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Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	6
Introduction	6
1 Scope	8
2 References	8
2.1 Normative references	8
2.2 Informative references.....	9
3 Definitions, abbreviations and symbols	9
3.1 Definitions	9
3.2 Abbreviations	10
3.3 Symbols.....	10
3.4 Terminal Types (informative)	10
4 Frequency bands and channel arrangement.....	11
4.0 General	11
4.1 Frequency bands and duplex method	11
4.2 RF carrier spacing and designation	12
4.3 RF carrier used for synchronization and spot beam selection	13
4.4 Frequency assignment to spot beams	13
5 Stability requirements.....	14
5.1 Frequency and symbol timing stability	14
5.1.0 General.....	14
5.1.1 Definition of operating conditions	14
5.1.2 Frequency and timing stability requirement	14
5.1.3 Frequency and timing stability requirements for packet data	14
5.2 Frequency switching time	15
5.3 MES time alignment accuracy.....	15
6 Transmitter characteristics	15
6.1 Power output characteristics and power class	15
6.1.0 General.....	15
6.1.1 Average EIRP - Extreme Conditions	16
6.1.2 Average EIRP - Normal Conditions	16
6.1.3 Single Burst EIRP.....	16
6.1.4 Access Burst EIRP.....	17
6.2 Antenna radiation pattern	17
6.2.0 General.....	17
6.2.1 Boresight Oriented Radiation Patterns.....	17
6.2.2 Non-Boresight Oriented Radiation Patterns	18
6.3 Transmit polarization	18
6.4 Carrier-off conditions	19
6.4a Carrier-standby conditions	19
6.5 Droop, ramp-up and ramp-down	19
6.6 Power control range and accuracy.....	20
6.6.1 Approach	20
6.6.2 Procedures and timing	20
6.6.3 Range	20
6.6.4 Accuracy	20
6.6.5 Attenuation step size	20
6.6.6 Initial power level P_{init}	20
6.7 Adjacent channel interference	21
6.7.0 General.....	21
6.7.1 Interference due to modulation	21
6.7.2 Interference due to switching transients.....	23

6.8	Unwanted emissions.....	23
6.8.1	Unwanted emissions in the carrier-on state and carrier-standby state (L-band)	23
6.8.2	Unwanted emissions in the carrier-off state (L-band).....	23
6.8.3	Unwanted emissions in the carrier-on state and carrier-standby state (S-Band).....	23
6.8.4	Unwanted emissions in the carrier-off state (S-band).....	24
6.9	Network Packet Burst EIRP Consistency	24
7	Receiver characteristics.....	24
7.1	Receive antenna pattern.....	24
7.1.0	General.....	24
7.1.1	Boresight Oriented Radiation Patterns.....	24
7.1.2	Non-Boresight Oriented Radiation Patterns	24
7.2	Receive polarization.....	25
7.3	Receiver figure of merit	25
7.4	Receiver sensitivity	26
7.4.0	General.....	26
7.4.1	Receiver BER in static conditions	27
7.4.2	Receiver BER in Rician fading (A/Gb mode only)	28
7.4.3	FER of logical channels (A/Gb mode only).....	28
7.4.4	FER of PUI (A/Gb mode only).....	28
7.4.5	FER of PUI and ULMAP (Tu mode only).....	29
7.4.6	FER of Common Control Channels (system using FCCH3)	29
7.5	Receiver selectivity	29
7.6	Receiver intermodulation	30
7.7	Receiver blocking characteristics	30
7.7.1	L-Band	30
7.7.2	S-Band	30
7.8	Receive signal strength.....	30
7.9	Erroneous frame Indication Performance.....	32
7.10	Maximum Received Power Level.....	32
8	GPS receiver characteristics.....	32
Annex A (informative):	Antenna factor equation.....	33
Annex B (normative):	Environmental conditions	34
B.1	General	34
B.2	Temperature	34
B.3	Voltage	34
B.4	Vibration.....	34
Annex C (normative):	Channel model.....	35
Annex D (informative):	Derivation of receiver sensitivity specifications	36
D.1	Introduction	36
D.2	Definitions.....	36
D.2.0	General	36
D.2.1	Integral sensitivity	36
D.2.2	Radiated sensitivity	37
D.2.3	Conducted sensitivity	37
D.3	Parameters	38
D.4	Calculations.....	38
Annex E (informative):	Bibliography.....	40
History		41

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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:

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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 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; 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".

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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 ETSI TS 101 376-1-2 [6].

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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

2.1 Normative 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.

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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 version of that document in Release 7 or to the latest version of that document in the latest release less than 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 101 376-5-4: "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".
- [3] 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".
- [4] ETSI EN 301 681: "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 the essential requirements of article 3.2 of the R&TTE Directive".
- [5] ETSI TS 101 376-5-5: "GEO-Mobile Radio Interface Specifications (Release 1); Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMR-1 05.005".

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

- [6] 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".
- [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 of article 3.2 of the R&TTE directive".
- [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 101 376-5-2: "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".
- [10] ETSI EN 302 574-3: "Satellite Earth Stations and Systems (SES); Harmonized Standard for satellite earth stations for MSS operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to- earth) frequency bands; Part 3: User Equipment (UE) for narrowband systems: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [11] 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".

2.2 Informative 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.

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

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

carrier-standby state: 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)

Terminal Type: alphabetic designator defining a terminal, as described in ETSI TS 101 376-5-2 [9]

Terminal Type Identifier: numerical identifier defining a terminal, as described in ETSI TS 101 376-5-2 [9]

NOTE: Each Terminal Type can have more than one associated Terminal Type Identifier.

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_0	Average channel noise (the noise power spectral density integrated over the channel bandwidth)
0x	Prefix used for Hexadecimal representation of identifiers or numbers

3.4 Terminal Types (informative)

Terminal Types and related Terminal Type Identifiers are defined in ETSI TS 101 376-5-2 [9]. The following information is provided for information only and in the event of any conflict the definitions in ETSI TS 101 376-5-2 [9] take precedence.

Terminals are defined throughout the present document in terms of Terminal Type Identifiers in Hexadecimal format. Table 3.1 summarizes the relationship between Terminal Types and Terminal Type Identifiers.

Table 3.1: Terminal Types and Identifiers

Terminal Type Identifier (Binary)	Terminal Type Identifier (Hexadecimal)	Terminal Type	Operating Band	Antenna Radiation Pattern Category (see note)	Notes
0001001	0x9	C	L	B	Handheld
0001010	0xA	C	L	B	Handheld
0001011	0xB	C	L	B	Handheld
0001100	0xC	C	L	B	Handheld
0001101	0xD	D	L	B	Portable - Internal Antenna
0001110	0xE	D	L	B	Portable - Passive Ext. Antenna
0001111	0xF	D	L	B	Portable - Active Ext. Antenna
0010000	0x10	E	S	N	Handheld
0010001	0x11	E	S	N	Handheld
0010010	0x12	E	S	N	Handheld
0010101	0x15	F	S	N	Handheld
0011010	0x1A	G	S	N	Handheld
0011111	0x1F	H	S	B	Vehicular
0100000	0x20	H	S	B	Vehicular
0100100	0x24	I	S	B	Fixed
0100101	0x25	I	S	B	Fixed
0101001	0x29	J	L	N	Handheld
0101110	0x2E	K	L	N	Handheld
0110011	0x33	L	L	N	Handheld

Terminal Type Identifier (Binary)	Terminal Type Identifier (Hexadecimal)	Terminal Type	Operating Band	Antenna Radiation Pattern Category (see note)	Notes
0 1 1 1 0 0 0	0x38	M	L	B	Fixed
0 1 1 1 1 0 1	0x3D	N/A	L	N	Handheld - Small
0 1 1 1 1 1 0	0x3E	N/A	L	B	Handheld - Smartphone
0 1 1 1 1 1 1	0x3F	N/A	L	B	Handheld - Rugged
1 0 0 0 0 0 0	0x40	N/A	L	B	Asset Tracking
1 0 0 0 0 0 1	0x41	N/A	L	B	Portable
1 0 0 0 0 1 0	0x42	N/A	L	B	Semi-Fixed
1 0 0 0 0 1 1	0x43	N/A	L	B	Vehicular
1 0 0 0 1 0 0	0x44	N/A	L	B	Maritime
1 0 0 0 1 0 1	0x45	N/A	L	B	Aeronautical
1 0 0 0 1 1 0	0x46	N/A	L	B	Maritime - Small
1 0 0 0 1 1 1	0x47	N/A	L	B	Vehicular - Small
1 0 0 1 0 0 0	0x48	A	L	B	Fixed
1 0 0 1 0 0 1	0x49	N/A	L	B	Aeronautical – Small
1 0 0 1 0 1 0	0x4A	N/A	S	B	Portable
1 0 0 1 0 1 1	0x4B	N/A	S	B	Portable

NOTE: Antenna radiation patterns are categorized as Boresight Oriented (B) or Non-Boresight Oriented (N). Refer to clause 6.2 for more details.

4 Frequency bands and channel arrangement

4.0 General

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 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 MHz to 2 200 MHz; Earth-to-Space: 2 000 MHz 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 MHz to 2 200 MHz; Earth-to-space: 1 980 MHz 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.

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 ($1 \leq N \leq 1\,087$) when operating in L-Band.

ARFCNs, N , are numbered from 1 through 1 280 ($1 \leq N \leq 1\,280$) when operating in S-Band for Earth-to-Space and from 1 through 960 ($1 \leq N \leq 960$) 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	$1\,525\,000,00 + 31,25 \times N$	$1 \leq N \leq 1\,087$
Mobile earth station transmit	$1\,626\,500,00 + 31,25 \times N$	$1 \leq N \leq 1\,087$

Table 4.1a: ARFCNs for S-Band

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

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