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GEO-Mobile Radio Interface Specifications (Release 3);
Third Generation Satellite Packet Radio Service;
Part 5: Radio interface physical layer specifications;
Sub-part 1: Physical Layer on the Radio Path:
General Description;
GMR-1 3G 45.001

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Contents

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Foreword

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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 3.m.n

where:

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- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 5, sub-part 1 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service, as identified below:

Part 1: "General specifications":

Part 2: "Service specifications";

Part 3: "Network specifications";

Part 4: "Radio interface protocol specifications";

Part 5: "Radio interface physical layer specifications";

Sub-part 1: "Physical Layer on the Radio Path: General Description; GMR-1 3G 45.001";

Sub-part 2: "Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 3G 45.002";

Sub-part 3: "Channel Coding; GMR-1 3G 45.003";

Sub-part 4: "Modulation; GMR-1 3G 45.004";

Sub-part 5: "Radio Transmission and Reception; GMR-1 3G 45.005";

Sub-part 6: "Radio Subsystem Link Control; GMR-1 3G 45.008";

Sub-part 7: "Radio Subsystem Synchronization; GMR-1 3G 45.010";

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.

The present document is part of the GMR Release 3 specifications. Release 3 specifications are identified in the title and can also be identified by the version number:

- Release 1 specifications have a GMR 1 prefix in the title and a version number starting with "1" (V1.x.x).
- Release 2 specifications have a GMPRS 1 prefix in the title and a version number starting with "2" (V2.x.x).
- Release 3 specifications have a GMR-1 3G prefix in the title and a version number starting with "3" (V3.x.x).

The GMR release 1 specifications introduce the GEO-Mobile Radio interface specifications for circuit mode Mobile Satellite Services (MSS) utilizing geostationary satellite(s). GMR release 1 is derived from the terrestrial digital cellular standard GSM (phase 2) and it supports access to GSM core networks.

The GMR release 2 specifications add packet mode services to GMR release 1. The GMR release 2 specifications introduce the GEO-Mobile Packet Radio Service (GMPRS). GMPRS is derived from the terrestrial digital cellular standard GPRS (included in GSM Phase 2+) and it supports access to GSM/GPRS core networks.

The GMR release 3 specifications evolve packet mode services of GMR release 2 to 3rd generation UMTS compatible services. The GMR release 3 specifications introduce the GEO-Mobile Radio Third Generation (GMR-1 3G) service. Where applicable, GMR-1 3G is derived from the terrestrial digital cellular standard 3GPP and it supports access to 3GPP core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM or 3GPP standard are necessary. Some GSM and 3GPP specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM and 3GPP specifications do not apply, while some GMR specifications have no corresponding GSM or 3GPP specification.

Since GMR is derived from GSM and 3GPP, the organization of the GMR specifications closely follows that of GSM or 3GPP as appropriate. The GMR numbers have been designed to correspond to the GSM and 3GPP numbering system. All GMR specifications are allocated a unique GMR number. This GMR number has a different prefix for Release 2 and Release 3 specifications as follows:

- Release 1: GMR-n xx.zyy
- Release 2: GMPRS-n xx.zyy
- Release 3: GMR-1 3G xx.zyy

where:

- xx.0yy (z = 0) is used for GMR specifications that have a corresponding GSM or 3GPP specification. In this case, the numbers xx and yy correspond to the GSM or 3GPP numbering scheme.
- xx.2yy (z = 2) is used for GMR specifications that do not correspond to a GSM or 3GPP specification. In this case, only the number xx corresponds to the GSM or 3GPP 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 and 3GPP specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM or 3GPP specification (if any). This precedence rule applies to any references in the corresponding GSM or 3GPP specifications.

NOTE: Any references to GSM or 3GPP 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 or 3GPP specification.

- If a GMR specification does not exist, the corresponding GSM or 3GPP specification may or may not apply. The applicability of the GSM and 3GPP specifications is defined in TS 101 376-1-2 [2].

1 Scope

The present document is an introduction to the 05 series of technical specifications for the GMR-1 3G Mobile Satellite System. It is not of a mandatory nature, but consists of a general description of the organization of the physical layer with reference to the technical specifications where each part is specified in detail. It introduces furthermore, the reference configuration that will be used throughout this series of technical specifications. Finally, the present document introduces several characteristics of the mobile satellite operating environment, and summarizes several important properties of the physical layer that are developed in detail within the rest of the 45 series.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest release and the latest version of that document up to and including Release 7.

In the case of a reference to a GMR-1 3G document, a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] ETSI TS 101 376-1-1: "GEO-Mobile Radio Interface Specifications (Release 2) General Packet Radio Service; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMPRS-1 01.004".

NOTE: This is a reference to a GMR-1 Release 2 specification. See the introduction for more details.

[2] ETSI TS 101 376-1-2: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 family; GMR-1 3G 41.201".

[3] ETSI TS 101 376-5-2: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 2: Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 3G 45.002".

[4] ETSI TS 101 376-5-3: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-1 3G 45.003".

[5] ETSI TS 101 376-5-4: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 4: Modulation; GMR-1 3G 45.004".

[6] ETSI TS 101 376-5-5: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMR-1 3G 45.005".

[7] ETSI TS 101 376-5-6: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 3G 45.008".

[8] ETSI TS 101 376-5-7: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 7: Radio Subsystem Synchronization; GMR-1 3G 45.010".

[9] 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".

NOTE: This is a reference to a GMR-1 Release 1 specification. See the introduction for more details.

[10] Void.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 101 376-1-2 [2] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TS 101 376-1-1 [1].

4 Reference configuration

For the purpose of elaborating on the physical layer specification, a reference configuration of the transmission chain is used, as shown in annex A. This reference configuration also indicates which parts are dealt with in detail and in which technical specification these details occur. It shall be noted that only the transmission part is specified, the receiver being specified only via the overall performance requirements. With reference to this configuration, the technical specifications in the 45 series address the following functional units:

- TS 101 376-5-2 [3]: "Multiplexing and Multiple Access; Stage 2 Service Description";
- TS 101 376-5-3 [4]: "Channel Coding";
- TS 101 376-5-4 [5]: "Modulation";
- TS 101 376-5-5 [6]: "Radio Transmission and Reception";
- TS 101 376-5-6 [7]: "Radio Subsystem Link Control";
- TS 101 376-5-7 [8]: "Radio Subsystem Synchronization".

5 Channel description

5.1 Physical channels

5.1.1 Frequency bands, duplex method and carrier spacing

MESs operate in frequency division multiplexing (FDM) mode at L-band in two paired 34 MHz frequency bands, which are allocated world-wide for land mobile satellite service (LMSS). The frequency bands are:

- MES receives: 1 525,0 MHz to 1 559,0 MHz;
- MES transmits: 1 626,5 MHz to 1 660,5 MHz.

In the FDM scheme, L-band downlink (forward) radio frequency (RF) carriers in the satellite-to-MES direction are paired with L-band uplink (return) RF carriers in the MES-to-satellite direction at a frequency offset of 101,5 MHz for circuit switched operation.

MESs operate at S-band frequencies, which are allocated world-wide for land mobile satellite service (LMSS). The combined frequency bands are:

- MES receives (Space-to-Earth): 2 170,0 MHz to 2 200,0 MHz;
- MES transmits (Earth-to-Space): 1 980,0 MHz to 2 020,0 MHz

MESs operate in a subset of these combined S-band frequencies as appropriate for the region of operation.

NOTE 1: In North America, current S-Band frequency allocations are the following subset of the combined frequency bands: space-to-Earth: 2 180 to 2 200 MHz; Earth-to-space: 2 000 to 2 020 MHz.

NOTE 2: In Europe, current S-Band frequency allocations are the following subset of the combined frequency bands: space-to-Earth: 2 170 to 2 200 MHz; Earth-to-space; 1 980 to 2 010 MHz.

For packet switched operation, the FDM scheme may be operated in full duplex with any downlink (forward) RF carrier used with any uplink (return) RF carrier without necessarily having a fixed frequency offset between the two carriers.

The 34 MHz of L-band operating band is divided into 1 087 paired carriers, with carrier spacing of 31,250 kHz.

The 40 MHz of S-band spectrum in Earth-to-Space direction is divided into 1 280 carriers with carrier spacing of 31,250 kHz. The 30 MHz of S-Band spectrum in Space-to-Earth direction is divided into 960 carriers with carrier spacing of 31,250 kHz.

5.1.2 Multiple access and timeslot structure

The GMR-1 satellite system is a Time Division Multiple Access (TDMA) system. Timing configuration in the system is composed of hyperframe, superframe, multiframe, frame, and timeslot.

- **Hyperframe**: 3 hours 28 minutes 53 seconds 760 msec in duration, including 4 896 superframes, 19 584 multiframes or 313 344 TDMA frames.
- **Superframe**: 2,56 seconds in duration, including four multiframes or 64 TDMA frames.
- **Multiframe**: 640 msec in duration, including 16 TDMA frames.
- **Frame**: 40 msec in duration, including 24 timeslots.
- **Timeslot**: approximately 1,67 msec (5/3 msec) in duration, including 78 bits.

The complete timeframe structure is given in figure 5.1.

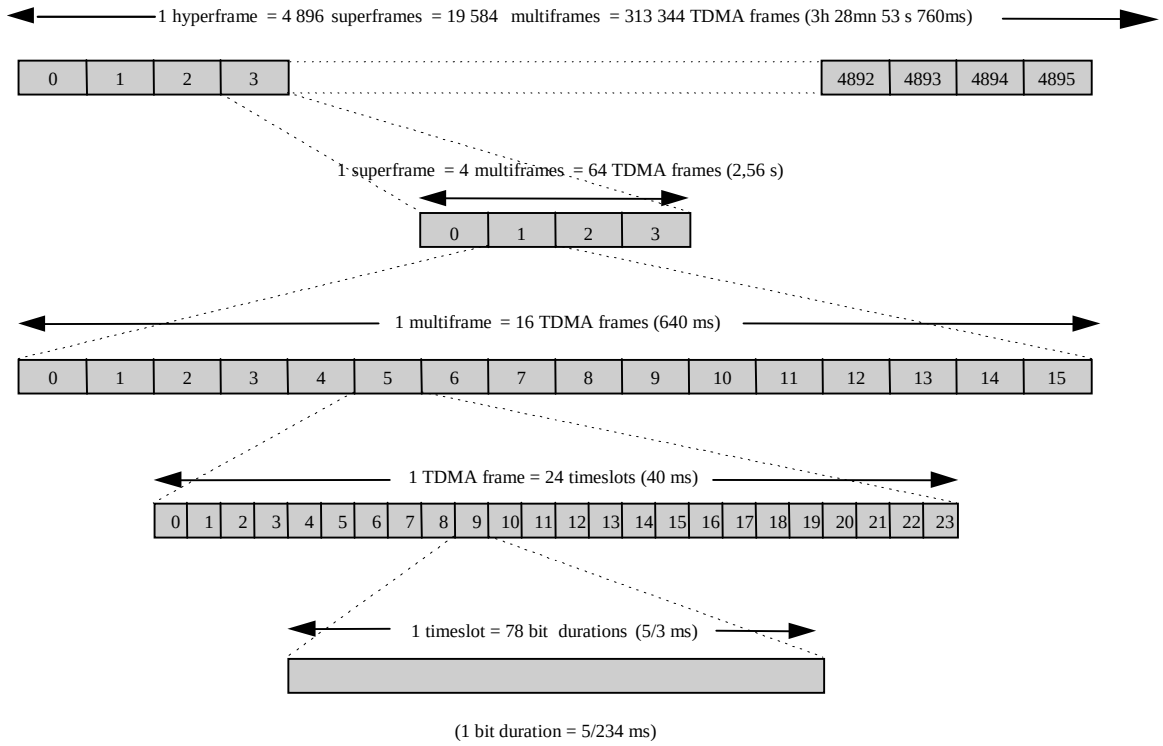

Figure 5.1: Timeframe and timeslot structure

5.2 Logical channels

The logical channels associated with the GMR-1 system may either be a Traffic Channel (TCH) or a control channel. For details, refer to TS 101 376-5-2 [3].

5.2.1 Traffic channels

5.2.1.1 A/Gb mode traffic channels

TCHs are intended to carry encoded speech or user data. These are all bidirectional channels.

- TCH3: This channel carries normal speech and has a gross information rate of 5,2 kbps, it takes 3 contiguous timeslots.
- TCH6: This channel carries 2,4 kbps and 4,8 kbps user data and has a gross transmission rate of 10,75 kbps, it takes 6 contiguous timeslots.
- TCH9: This channel carries 2,4 kbps, 4,8 kbps, and 9,6 kbps user data and has a gross transmission rate of 16,45 kbps, it takes 9 contiguous timeslots.

PDTCHs are used to carry packet data traffic.

- PDTCH and PDTCH2: Different PDTCHs are defined by the suffix (m,n) where m indicates the bandwidth of the physical channel in which the PDTCH is mapped, m × 31,25 kHz, and n defines the number of timeslots allocated to this physical channel. Table 5.2 in TS 101 376-5-2 [3] summarises the different types of PDTCH.

5.2.1.2 Iu mode traffic channels

- PDTCH3: PDTCH3s are used to carry packet data traffic. Different PDTCH3s are defined by the suffix (m,n) where m indicates the bandwidth of the physical channel in which the PDTCH3 is mapped, m × 31,25 kHz, and n defines the number of timeslots allocated to this physical channel. Table 5.3 in TS 101 376-5-2 [3] summarizes different types of packet traffic data channels, PDTCH3(m, 3), (m = 1, 5 and 10), where the burst duration is 5 ms, PDTCH3(m, 6), (m = 1, 2), where the burst duration is 10 ms, and PDTCH3(m, 12), (m = 5), where the burst duration is 20 ms.

- DTCH: A Dedicated Traffic Channel (DTCH) is used to carry user traffic when a dedicated channel (DCH) is allocated to the terminal in packet dedicated mode. A DTCH is unidirectional. DTCH/U is used for the uplink and a DTCH/D is used for the downlink. A DTCH may support either 2,45 kbps or 4,0 kbps encoded speech.

5.2.2 Control channels

5.2.2.1 A/Gb mode control channels

The control channels are intended to carry signalling or synchronization data. There are three different categories of control channels:

a) Broadcast channel: this is a downlink (forward) only channel and consists of the following:

   1) Frequency Correction Channel (FCCH) is used by the MES for system synchronization and for frequency correction of the MES.

   2) GPS Broadcast Control Channel (GBCH) carries Global Positioning System (GPS) time information and GPS satellite ephemeris information.

   3) Broadcast Control Channel (BCCH) is used to broadcast system information and informs the MESs about the system timing.

   4) Cell Broadcast Channel (CBCH) is used to broadcast Short Message Service (SMS) cell broadcast information to the MESs on a spot beam basis. This channel is allocated on demand basis. To achieve the best resource efficiency, the same physical channel can be shared by CBCH and SDCCH in a spotbeam.

b) Common Control Channel (CCCH): This consists of the following:

   1) Paging Channel (PCH) is a downlink only channel and used to page MESs.

   2) Random Access Channel (RACH) is an uplink-only channel and is used to request a channel (SDCCH (Standalone Dedicated Control Channel) or TCH) allocation.

   3) Access Grant Channel (AGCH) is a downlink-only channel used to allocate a standalone SDCCH or TCH.

   4) Basic Alerting Channel (BACH) is a downlink-only channel and used to alert MESs. It is transmitted with higher link margin than the normal Paging Channel. When the user is in a disadvantaged position and the downlink signal is heavily shadowed, the BACH channel is used to page the user after several unsuccessful paging attempts through the PCH.

   5) Common Idle Channel (CICH) is a downlink-only channel and used by the MESs for calibration measurements. During a beam selection process, the MES may decide the optimized beam based on the power difference measured from BCCH and CICH channels. For details of the CICH channel requirement, see TS 101 376-5-5 [6].

c) Dedicated Control Channel (DCCH): This is a channel resource that is dedicated for MES. They are all bidirectional except for the TACCH, which is downlink only. The SACCH3 channel is a logical channel with the same physical burst structure as the FACCH3. The multiplexing of the FACCH3 and SACCH3 with the TCH3 is described in TS 101 376-4-6 [9].

d) Slow TCH6-Associated Control Channel (SACCH6):

   1) Slow TCH9-Associated Control Channel (SACCH9);

2) Fast TCH3-Associated Control Channel (FACCH3);

3) Fast TCH6-Associated Control Channel (FACCH6);

4) Fast TCH9 Associated Control Channel (FACCH9);

5) Standalone Dedicated Control Channel (SDCCH);

6) Terminal-to-Terminal (TtT) Associated Control Channel (TACCH) can be shared among a subset of TtT calls and is not necessarily dedicated to a single TtT call;

7) Power control subchannel. The information bits of the power control subchannel are multiplexed into 6 consecutive bursts during TCH3/6/9 calls, so that a constant power control information throughput can be maintained during the call.

e) Packet Common Control Channels (PCCCH):

1) Packet Random Access Channel (PRACH): Uplink only, used to request allocation of one or several PDTCHs (for uplink or downlink direction).

2) Packet Access Grant Channel (PAGCH): Downlink only, used to allocate one or several PDTCHs.

f) Packet dedicated control channels:

1) The Packet Associated Control Channel (PACCH): The PACCH is bidirectional. For description purposes PACCH/U is used for the uplink and PACCH/D for the downlink.

2) Packet Timing Advance Control Channel Uplink (PTCCH/U): Used to transmit packet normal bursts to allow estimation of the timing advance for one MES in packet transfer mode.

3) Packet Timing Advance Control Channel Downlink (PTCCH/D): Used to transmit timing advance updates for several MESs. One PTCCH/D is paired with several PTCCH/Us.

4) Dedicated Associated Control Channel (DACCH): The DACCH is unidirectional. For description purposes DACCH/U is used for the uplink and DACCH/D is used for the downlink. The DACCH is used to transmit dedicated associated control signalling when a terminal is allocated a DCH.

5.2.2.2 Iu mode control channels

The control channels are intended to carry signalling or synchronization data. There are four different categories of control channels:

a) Broadcast channel: this is a downlink (forward) only channel and consists of the following:

1) Frequency Correction Channel (FCCH3) is used by the MES for system synchronization and for frequency correction of the MES. In Iu mode, FCCH3 burst defined in TS 101 376-5-2 [3] is used.

2) Broadcast Control Channel (BCCH) is used to broadcast system information and informs the MESs about the system timing. In Iu mode, BCCH is transmitted using DC12 burst defined in TS 101 376-5-2 [3].

3) Cell Broadcast Channel (CBCH) is used to broadcast software/firmware upgrade notifications and network alerts to the MESs on a spot beam basis. This channel is allocated on demand basis.

b) Common Control Channel (CCCH): This consists of the following:

1) Paging Channel (PCH) is a downlink only channel and used to page MESs.

2) Random Access Channel (RACH) is an uplink-only channel and is used to request a channel (SDCCH (Standalone Dedicated Control Channel) or TCH) allocation.

3) Access Grant Channel (AGCH) is a downlink-only channel used to allocate a standalone SDCCH or TCH.

4) Basic Alerting Channel (BACH) is a downlink-only channel and used to alert MESs. It is transmitted with higher link margin than the normal Paging Channel. When the user is in a disadvantaged position and the downlink signal is heavily shadowed, the BACH channel is used to page the user after several unsuccessful paging attempts through the PCH. In Iu mode, BACH channel uses the BACH3 burst defined in TS 101 376-5-2 [3].

c) Packet Common Control Channels (PCCCH):

1) Packet Random Access Channel (PRACH): Uplink only, used to request allocation of one or several PDTCHs (for uplink or downlink direction).

2) Packet Access Grant Channel (PAGCH): Downlink only, used to allocate one or several PDTCHs.

d) Packet Associated Control Channel (PACCH): This is a shared channel resource is used to carry MAC/RLC control messages. DACCH operates on the PDCH physical channel.

e) Dedicated Associated Control Channel (DACCH): This is a channel resource that is dedicated for MES. DACCH operates on the DCH physical channel.

6 Coding and interleaving

6.1 A/Gb mode

Coding and interleaving for A/Gb mode are described in TS 101 376-5-3 [4].

6.2 Iu mode

Coding and interleaving for Iu mode are described in TS 101 376-5-3 [4].

7 Modulation

7.1 A/Gb mode

Modulation schemes for A/Gb mode is described in TS 101 376-5-4 [5].

7.2 Iu mode

Modulation schemes for Iu mode is described in TS 101 376-5-4 [5].

8 Transmission and reception

8.1 A/Gb mode

Radio Transmission and Reception for A/Gb mode is described in TS 101 376-5-5 [6].

8.2 Iu mode

Radio Transmission and Reception for Iu mode is described in TS 101 376-5-5 [6].

9 Link control

9.1 A/Gb Mode

Radio link control, Idle mode behavior and Radio Link measurements for A/Gb mode are described in TS 101 376-5-6 [7].

9.2 Iu Mode

Radio link control, Idle mode behavior and Radio Link measurements for Iu mode are described in TS 101 376-5-6 [7]

10 Synchronization

Synchronization in the GMR-1 system has three different aspects: timing synchronization, frequency synchronization, and message synchronization. See TS 101 376-5-7 [8] for details.

10.1 A/Gb mode

Synchronization aspects for A/Gb mode is described in TS 101 376-5-7 [8].

10.2 Iu mode

Synchronization aspects for Iu mode is described in TS 101 376-5-7 [8].

Annex A (informative): Bibliography

ETSI ETS 300 573 (V4.6.0): "Digital cellular telecommunications system (Phase 2) (GSM); Physical layer on the radio path; General description (GSM 05.01)".

History

Document history		
V3.3.1	December 2012	Publication