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Technical Specification

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

Reference

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Foreword

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The present document is part 5, sub-part 5 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";

Sub-part 2: "Multiplexing and Multiple Access; Stage 2 Service Description";

Sub-part 3: "Channel Coding";

Sub-part 4: "Modulation";

Sub-part 5: "Radio Transmission and Reception";

Sub-part 6: "Radio Subsystem Link Control";

Sub-part 7: "Radio Subsystem Synchronization";

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 GMR 1 3G 41.201 [6].

1 Scope

The present document defines the performance requirements for the Mobile Earth Station (MES) radio transceiver for the GMR-1 3G Mobile Satellite System.

Requirements are defined for two categories of parameters:

- Those that are required to provide compatibility among the radio channels, connected either to separate or common antennas, which are used in the system. This category also includes parameters providing compatibility with existing systems in the same or adjacent frequency bands.
- Those that define the transmission quality of the system.

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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 indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] GMPRS-1 01.004 (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".

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

[2] GMR-1 3G 45.004 (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".

[3] GMR-1 3G 45.008 (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".

[4] ETSI EN 301 681 (V1.3.2): "Satellite Earth Stations and Systems (SES); Harmonized EN for Mobile Earth Stations (MESs) of Geostationary mobile satellite systems, including handheld earth stations, for Satellite Personal Communications Networks (S-PCN) in the 1,5/1,6 GHz bands under the Mobile Satellite Service (MSS) covering essential requirements under Article 3.2 of the R&TTE Directive".

[5] GMR-1 05.005 (ETSI TS 101 376-5-5) (V1.3.1): "GEO-Mobile Radio Interface Specifications (Release 1); Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception".

[6] GMR-1 3G 41.201 (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".

[7] ETSI EN 301 444: "Satellite Earth Stations and Systems (SES); Harmonized EN for Land Mobile Earth Stations (LMES) operating in the 1,5 GHz and 1,6 GHz bands providing voice and/or data communications covering essential requirements under Article 3.2 of the R&TTE directive".

[8] GMR-1 3G 45.010 (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".

[9] GMR-1 3G 45.002 (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".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3 Definitions, abbreviations and symbols

3.1 Definitions

For the purposes of the present document, the terms and definitions given in GMR-1 3G 41.201 [6] and the following apply:

active transmission: defined as the combination of the ramp-up, ramp-down, and active burst transmission periods

average EIRP: burst EIRP averaged over at least 200 bursts

burst EIRP: instantaneous EIRP measured over 90 % of the active portion of a burst

carrier-off state: an MES is in this state when it does not transmit any signal and it is more than 20 ms away from any active transmission (i.e. the carrier-off state excludes the carrier-standby state)

carrier-on state: a MES is in this state when it transmits a signal (i.e. the carrier-on state corresponds to an active transmission)

carrier-standby state: a MES is in this state when it does not transmit any signal but it is within 20 ms of the carrier-on state (i.e. the carrier-standby state occurs for up to 20 ms immediately before, and up to 20 ms immediately after the carrier-on state)

3.2 Abbreviations

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

3.3 Symbols

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

E_b Average energy per bit in the wanted signal.
E_s Average energy per symbol in the wanted signal.
N_o Average channel noise (the noise power spectral density integrated over the channel bandwidth).

4 Frequency bands and channel arrangement

GMR-1 operation is defined for L-Band and S-Band LMSS frequency allocations.

4.1 Frequency bands and duplex method

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 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.

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.

4.2 RF carrier spacing and designation

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.

Absolute Radio Frequency Channel Numbers (ARFCN), N, are assigned to each carrier pair and take the values from 1 through 1 087 ($1 \le N \le 1\,087$) when operating in L-Band.

ARFCNs, N, are numbered from 1 through 1 280 ($1 \le N \le 1\,280$) when operating in S-Band for earth-to-space and from 1 through 960 ($1 \le N \le 960$) when operating in S-Band for space-to-earth.

The centre frequency of the carriers in kHz corresponding to an ARFCN is given by the expressions in table 4.1 for L-band and in table 4.1a for S-band.

Table 4.1: ARFCNs for L-Band

	Carrier centre frequencies (kHz)	ARFCN
Mobile earth station receive	1 525 000,00 + 31,25 x N	$1 \le N \le 1\,087$
Mobile earth station transmit	1 626 500,00 + 31,25 x N	$1 \le N \le 1\,087$

Table 4.1a: ARFCNs for S-Band

	Carrier centre frequencies (kHz)	ARFCN
Mobile earth station receive	2 170 000,00 + 15,625 + 31,25 x (N_{RX} - 1)	$1 \leq N_{RX} \leq 960$
Mobile earth station transmit	1 980 000,00 + 15,625 + 31,25 x (N_{TX} - 1)	$1 \leq N_{TX} \leq 1\,280$

The ARFCN and centre frequency of the carriers are given in table 4.2 for L-band and table 4.2a for S-band space-to-earth and table 4.2b for S-band earth-to-space. The RF channels are spaced at 31,25 kHz intervals, which provides 32 carriers per MHz.

Table 4.2: ARFCN and frequencies for L-Band

MES-RX centre frequencies (kHz)	MES-TX centre frequencies (kHz)	ARFCN (N)
1 525 031,25	1 626 531,25	1
1 525 062,50	1 626 562,50	2
1 529 937,50	1 631 437,50	158
1 529 968,75	1 631 468,75	159
1 530 000,00	1 631 500,00	160
1 530 031,25	1 631 531,25	161
1 532 937,50	1 634 437,50	254
1 532 968,75	1 634 468,75	255
1 533 000,00	1 634 500,00	256
1 543 968,75	1 645 468,75	607
1 544 000,00	1 645 500,00	608
1 544 968,75	1 646 468,75	639
1 545 000,00	1 646 500,00	640
1 554 968,75	1 656 468,75	959
1 555 000,00	1 656 500,00	960
1 558 968,75	1 660 468,75	1 087

Table 4.2a: Receive ARFCNs and frequencies for S-Band

MES-RX centre frequency (kHz)	RX ARFCN (N_{RX})
2 170 015,625	1
2 170 046,875	2
2 199 984,375	960

Table 4.2b: Transmit ARFCNs and frequencies for S-Band

MES-TX centre frequency (kHz)	TX ARFCN (N_{TX})
1 980 015,625	1
1 980 046,875	2
2 009 984,375	960
2 019 984,375	1 280

The packet services use nominal transmission bandwidths that are multiples of the 31,25 kHz basic transmission bandwidth. These different transmission bandwidths defined over the sub bands are used to support transmission symbol rates that are multiples of the basic symbol rate of 23,4 ksps. A 3-bit bandwidth suffix is added to the AFRCN to indicate the bandwidth and transmission rate of the modulated carrier. The association of transmission bandwidths to transmission rates is given in table 4.3.

If the transmission bandwidth is an even multiple of 31,25 kHz, then the carrier frequency shall be shifted by + 15,625 kHz.

Table 4.3: Transmission bandwidth and associated transmission symbol rates

Bandwidth suffix	Transmission bandwidth (kHz)	Transmission Symbol rate (ksps)
000	reserved	Reserved
001	31,25	23,4
010	62,50	46,8
011	reserved	Reserved
100	125,00	93,6
101	156,25	117,0
110	312,5	234,0
111	reserved	Reserved

4.3 RF carrier used for synchronization and spot beam selection

To minimize the time spent by MESs during spot beam synchronization, identification, and selection, a subset of RF carriers called Broadcast Control CHannel (BCCH) carriers may be used by the network to broadcast BCCHs. MES synchronization to the BCCH carrier is defined in GMR-1 3G 45.008 [3] and GMR-1 3G 45.010 [8].

4.4 Frequency assignment to spot beams

L-band RF or S-band RF carriers are configured for each spot beam, depending on traffic demand, frequency reuse considerations, and available spectrum as a result of coordination with other systems using the same spectrum. Any RF channel can be used in any spot beam.

5 Stability requirements

5.1 Frequency and symbol timing stability

Same as clause 5.1 in GMR-1 05.005 [5].

5.1.1 Definition of operating conditions

Same as clause 5.1.1 in GMR-1 05.005 [5] for MESs operating in the L-band. For MESs operating in the S-Band, the carrier frequency, f_c, is 2,0 GHz.

5.1.2 Frequency and timing stability requirement

Same as clause 5.1.2 in GMR-1 05.005 [5].

5.1.3 Frequency and timing stability requirements for packet data mode

In the tests of this clause, the MES shall be receiving the logical channel specified in table 5.1 and shall be transmitting a PDCH logical channel. In all test cases, AWGN shall be used.

The rms frequency and symbol timing error of the transmitted signal from the MES shall not exceed the values given in table 5.1 when the unit is receiving the logical channels given in the table with the E_s/N_o values listed in the table.

Table 5.1: Frequency and timing stability requirements

Received logical channel	Operational condition (see note)	E_s/N_o (dB)	RMS Frequency Error (Hz)	RMS timing error (µs)
PDCH (at 23,4 ksps)	Steady state	5	10	0,9
PDCH (at 46,8 ksps)	Steady state	5	10	0,9
PDCH (at 93,6 ksps)	Steady state	5	10	0,9
PDCH (at 117,0 ksps)	Steady state	5	10	0,9
PDCH (at 234,0 ksps)	Steady state	5	10	0,9
NOTE: The Steady State operational condition is defined in GMR-1 05.005 [5].				

5.2 Frequency switching time

MESs shall be capable of switching from any receive frequency to any other receive frequency in less than 1,6 ms and maintain the frequency stability in clause 5.1. MESs shall be capable of switching from any transmit (receive) frequency to any receive (transmit) frequency in less than 2,2 ms and maintain the frequency stability in clause 5.1. During frequency switching, the MES transmit level corresponds to the carrier-off conditions defined in clause 6.4. These requirements apply to MES type A, C and D.

MES types E, and above shall be capable of switching from any transmit (receive) frequency to any receive (transmit) frequency in less than 1,0 ms and maintain the frequency stability in clause 5.1. During frequency switching, the MES transmit level corresponds to the carrier-off conditions defined in clause 6.4.

These requirements shall be met under the extreme environmental conditions defined in annex B.

For full duplex operation, the transmit (receive) to receive (transmit) frequency switching time is not applicable. In addition, the MES shall be capable of switching from any transmit frequency to any other transmit frequency with the same specification as the receiver frequency switching.

5.3 MES time alignment accuracy

Same as clause 5.3 in GMR-1 05.005 [5].