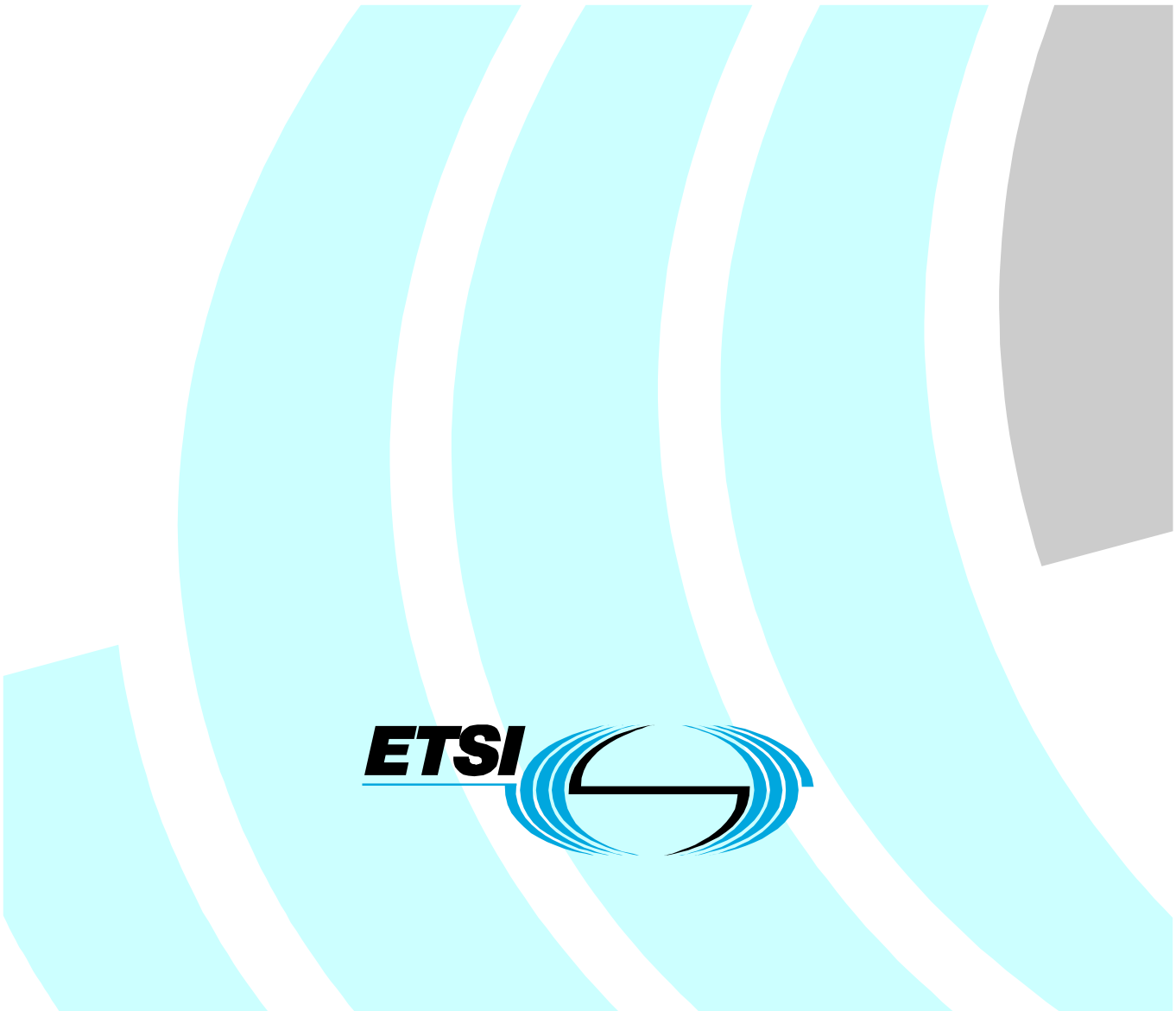
ETSI TS 101 376-4-4 V1.2.1 (2002-04)

Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 4: Radio interface protocol specifications;
Sub-part 4: Layer 1 General Requirements;
GMR-1 04.004



Reference
RTS/SES-001-04004R1

Keywords
GMR, MSS, MES, satellite, GSO, S-PCN, GSM, interface, layer 1, mobile, radio

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, send your comment to:
editor@etsi.fr

Copyright Notification

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

The attention of ETSI has been drawn to the Intellectual Property Rights (IPRs) listed below which are, or may be, or may become, Essential to the present document. The IPR owner has undertaken to grant irrevocable licences, on fair, reasonable and non-discriminatory terms and conditions under these IPRs pursuant to the ETSI IPR Policy. Further details pertaining to these IPRs can be obtained directly from the IPR owner.

The present IPR information has been submitted to ETSI and pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

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

IPR Owner: Digital Voice Systems Inc
One Van de Graaff Drive Burlington,
MA 01803
USA

Contact: John C. Hardwick
Tel.: +1 781 270 1030
Fax: +1 781 270 0166

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, equalizers	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

IPR Owner: Ericsson Mobile Communications (UK) Limited
The Keytech Centre, Ashwood Way
Basingstoke
Hampshire RG23 8BG
United Kingdom

Contact: John Watson
Tel.: +44 1256 864 821

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

IPR Owner: Hughes Network Systems
11717 Exploration Lane
Germantown, Maryland 20876
USA

Contact: John T. Whelan
Tel: +1 301 428 7172
Fax: +1 301 428 2802

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-Margin 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

IPR Owner: Lockheed Martin Global Telecommunications, Inc.
900 Forge Road
Norristown, PA. 19403
USA

Contact: R.F. Franciose
Tel.: +1 610 354 2535
Fax: +1 610 354 7244

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: "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 defines the service offered by the physical layer to the upper layers of the MES-GS interface in the GMR-1 Mobile Satellite System. Its main objective is to provide guidance for the interface between the GMR-1 Technical Specifications in the 05-series and the 04-series. It also specifies the format of signalling channels and the order of bit transmission.

As far as possible, the present document makes use of the layering principles of the Reference Model for Open System Interconnection (OSI) as contained in ITU-T Recommendations X.200 [9] and X.210 [10].

The present document is based on GSM 04.04 [8].

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 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".

[4] GMR-1 04.006 (ETSI TS 101 376-4-6): "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".

[5] 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".

[6] 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".

[7] 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".

[8] GSM 04.04 (ETSI ETS 300 553): "European digital cellular telecommunications system (Phase 2); Layer 1; General requirements, GSM 04.04".

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

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

3 Terminology and abbreviations

3.1 Terminology

For the purposes of the present document, in the context of the GMR-1 system, the terminology changes in annex A of GMR-1 01.004 [1] shall be applied when comparing GSM and GMR-1 functionality.

Also, the following terms and definitions are additionally used in present document:

- **Idle mode:** In this mode the MES is not allocated any dedicated physical channel.
- **Dedicated mode:** In this mode the MES is allocated a dedicated physical channel.
- **Physical block:** minimal unit which can be transferred by the physical layer

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

MES	Mobile earth station
GMR-1	GEO-Mobile Radio interface - family 1
GSS	Gateway station system

Also refer to GMR-1 01.004 [1].

4 Interfaces to the physical layer

Same as clause 2 of GSM 04.04 [8].

4.1 Interface to the data link layer

Same as clause 2.1 of GSM 04.04 [8].

4.2 Interface to radio resource management

Same as clause 2.2 of GSM 04.04 [8].

4.3 Interface to other functional units

Same as clause 2.3 of GSM 04.04 [8].

5 Service of the physical layer

Same as clause 3 of GSM 04.04 [8].

5.1 Service Access Point

In the Reference Model for Open System Interconnection, Service Access Points (SAPs) of a layer are defined as gates through which services are offered to an adjacent higher layer (see figure 5.1). Through a SAP the physical layer offers a service to the data link layer. The SAP is used both for the control of the service providing entity (in case this is the physical layer; commands related to the establishment and release of channels) and the transfer of data (in case of the physical layer; the transfer of bits). The physical layer service access points defined in the present document differ from the OSI physical layer Service Access Points; the layer 3 RR-management instead of the data link layer controls the SAPs (establishment and release of channels).

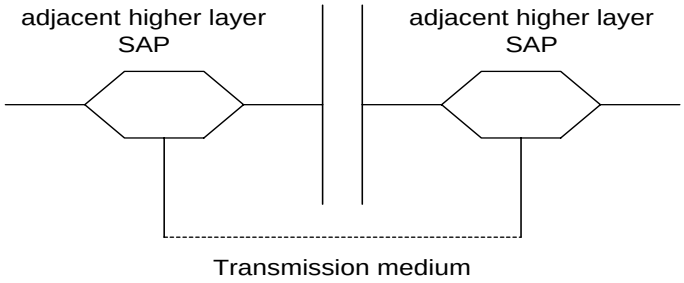


Figure 5.1: Service Access Point principle

On the physical layer of the GMR-1 system a SAP is defined between the physical layer and the data link layer for each control channel (see figure 5.2). The characteristics of SAPs (channels) are listed in GMR-1 04.003 [3].

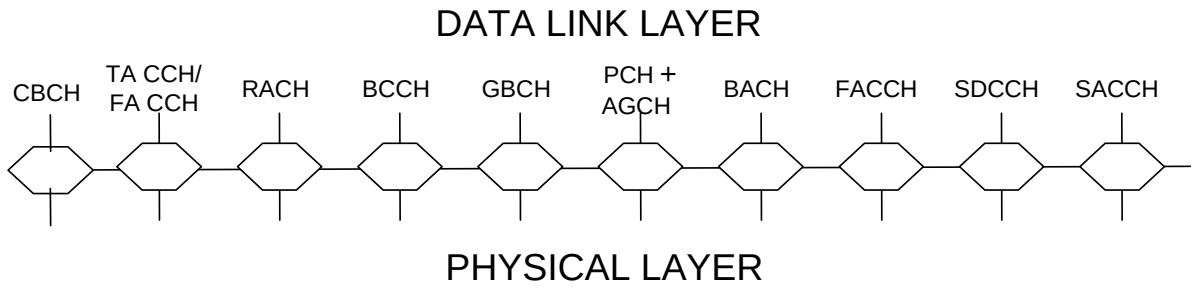


Figure 5.2: SAPs between the physical layer and the data link layer in the MES

5.2 Service of the physical layer

- Access capabilities:

The physical layer offers a transmission service on a limited set of logical channels. The GS and MES access capabilities and the characteristics of logical channels (SAPs) are defined in GMR-1 04.003 [3].

Logical channels are multiplexed on physical channels. Physical channels are the units scheduled on the radio medium. Some are reserved by the network for common use (a combination of CCCH and BCCH), others are assigned to connections with MESs (dedicated physical channels). In time the combination of logical channels used on an assigned dedicated physical channel may change. Allowed combinations of logical channels on a dedicated physical channel are defined in GMR-1 04.003 [3]. Data on SAPs of control channels is either multiplexed with another channel or exchanged in discrete block sizes. Synchronization between layer 1 and layer 2 is provided for piggy-backing of RR (receive ready) frames, and the starting of timers (T200). See also GMR-1 04.006 [4].

- Error detection:

Same as "Error Detection" described in clause 3.2 of GSM 04.04 [8].

- Encryption:

Same as "Encryption" described in clause 3.2 of GSM 04.04 [8].

5.2.1 Specific services of the physical layer in the MES

The access capability service of the physical layer in the MES is different for dedicated physical channels than for BCCH/CCCHs;

- Establishment of dedicated physical channels:

The radio resource management of layer 3 (GMR-1 04.008 [5]) controls the establishment of dedicated physical channels on the physical layer.

- Spot beam selection in idle mode:

In idle mode the physical layer selects the best spot beam with its BCCH/CCCH in close co-operation with layer 3. Examples of procedures for spot beam selection are described in GMR-1 05.008 [7].

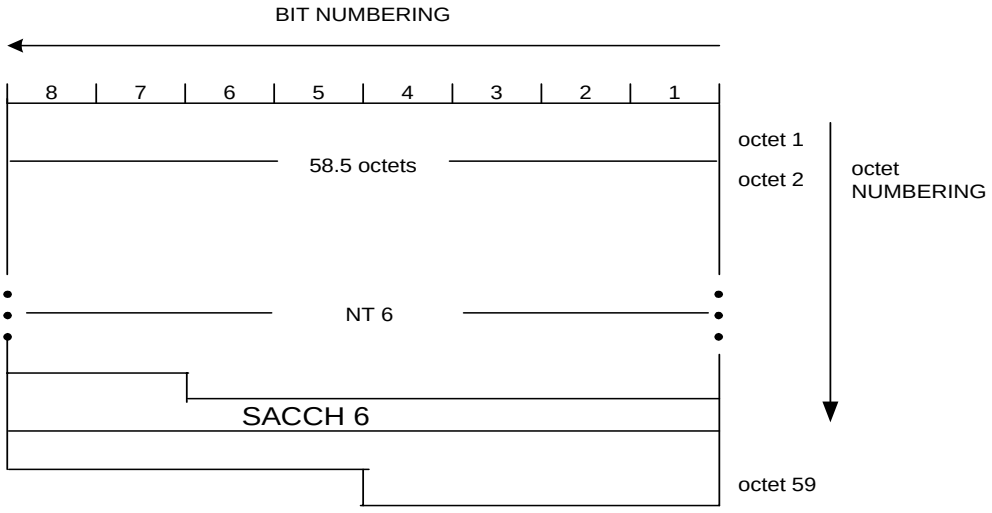
6 Block transmission

6.1 SACCH3 block format

SACCH3 frames are transmitted on TCH3 during periods of voice inactivity, provided no FACCH3 frames are awaiting transmission. The block format of SACCH3, therefore, is identical to that of FACCH3. See clause 6.9 for detail.

6.2 SACCH6 block format

The TCH6 channel is combined with SACCH and multiplexed as described in clause 5.1 of GMR-1 05.003 [6]. Then, the output of multiplexing unit is encrypted as described in clause 6 of GMR-1 05.003 [6]. A 58,5 octets of NT6 block contains 10 bits of SACCH6 message in the following way.

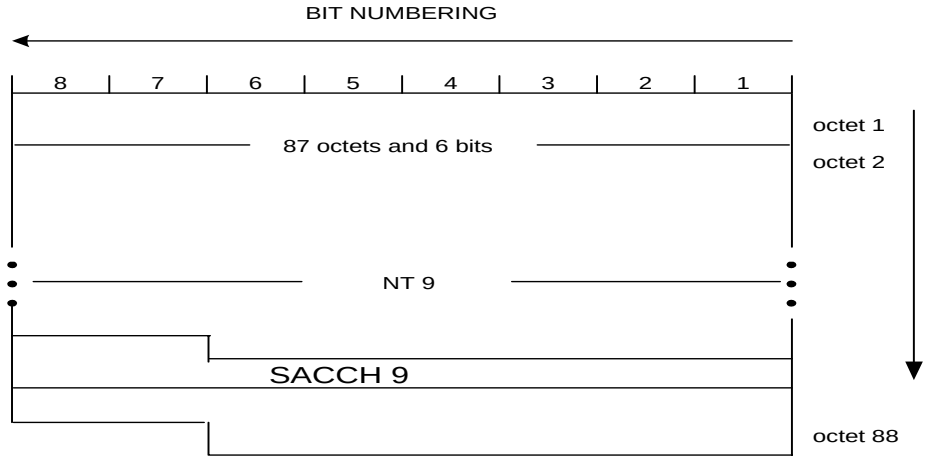


NOTE: The numbering convention specified in GMR-1 04.006 [4] applies.

Figure 6.1: SACCH6 block format

6.3 SACCH9 block format

The TCH9 channel is combined with SACCH and multiplexed as described in clause 5.1 of GMR-1 05.003 [6]. Then, the output of multiplexing unit is encrypted as described in clause 6 of GMR-1 05.003 [6]. A 702 bits of NT9 block contains 10 bits of SACCH9 message in the following way.



NOTE: The numbering convention specified in GMR-1 04.006 [4] applies.

Figure 6.2: SACCH9 block format

6.4 BCCH/PCH/AGCH/CBCH block format

The originally 24 octets blocks are used in the following way.

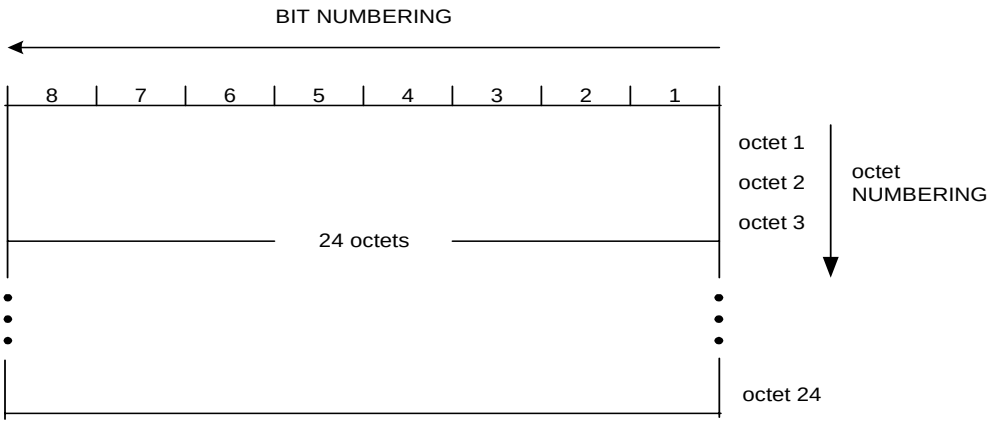


Figure 6.3: BCCH/PCH/AGCH/CBCH block format

6.5 BACH block format

The originally 4,5 octets blocks are used in the following way.

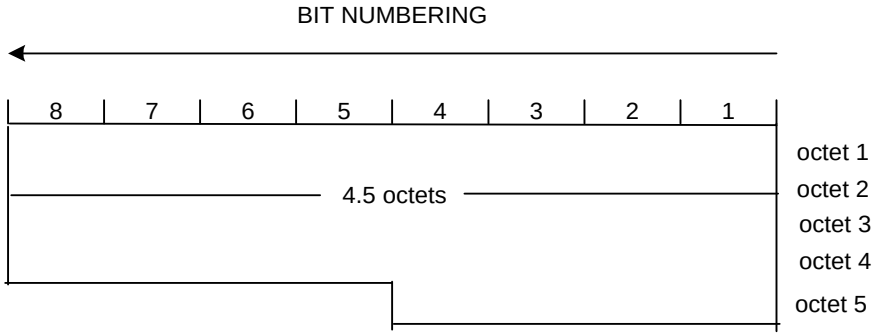


Figure 6.4: BACH block format

6.6 GBCH block format

The originally 13,5 octets blocks are used in the following way.

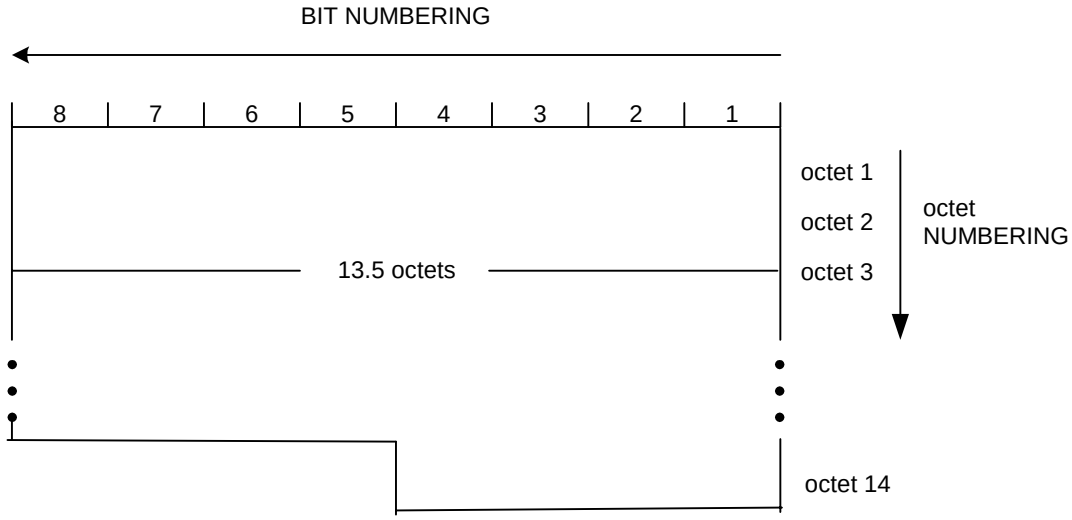


Figure 6.5: GBCH block format

6.7 RACH block format

There are two classes of RACH message as follows:

(a) Class 1:

The originally 2 octets blocks are used in the following way.

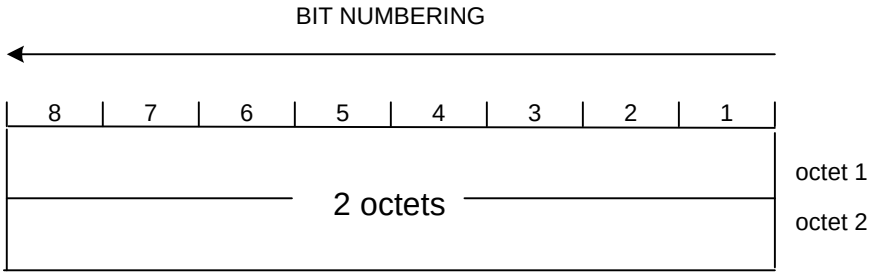


Figure 6.6: RACH class 1 block format

(b) Class 2:

The originally 15 octets and 3 bits blocks are used in the following way.

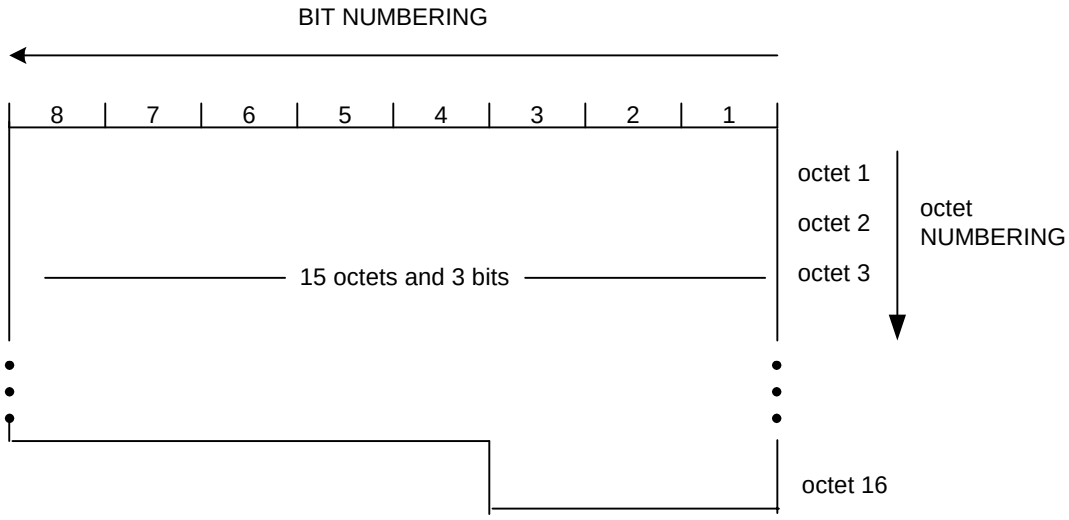


Figure 6.7: RACH class 2 block format

6.8 SDCCH block format

The originally 10,5 octets blocks are used in the following way.

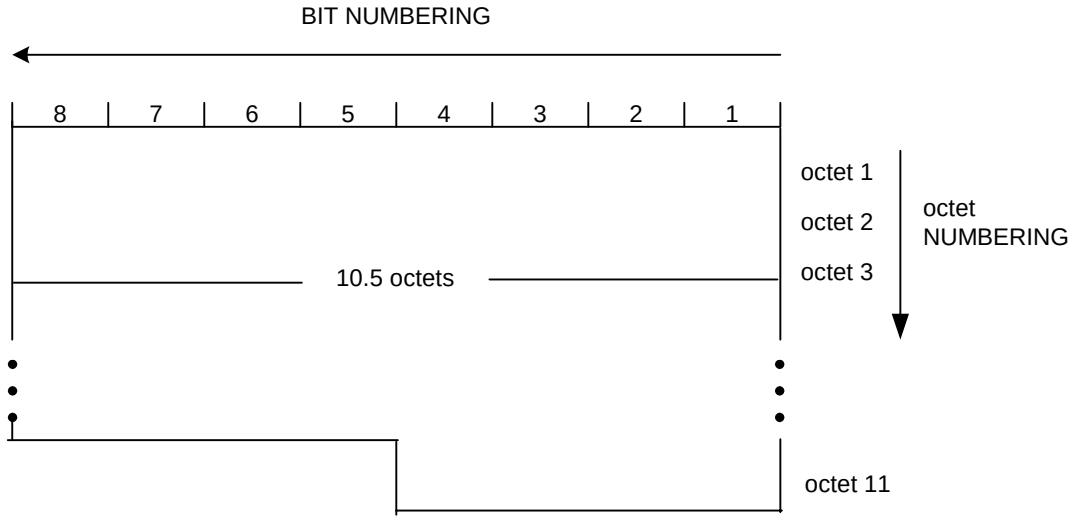


Figure 6.8: SDCCH block format

6.9 FACCH3 block format

The originally 9,5 octets blocks are used in the following way.

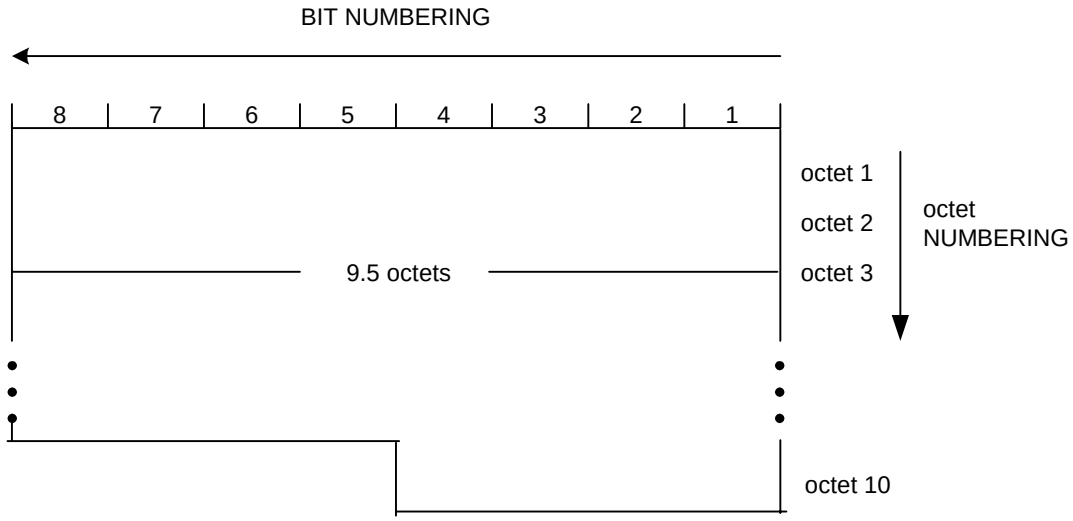


Figure 6.9: FACCH3 block format

6.10 FACCH6 block format

The originally 23,5 octets blocks are used in the following way.

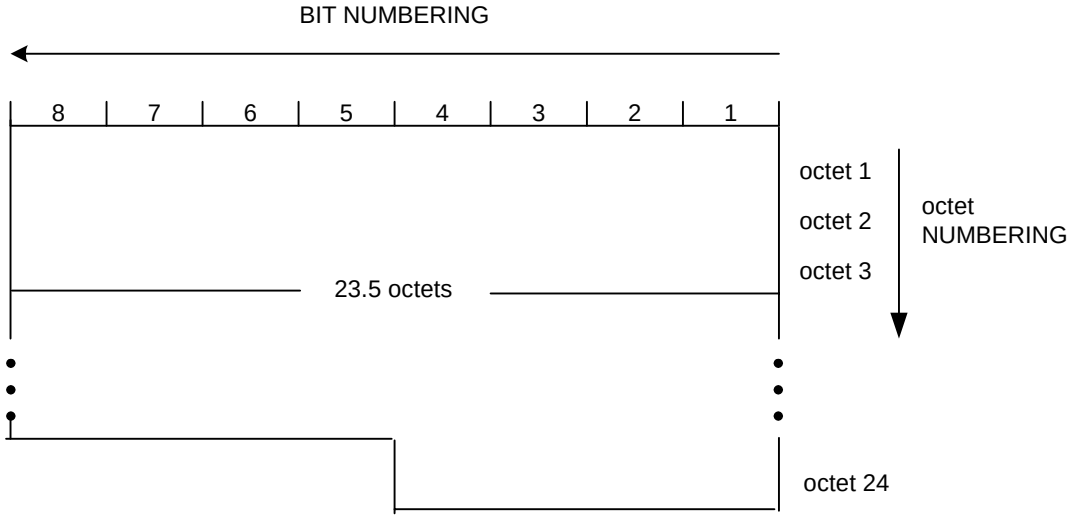


Figure 6.10: FACCH6 block format

6.11 FACCH9 block format

The originally 37,5 octets blocks are used in the following way.

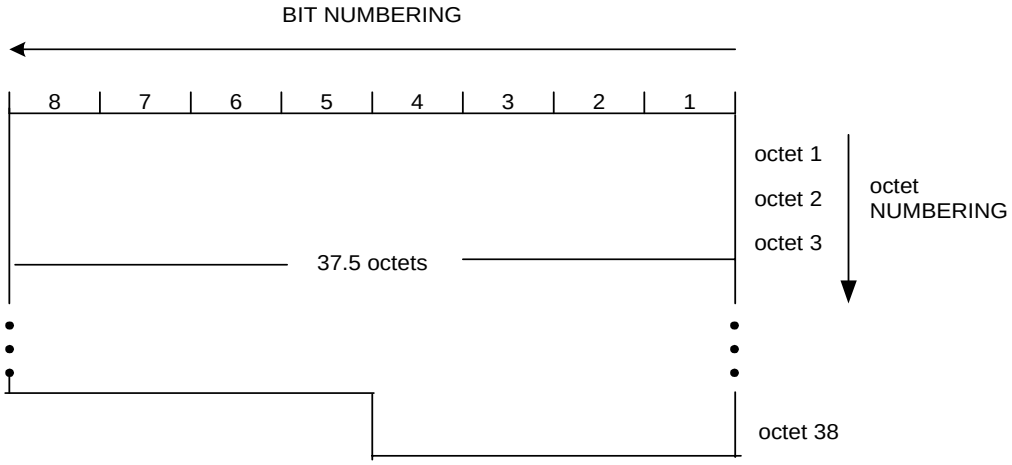


Figure 6.11: FACCH9 block format

6.12 TACCH block format

Each TACCH burst contains a 1-octet PHY header and DL message. The physical header is made up of a 4-bit temporary terminal identifier (TTID), 2 reserved bits, and 2-bit message type field. Detailed description for TTID and reserved bits are in GMR-1 04.006 [4]. The message type field shall indicate to the physical layer how to parse the TACCH message. The value and interpretation of the message type field are shown in table 6.1.

Table 6.1: Physical Header Interpretation

bit (7)	bit (8)	interpretation
0	0	Header followed by null message (physical layer to discard)
0	1	Header followed by a 3-octet DL message and then another physical header
1	0	Header followed by one DL message
1	1	Reserved

If the value of the message type field is "01", the 4 octets of TACCH block is shown as:

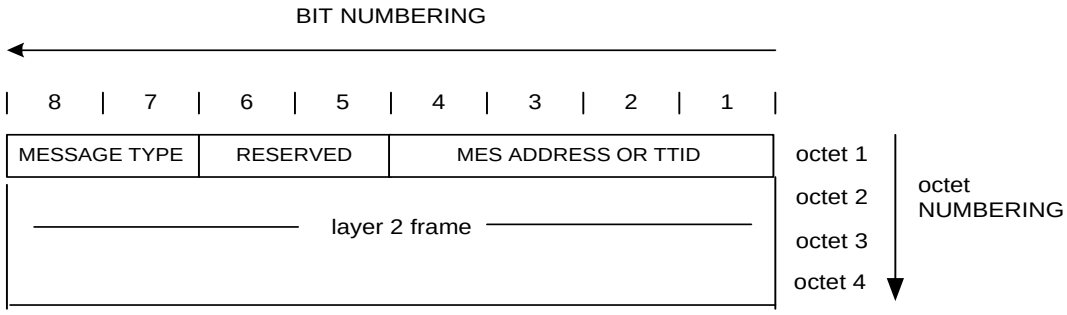


Figure 6.12: TACCH block format when the message type field indicates "01"

If the value of the message type field is "10", the 13,5 octets TACCH block is shown as:

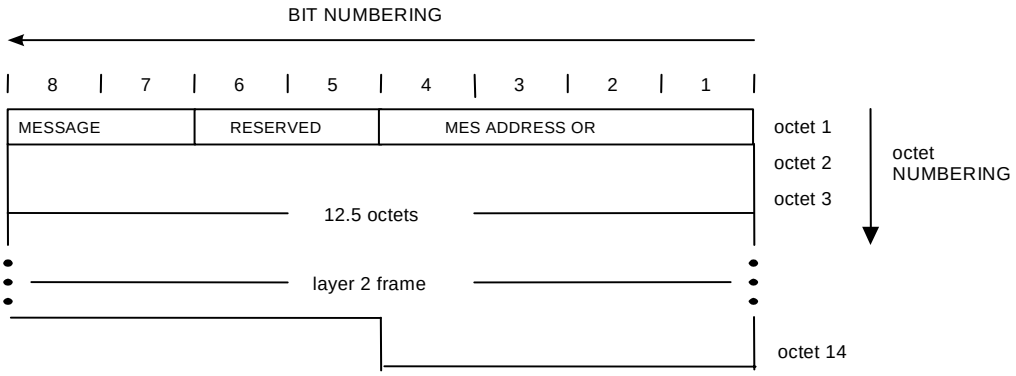


Figure 6.13: TACCH block format when the message type field indicates "10"

6.13 Order of bit transmission

The following rule apply for order of bit transmission:

- Bit m of octet n shall be transmitted as bit d ((n-1) × 8 + m-1) with m = (1..x) and n = (1..y) where x and y are given by the definition of the respective layer 3 information in GMR-1 04.008 [5].

7 Power Control Status Field

Power control status field (12 bits) consists of PAR and PAN values. PAR and PAN are 6 bit integer values with the range from 0 to 63. See GMR-1 05.008 [7] for the interpretation of PAR and PAN values.

The 12-bit field is encoded into 24 bits using a systematic Golay (24,12) code. For the traffic channels, the encoded 24 bits are transmitted over a duration of 6 bursts. Each burst contains 4-bit power control status field.
See GMR-1 05.003 [6] for details.

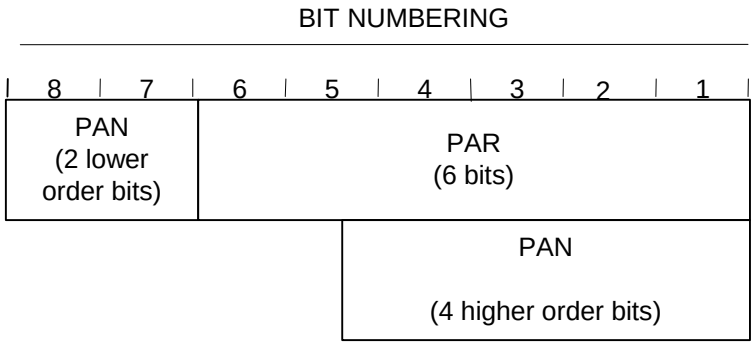


Figure 7.1: Power Control Status Field

History

Document history		
V1.1.1	March 2001	Publication
V1.2.1	April 2002	Publication