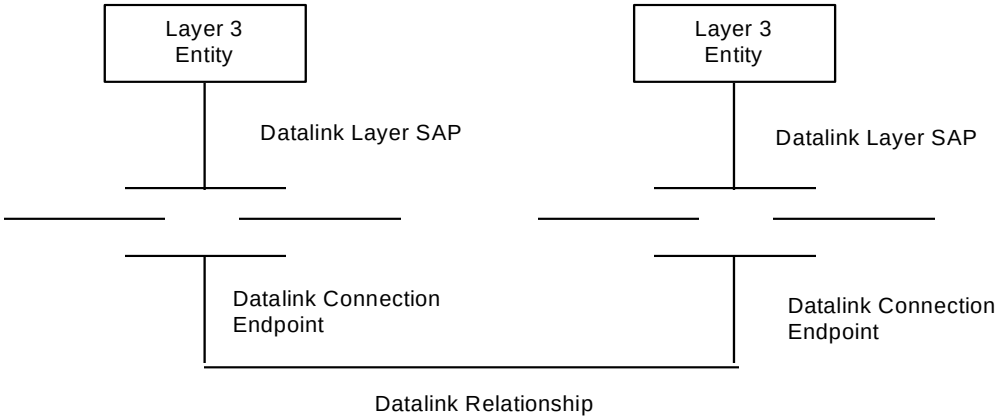


Figure 4.2: Peer-to-Peer relationship

Data link layer message units are conveyed between data link layer entities by means of physical connection.

Layer 3 requests services from the data link layer via service primitives. The same applies for the interaction between the data link layer and the physical layer. The primitives represent, in an abstract way, the logical exchange of information and control between the data link layer and its adjacent layers. They do not specify or constrain implementations.

The primitives that are exchanged between the data link layer and adjacent layers are of the following four types (see figure 4.3).

1) The REQUEST primitive type is used when a higher layer is requesting a service from the next lower layer.

2) The INDICATION primitive type is used by a layer providing a service to notify the next higher layer of activities related to the primitive type REQUEST.

3) The RESPONSE primitive type is used by a layer to acknowledge receipt, from a lower layer, of the primitive type INDICATION.

4) The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

The precise specification of layer-to-layer interactions is given in GMR-2 04.006 [5].

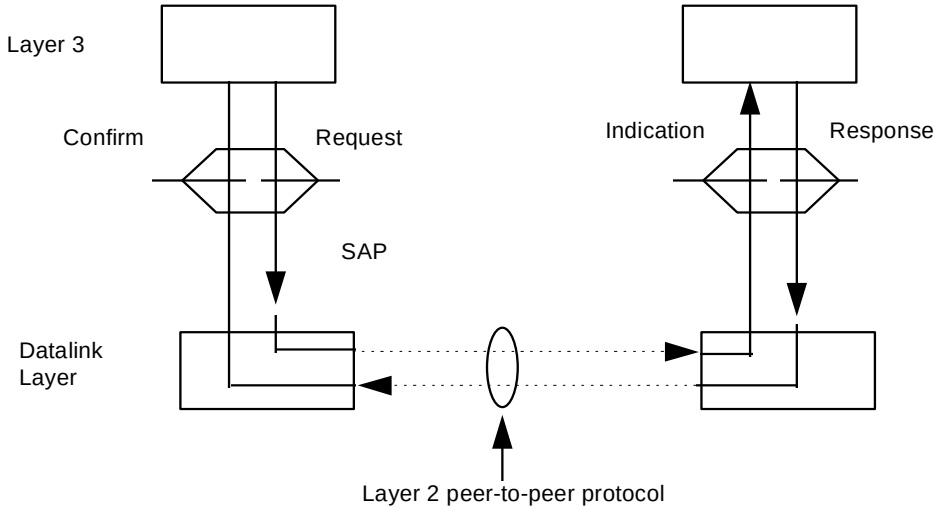


Figure 4.3: Primitive action sequence

NOTE: The same principle applies for data link layer-physical layer interactions.

Information between peer entities and between entities in adjacent layers attached to the same SAP is transferred in two different types of message units:

a) Message units of a peer-to-peer protocol;

b) Message units that contain layer-to-layer information concerning status and specialized service requests.

The message units of the layer 3 peer-to-peer protocol are carried by the data link connection. The message units containing layer-to-layer information concerning status and specialized service requests are never conveyed over a data link connection or a physical connection.

The present document introduces (see figure 4.4):

a) the peer-to-peer protocol for the transfer of information and control between any pair of data link layer service access points;

b) the interactions between the data link layer and layer 3, and between the data link layer and the physical layer.

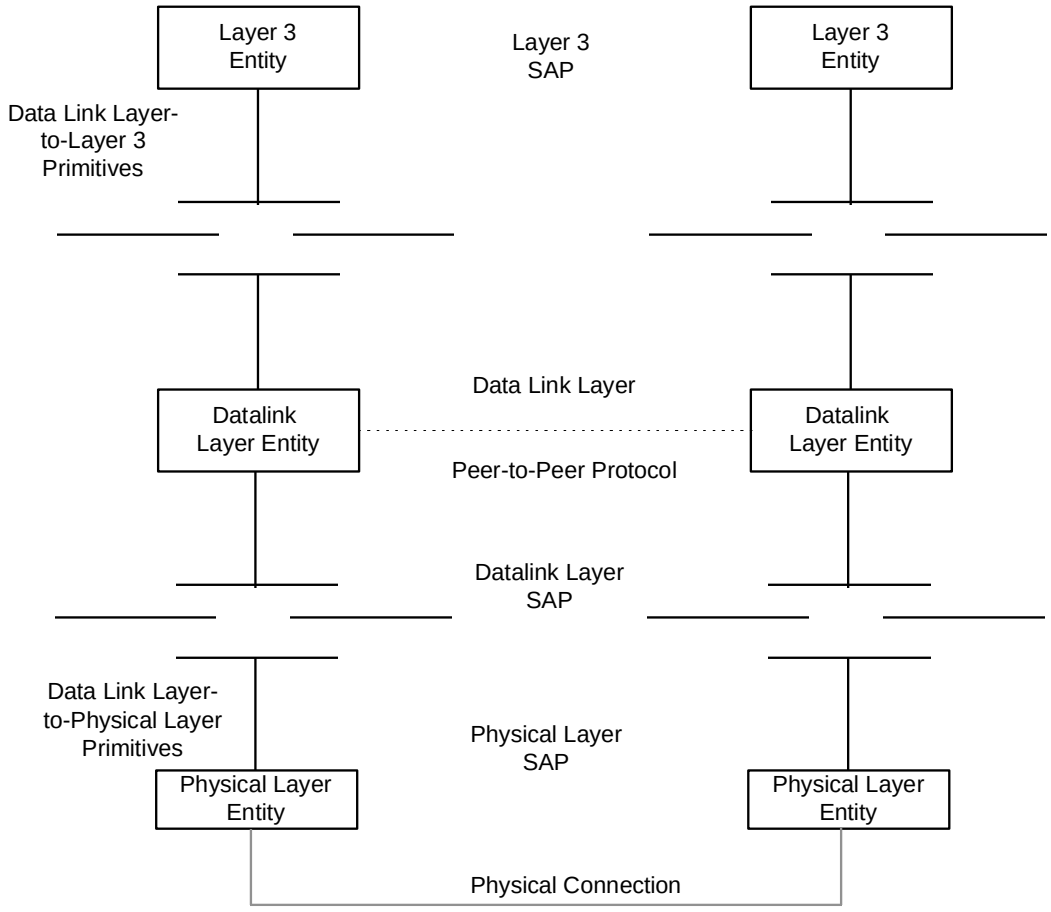


Figure 4.4: Data Link Layer reference model

5 Overview description of LAPDm functions and procedures

5.1 General

The purpose of LAPDm is to convey information between layer 3 entities across the radio interface using the Dm channel. Specifically LAPDm will support:

a) Multiple layer 3 entities;

b) Multiple physical layer entities;

c) Broadcast control channel (S-BCCH) signaling;

d) Paging channel (S-PCH) signaling;

e) High power alerting channel (S-HPACH) signaling;

f) Access grant channel (S-AGCH) signaling;

g) Dedicated control channel (S-DCCH) signaling.

NOTE 1: The term "DCCH" designates a number of control channels (S-SDCCH, S-FACCH and S-SACCH) as defined in GMR-2 04.003 [3].

NOTE 2: The random access channel (S-RACH) does not utilize LAPDm. However, for the purpose of specification, the data link layer acts as a protocol interface between layer 3 and the physical layer also for random access.

The frame structure of data link layer messages is defined in GMR-2 04.006 [5].

The Dm channel between the network and a specific MES may be distributed over several control channels, e.g., S-PCH, S-SDCCH and S-FACCH during a connection (see GMR-2 04.003 [3]). Selection and activation of these channels is performed by layer 3.

LAPDm includes functions for:

a) The provision of one or more data link connections on a Dm channel. Discrimination between the data link connections is by means of a data link connection identifier (DLCI);

b) allowing recognition of frame types;

c) allowing layer 3 message units to be passed transparently between layer 3 entities;

d) sequence control, to maintain the sequential order of frames across a data link connections;

e) detection of format and operational errors on a data link;

f) notification to the layer 3 entity of unrecoverable errors;

NOTE 3: It is the responsibility of layer 3 entities to recover from these errors.

g) flow control;

h) contention resolution when establishing a data link after an access request has been made on the S-RACH.

Two types of operation of the data link layer are defined for layer 3 information transfer: unacknowledged operation and acknowledged operation (also called multiple frame operation). They may co-exist on a Dm channel.

The S-BCCH, S-HBCCH, S-HPACH, and (S-PCH+S-AGCH) will only support unacknowledged operation. The S-SDCCH, S-SACCH and S-FACCH will support both types of operation.

5.2 Unacknowledged operation

In unacknowledged operation, layer 3 information is transmitted in Unnumbered Information frames (UI- frames).

At the data link layer, the UI frames are not acknowledged. Flow control mechanisms and error recovery mechanisms are not defined.

Applicability of unacknowledged operation to different types of control channels is specified in clause 8.1.

5.3 Acknowledged operation

In acknowledged operation, layer 3 information is transmitted in numbered information frames (I-frames) that are acknowledged by the receiving data link layer.

Error recovery procedures based on retransmission of unacknowledged frames are specified in GMR-2 04.006 [5]. In case of errors which cannot be corrected by the data link layer, a report is issued to the layer 3 entity. Flow control procedures are also defined.

Applicability of acknowledged operation to different types of control channels is specified in clause 8.1.

Only one form of acknowledged information transfer is defined, i.e., multiple frame operation. Multiple frame operation is initiated by a multiple frame establishment procedure using a Set Asynchronous Balanced Mode (SABM) command.

For multiple frame operation, layer 3 information is sent in numbered Information (I) frames. In principle, a number of I frames may be outstanding at the same time (i.e., the window size). However, for many applications (e.g., signaling), a window size of 1 is required.

If an access request has been made on the S-RACH, the establishment procedure also contains functions for resolving any ambiguity that may arise as a result of this access method (see GMR-2 04.008 [7]).

5.4 Information transfer mode

5.4.1 Information transfer on the S-BCCH/S-HBCCH

The S-BCCH and S-HBCCH exist only in the network to MES direction and are used for broadcasting spotbeam unique information to MESs. Only Ul frames are sent on the S-BCCH and S-HBCCH.

5.4.2 Information transfer on the S-HPACH and S-PCH + S-AGCH

These channels exist only in the network to MES direction. On the S-HPACH or S-PCH + S-AGCH, only unacknowledged operation is possible and only Ul frames are sent.

5.4.3 Information transfer on S-DCCHs

On S-DCCHs, both unacknowledged operation and multiple frame operation are possible (see clause 8.1). The type of operation required at any time is determined by layer 3.

5.5 Release of data links

Multiple frame operation may be released in the following ways:

a) normal release by exchange of commands/responses. This type of release is initiated by layer 3;

b) local end release, i.e., without exchange of commands/responses, initiated and controlled by layer 3;

c) abnormal local end release, i.e., without exchange of commands/responses, commanded by layer 3.

The release mode is indicated by layer 3 (see GMR-2 04.006 [5]).

No release mechanism using exchange of commands/responses is defined for unacknowledged operation.

6 Service characteristics

6.1 General

The data link layer provides services to layer 3 and utilizes the services provided by the physical layer.

In the present document, the following general syntax is used for describing primitives:

- XX - Generic Name - Type (Parameters),

where XX designates the layer providing the services. In the present document, XX is DL and MDL for the data link layer and PH for the physical layer.

6.2 Services provided to layer 3

6.2.1 General

The specification of the interactions with layer 3 (primitives) provides a description of the services that the data link layer, plus the physical layer, offer to layer 3, as viewed from layer 3.

Two forms of information transfer services are associated with layer 3. The first is based on unacknowledged information transfer at the data link layer, and the second service is based on acknowledged information transfer at the data link layer using multiple frame operation. Different information transfer services may co-exist on the same data link subject to restrictions imposed by the type of channel being used (see clause 5.4).

In addition, the data link layer will pass primitives between the physical layer and layer 3 for random access operation on the S-RACH.

6.2.2 Priority

The priority between data links shall be as follows:

a) On S-SDCCH:
   1) Highest priority: SAPI = 0
   2) Lowest priority: SAPI = 3.

b) On S-SACCH:
   The priority arrangement on the S-SACCH must ensure that if a SAPI = 3 frame is awaiting transmission, two SAPI = 0 frames are not sent in consecutive SACCH frames. In addition, for the MES to network direction, it must also be ensured that any SAPI = 3 frame is followed by at least one SAPI = 0 frame.

6.2.3 Segmentation

For the acknowledged mode of information transfer the data link layer offers segmentation for sending layer 3 message units if the message unit is longer than the information field of the data layer frames. At the receiver, the segmented layer 3 message units are concatenated such that the integrity of the layer 3 message unit is restored.

Segmentation does not apply to unacknowledged operation.

6.2.4 Unacknowledged information transfer service

NOTE: In this case, the information transfer is not acknowledged at the data link layer. Acknowledgment procedures may be provided at higher layers.

The characteristics of the unacknowledged information transfer service are summarised in the following:

a) provision of a data link connection between layer 3 entities for unacknowledged information transfer of layer 3 message units;

b) identification of data link connection endpoints to permit a layer 3 entity to identify another layer 3 entity;

c) sending of frames in accordance with priority given to the message;

d) data link layer. does not provide any verification of message arrival.

The primitives associated with the unacknowledged information transfer service are:

1) DL-UNIT DATA-REQUEST: Used to request that a message unit be sent using the procedures for unacknowledged information transfer service;

2) DL-UNIT DATA-INDICATION: Indicates the arrival of a message unit received by means of unacknowledged information transfer.

Parameters associated with these primitives are the message unit, priority and the type of channel being used (S-BCCH, S-HBCCH, S-HPACH, S-PCH + S-AGCH or specific type of DCCH).

6.2.5 Acknowledged information transfer services

Only one mode of acknowledged operation is defined, i.e., multiple frame operation. The characteristics of this service are summarised in the following:

a) Provision of a data link connection between layer 3 entities for acknowledged information transfer of layer 3 message units;

b) Identification of data link connection endpoints to permit a layer 3 entity to identify another layer 3 entity;

c) Sequence integrity of data link layer message units in the absence of machine malfunctions;

d) Notification to the peer entity in the case of errors, for example, loss of sequence;

e) Notification to the layer 3 entity of unrecoverable errors detected by the data link layer;

f) Flow control;

g) Sending of frames in accordance with the indicated SAPI value (see also clause 6.2.2);

h) Segmentation and concatenation control functions;

i) Suspension of the service during change of dedicated channels and resumption of service on the new channel without message loss (SAPI = 0 only); duplication of messages which may occur are treated on layer 3 (SAPI = 0 only).

The following list gives an overview of the primitives associated with the multiple frame acknowledged information transfer services (for detailed specification, see GMR-2 04.006 [5]):

a) Data transfer using I frames:

DL-DATA-REQUEST/INDICATION: The parameters associated with these primitives are the message unit and the type of channel being used.

1) The DL-DATA-REQUEST primitive is used to request that a message unit be sent using the procedures for multiframe acknowledged information transfer.

2) The DL-DATA-INDICATION primitive indicates the arrival of a message unit received by means of acknowledged information transfer.

b) Establishment of multiple frame operation using the SABM command:

DL-ESTABLISH-REQUEST/INDICATION/CONFIRM: These primitives are used to request, indicate and confirm the establishment of multiple frame operation between two data link layer entities. Possible parameters are the message unit, the establish mode and the type of channel being used.

c) Suspension of multiple frame operation:

DL-SUSPEND-REQUEST/CONFIRM: These primitives are used in a MES to request and confirm the suspension of multiple frame operation while changing a dedicated channel. A possible parameter is the type of channel to be affected.

d) Resumption of multiple frame operation:

DL-RESUME-REQUEST/CONFIRM: These primitives are used in a MES to request and confirm the resumption of multiple frame operation after it has been suspended (see paragraph c.) above). Possible parameters are the message unit and the type of channel to be affected.

e) Restoration of multiple frame operation (TBR-001):

DL-RECONNECT-REQUEST/CONFIRM: These primitives are used in a MES to request and confirm the restoration of multiple frame operation on the old channel after failure of the channel change. Possible parameters are the message unit and the type of channel to be affected.

f) Termination of multiple frame operation:

DL-RELEASE-REQUEST/INDICATION/CONFIRM: These primitives are used to request, indicate and confirm an attempt to terminate multiple frame operation between two data link layer entities or an attempt to perform local end release. The parameters associated with this primitive are the type of channel and the release mode.

6.2.6 Random Access Procedure

The primitives associated with random access are:

DL-RANDOM ACCESS-REQUEST/INDICATION/CONFIRM

1) The DL-RANDOM ACCESS-REQUEST primitive is used in the MES to request the transmission of a random access burst. The parameter associated with the REQUEST primitives is the random access message unit.

2) The DL-RANDOM ACCESS-INDICATION primitive is used in the network to indicate the arrival of a random access burst. The parameters associated with the INDICATION primitive are the random access message unit and the time slot in which the random access burst was received.

3) The DL- RANDOM ACCESS-CONFIRM primitive is used to notify layer 3 that the random access burst has been sent. The parameter associated with the CONFIRM primitive is a message unit containing the number of the time slot in which the random access burst was sent.

6.3 Services required from the physical layer

The services provided by the physical layer are described in detail in GMR-2 04.004 [4]. They are summarized in the following:

a) Physical layer connection for transparent transmission of frames. The bits of a frame are to be delivered to the peer data link entity in the same order in which they were submitted to the physical layer by the sender;

b) Indication of the physical status of the Dm channel;

c) Transmission of data link layer message units in the same order as they were issued by the data link layer;

d) Provision of frame synchronization;

e) Provision of error protection to ensure a low residual bit error rate at the data link layer;

f) Transmission (by MES) and reception (by network) of random access bursts.

The primitives between the data link layer and the physical layer are:

a) Data Transfer:

PH-DATA-REQUEST/INDICATION:
These primitives are used to request that a message unit be sent and to indicate the arrival of message unit. Parameters associated with these primitives are the data link layer message unit, the priority and the type of channel being used.

b) Random Access:

PH-RANDOM ACCESS-REQUEST/INDICATION/CONFIRM:
The REQUEST primitive is used to request (in the MES) that a random access frame be sent and the INDICATION primitive is used to indicate (in the network) the arrival of a random access frame. A parameter associated with these primitives is the random access message unit. The CONFIRM primitive is used (in the MES) to confirm in which time slot the random access burst was sent.

c) Connection Establishment:

PH-CONNECT-INDICATION:
This primitive indicates that a specific physical resource has been established on the physical layer. The parameter associated with this primitive is the type of channel.

NOTE: Activation of a physical resource is usually initiated by the layer 3 entity without involving data link layer entities using MPH primitives (see GMR-2 04.004 [4]).

d) Transmission Synchronization:

PH-READY-TO-SEND-INDICATION:
This primitive enables the data link layer to synchronize to the next instant of physical transmission. The parameter associated with this primitive is the type of channel.

PH-EMPTY-FRAME-REQUEST:
This primitive is used by the data link layer instead of the PH-DATA-REQUEST primitive when no frame has to be sent after receiving the PH-READY-TO-SEND indication. The parameter associated with this primitive is the type of channel.

6.4 Administrative services

6.4.1 General description of administrative services

The data link layer entity supports several internal functions of the MES or the network other than layer 3 peer-to-peer information transfer. These functions are:

a) Error reporting between the data link layer and the layer 3 entity;

b) Abnormal release of the data link layer in case of protocol or other failures from which the data link layer cannot recover on its own.

The administrative functions and the interactions between the data link layer and the layer 3 entities are described in terms of service primitives.

6.4.2 Definition of primitives for administrative services

The primitives between the layer 3 entity and the data link layer for supporting administrative services are:

a) Error handling

MDL-ERROR-INDICATION:
This primitive is used by the data link layer to indicate that there is an error in the data link layer procedures that cannot be resolved by normal exception handling procedures. Parameters associated with this primitive are the reason for error reporting and the type of channel.

b) Release:

MDL-RELEASE-REQUEST:
This primitive is used by the layer 3 entity to initiate abnormal local end release of a data link. Parameters associated with this primitive are indications of which data links are to be released and the reason for abnormal release.

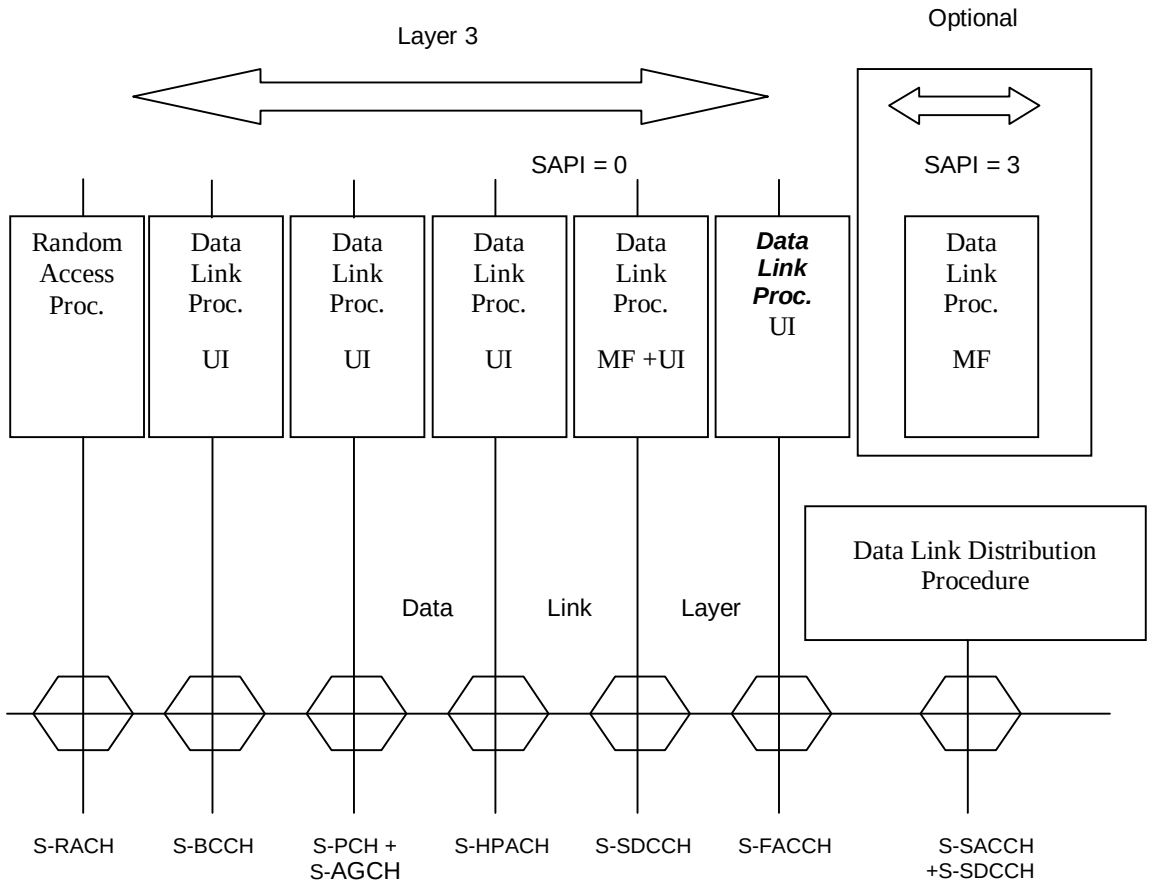
7 Overview of data link layer structure

7.1 Functional composition

Figure 7.1.1 is an example of a functional block diagram of the data link layer in the MES. In this example, the data link connection for all physical channels terminates at the SAP identified by SAPI = 0. Only the data link connection for an S- SACCH terminates at the SAP identified by SAPI = 3. Other arrangements are possible depending on the capabilities of the MES.

The network will contain a similar arrangement with one S-HPACH, (S-PCH + S-AGCH), S- SDCCH or S-SACCH, as required, for each active MES.

Figure 7.1.1 illustrates three procedural types: the data link procedure; the data link distribution procedure; and the random access procedure.



Note: UI = Unnumbered Information (Frame)
MF = Multi Frame

Figure 7.1.1: Example of the data link layer configuration in the MES

7.2 Identification of data link end points

The data link endpoints are identified by a Data Link Connection Identifier (DLCI).

The DLCI consists of two elements:

a) the Service Access Point Identifier (SAPI) which is carried in the address field of each frame;

b) the type of control channel associated with the data link connection. This information is not carried in frames between data link layer peer entities but is managed locally in each end system and is carried in primitives between the layers.

When a layer 3 message unit is to be sent, layer 3 will select the appropriate SAP and data link connection end point.

Layer 3 will indicate to the data link layer which data link connection end point has been chosen.

When receiving a frame containing a layer 3 message unit, the data link layer will receive from the physical layer an indication concerning the type of channel on which the frame was received. This information, together with the SAPI contained in the frame, enables the data link layer to deliver the layer 3 message unit to the required data fink connection end point of the indicated SAP.

The SAP takes a specific value for each of the following functions carried on the Dm channel:

a) Call control signaling, mobility management signaling, supplementary services signaling and radio resource management signaling information as defined in GMR-2 04.008 [7] and GSM 04.10 [8]: SAPI = 0;

b) Short message services (optional) as defined in GSM 04.11 [9]: SAPI = 3.

Other functions requiring specific SAPI values may be defined in the future.

7.3 Data link procedure

There is at most one instance of the data link layer procedure for each SAPI and channel type supported on that SAPI.

For some combinations of SAPI and channel type, only a subset (e.g., unacknowledged operation) of the overall data link layer procedure is required.

The procedure analyses the control field and the length indicator field of the received frame (see GMR-2 04.006 [5]) and provides appropriate peer-to-peer responses and layer-to-layer indications. In addition, it analyses the data link layer service primitives and transmits the appropriate peer-to-peer commands and responses.

The procedure also performs segmentation and concatenation of layer 3 message units.

7.4 Data link distribution procedure

This procedure is only required if there are more than one SAPI supported on a channel associated with a specific MES.

The procedure uses the address field of a received frame and the type of physical channel contained in the primitive received from the physical layer to distribute the frames to the appropriate data fink procedure block.

On frame transmission, the procedure delivers the frames to the required channel after layer 3 has established the respective association between the channel and its physical parameters. The procedure also provides for resolution of conflicts between the various data link procedure blocks on the same physical channel. The conflict resolution is based on the SAPI and the priority requested by layer 3 (see also note to clause 6.2.2).

7.5 Random access procedures

This procedure is used for data links on the random access channel (S-RACH). The procedure in the MES formats the random access frames and initiates transmission of them. The procedure in the network receives the random access frames and provides the appropriate indication to layer 3.

8 Specific requirements

8.1 Mode of operation and allowed SAPIs

The various types of channels shall support SAPIs and modes of operation as identified in table 8.1-1.

Table 8.1-1: Required data link layer information transfer modes

Type of channel	SAPI = 0	SAPI = 3
S-BCCH	Unacknowledged	Not supported
S-CCCH	Unacknowledged	Not supported
S- SDCCH	Unacknowledged and acknowledged	Acknowledged (optional)
S-SACCH (associated with S-SDCCH)	Unacknowledged	Not supported
S-SACCH (associated with S-TCH)	Unacknowledged	Acknowledged (optional)
S-FACCH	Unacknowledged and acknowledged	Not supported

8.2 Acknowledged mode of operation

8.2.1 Window size

The window size, k (see GMR-2 04.006 [5]), shall be:

a) for SAPI = 0, k = 1; (TBR-002);

b) for SAPI = 3, k = 1 (OPTIONAL).

Other SAPls, for further study.

8.2.2 Processing Capacity

The MES, GW and NCC shall provide sufficient processing capacity to avoid operating the data link layer entities (for SAPI = 0) in the receiver busy state (see GMR-2 04.006 [5]).

History

Document history		
V1.1.1	March 2001	Publication