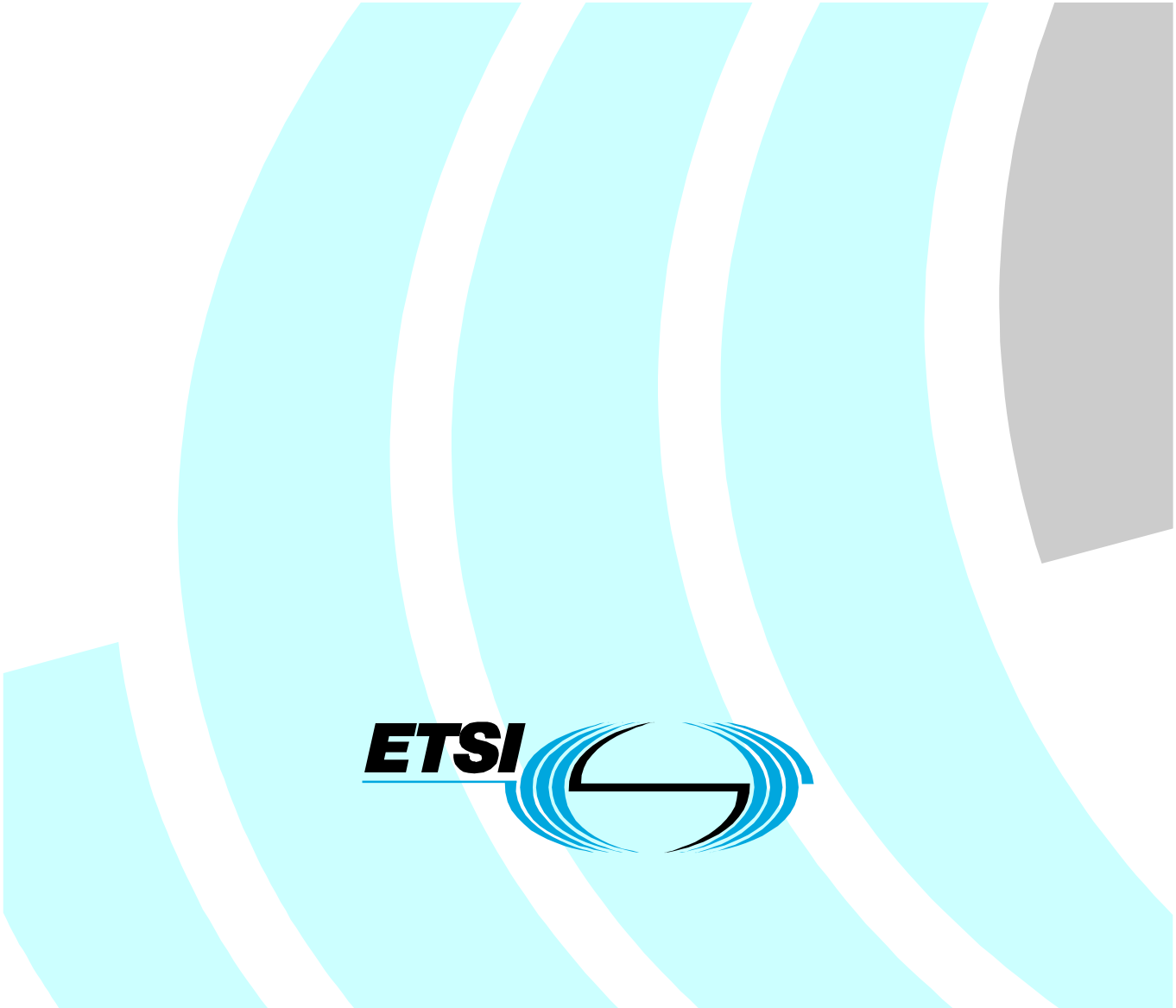
ETSI TS 101 376-5-6 V2.1.1 (2003-03)

Technical Specification

GEO-Mobile Radio Interface Specifications (Release 2);
General Packet Radio Service;
Part 5: Radio interface physical layer specifications;
Sub-part 6: Radio Subsystem Link Control;
GMPRS-1 05.008



Reference
RTS/SES-001-GMPRS-1-05008

Keywords
GMR, GSM, GSO, MES, mobile, MSS, radio, satellite, S-PCN, control, gateways, GMPRS, GPRS, interface, MSC

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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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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 5, sub-part 6 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";

Part 5: "Radio interface physical layer specifications";

Sub-part 1: "Physical Layer on the Radio Path: General Description; GMR-1 05.001";

Sub-part 2: "Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 05.002";

Sub-part 3: "Channel Coding; GMR-1 05.003";

Sub-part 4: "Modulation; GMR-1 05.004";

Sub-part 5: "Radio Transmission and Reception; GMPRS-1 05.005";

Sub-part 6: "Radio Subsystem Link Control; GMR-1 05.008";

Sub-part 7: "Radio Subsystem Synchronization; GMR-1 05.010";

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 specification is part of the GMR Release 2 specifications. Release 2 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.)

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.

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. This GMR number has a different prefix for Release 2 specifications as follows:

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

1 Scope

The present document specifies several control aspects for the radio link between the Mobile Earth Station (MES) and the Gateway Station (GS) in the GMR-1 Mobile Satellite System. It specifies the operation of power control and defines dead link detection. It makes requirements for DTX operation.

The present document also defines requirements for the MES for monitoring system information, as prerequisites to system access, and upon exit from dedicated mode. It makes requirements for spot beam selection and reselection. It defines the nature of the measurements that the MES uses to implement these processes.

Timing and frequency control aspects of link control are to be found in GMPRS-1 05.010 [6], and messages for timing and frequency control are defined in GMPRS-1 04.008 [3].

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.

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

[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] GMPRS-1 03.022 (ETSI TS 101 376-3-10): "GEO-Mobile Radio Interface Specifications (Release 2); Part 3: Network specifications; Sub-part 10: Functions related to Mobile Earth station (MES) in idle mode; GMPRS-1 03.022".

[3] GMPRS-1 04.008 (ETSI TS 101 376-4-8): "GEO-Mobile Radio Interface Specifications (Release 2); Part 4: Radio interface protocol specifications; Sub-part 8: Mobile Radio Interface Layer 3 Specifications; GMPRS-1 04.008".

[4] GMPRS-1 05.003 (ETSI TS 101 376-5-3): "GEO-Mobile Radio Interface Specifications (Release 2); Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMPRS-1 05.003".

[5] GMPRS-1 05.005 (ETSI TS 101 376-5-5): "GEO-Mobile Radio Interface Specifications (Release 2); Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMPRS-1 05.005".

[6] GMPRS-1 05.010 (ETSI TS 101 376-5-7): "GEO-Mobile Radio Interface Specifications (Release 2); Part 5: Radio interface physical layer specifications; Sub-part 7: Radio Subsystem Synchronization; GMPRS-1 05.010".

[7] GMR-1 05.008 (ETSI TS 101 376-5-6 (V1.2.1)): "GEO-Mobile Radio Interface Specifications; Radio Subsystem Link Control; GMR-1 05.008".

[8] GMPRS-1 04.060 (ETSI TS 101 376-4-12): "GEO-Mobile Radio Interface Specifications (Release 2); Part 4: Radio interface protocol specifications; Sub-part 12: GEO-Mobile Packet Radio Service (GMPRS); Mobile Earth Station (MES); Base Station System (BSS) Interface: Radio Link Control/Medium Access Control (RLC/MAC) Protocol; GMPRS-1 04.060".

[9] GMPRS-1 01.201 (ETSI TS 101 376-1-2): "GEO-Mobile Radio Interface Specifications (Release 2); Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 Family; GMPRS-1 01.201".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in GMR-1 01.004 [1] and the following apply:

Average Power Used (APU): At the beginning of each call, the MES will start a running power-averaged PAS setting, expressed in dB. This parameter will be transmitted upon receipt of an INFORMATION REQUEST message from the network, with a power control request code.

BCCH_FULL_LIST: list of all the broadcast control channel (BCCH) numbers used by the network

BCCH_NEIGHBOR_LIST: list of the neighboring spot beams' BCCH numbers, starting timeslots, and system information cycle offsets

Call Quality Metric (CQM): At the beginning of each call, the MES will start a running average of the percentage of post-FEC burst errors occurring for the call. This parameter will be transmitted upon receipt of an INFORMATION REQUEST message from the network, with a power control request code.

criterion C1: used by the MES for detecting the presence of the frequency control channel (FCCH) and switching out of the frequency search state

NOTE: C1 is the minimum usable threshold on the received LQI that must be satisfied at the MES before it camps on the system.

Link Quality Indication (LQI): amount of available link margin with respect to SQT, expressed in dB

NOTE: A positive value indicates the amount of additional link margin in reserve. A negative value indicates that power control is at saturation and that the SQT is not being met by the indicated value.

link margin: difference (in dB) between the SQI at the receiver corresponding to the maximum transmit power level and the SQT

Open Loop Threshold and Gain (Olthresh and Olgain): The parameter Olthresh is the threshold on the LQI estimate before activating open loop power control. The parameter Olgain is the loop gain for open loop control.

Power Attenuation Notification (PAN): the attenuation, in dB, used by the transmitter in the power control loop, relative to the maximum transmit power level

Power Attenuation Request (PAR): the attenuation, in dB, requested by the receiver in the power control loop, relative to the maximum transmit power level

Power Control Loop Gain (GainDn and GainUp): number by which the difference between SQT and SQI is multiplied to derive the power correction value

NOTE: If the difference is negative, GainDn is used as the loop gain; otherwise, GainUp is used as the loop gain. The loop gain is a unitless number with a default value of 1,0.

Power Control Topped-Out (PCTO): At the beginning of each call, the MES will start a running average of the percentage of messages for which the calculated PAS is less than PASmin. This parameter will be transmitted upon receipt of an INFORMATION REQUEST message from the network, with a power control request code.

Radio Link Failure Counter S: counter whose value of zero determines the failure of the radio link

reserve link margin: difference (in dB) between the SQI corresponding to the maximum transmit power level and the actual SQI at the receiver

RADIO_LINK_TIMEOUT: maximum value of the radio link failure counter S

Received Signal Strength Indication (RSSI): root mean squared (rms) value of the signal received at the receiver antenna

NOTE: The RSSI estimate is compensated for all the time-varying processes (such as automatic gain control) that affect the estimation procedure for obtaining a relative measure to use in comparing the strength of signals received at different times.

SB_RESELECT_HYSTERESIS: value in dB by which a nonserving beam's BCCH power measurement must exceed the serving beam's BCCH power before the MES switches to the nonserving beam

SB_SELECTION_POWER: During the spot beam selection and reselection, the MES selects only those BCCH carriers whose receive power is within SB_SELECTION_POWER dB of the strongest BCCH carrier.

SB_RESELECTION_TIMER: maximum time interval between consecutive spot beam reselection procedures

Signal Quality Indication (SQI): the estimate of the ratio of signal power to the noise and the interference power S/(N+I) formed at the receiver in the power control loop

NOTE: This estimate, averaged over one burst, is denoted here as SQIj (estimate for jth burst). For the power control algorithm, this estimate is averaged over six frames and it is denoted as $\overline{SQI6}$.

Signal Quality Target (SQT): desired receive signal quality, and it is defined as the targeted value for the ratio of the signal power to the noise and interference power

NOTE: The SQT is derived from a reference threshold and an allowance for fading and doppler shift.

3.2 Abbreviations

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

4 General

Same as clause 4 in GMR-1 05.008 [7].

5 RF power control

Same as clause 5 in GMR-1 05.008 [7].

6 Radio link failure

Same as clause 6 in GMR-1 05.008 [7] for dedicated mode, with the following modifications for packet service:

- Link failure may occur as result of adverse channel conditions. The MES shall detect link failure by determining that the received E_s/N_o is below 2,5 dB. This determination may be based on Bit Error Rate estimation. The Bit Error Rate estimate may be based on known bits within the packet bursts, or on an examination of the Golay decoder outputs.
- This detection procedure shall be performed for each successive link failure measurement interval.
- The measurement interval is defined as LINK_FAILURE_MEASUREMENT_INTERVAL. The GS shall broadcast the value of LINK_FAILURE_MEASUREMENT_INTERVAL as part of system information in BCCH (see GMPRS-1 04.008 [3]), and the default value is 10 seconds.

7 Idle mode tasks

Same as clause 7 in GMR-1 05.008 [7].

8 Network prerequisites

Same as clause 8 in GMR-1 05.008 [7].

9 Aspects of Discontinuous Transmission (DTX)

Same as clause 9 in GMR-1 05.008 [7].

10 Radio link measurements

Same as clause 10 in GMR-1 05.008 [7].

11 Control parameters

Same as clause 11 in GMR-1 05.008 [7].

12 GMPRS mode tasks

12.1 GMPRS spot beam selection and reselection

12.1.1 BCCH type identification

For the purpose of MES idle mode operation, the MES shall be able to identify BCCH type. The BCCH can be either an Anchored BCCH (A-BCCH) or Temporary BCCH (T-BCCH).

An Anchor BCCH (A-BCCH) shall have the following features:

1) It shall use an ARFCN on the BCCH_FULL_LIST for the serving satellite;

2) It shall be illuminated permanently in a satellite system;

3) It shall always be transmitted with full BCCH power;

4) It may be listed on a neighbor BCCH list;

5) It may be used for RSSI based spot beam selection.

A Temporary BCCH (T-BCCH)shall have the following features:

1) It may use any frequency, i.e., it may be assigned to an ARFCN not given in the BCCH_FULL_LIST for the serving satellite;

2) It may not be illuminated or activated all the time;

3) It may not be transmitted with full BCCH power;

4) It shall not be listed in the neighbor BCCH list;

5) It shall not be used for RSSI based spot beam selection.

The BCCH type differentiation shall be based on the BCCH_Type_Flag (see GMPRS-1 04.008 [3]) decoded from the System Information.

12.1.2 Spot beam selection

GMPRS spot beam selection shall operate according to clause 7.

12.1.3 Spot beam reselection

The spot beam reselection shall operate as described in clause 7.7.

12.2 Idle mode link loss

If an MES is camped on a T-BCCH, the MES shall check T-BCCH availability by receiving at least one burst every multiframe either from the PCH or the BCCH. If the MES is unable to read either the BCCH or PCH for 4 consecutive multiframes, the MES shall switch to one of the concurrent A-BCCHs. It shall then camp on the A-BCCH or any A-BCCH with the same spot beam ID as the dark T-BCCH. While camped on an A-BCCH in the same spot beam as the T-BCCH, the MES shall periodically read the system information broadcast on the A-BCCH as described in clause 7.10. If the concurrent list changes or if the MES reacquires the T-BCCH, it shall follow the procedures in GMPRS-1 03.022 [2].

The BCCH read operation of clause 7.10 shall apply to a MES camped on a T-BCCH or an A-BCCH in GMPRS mode.

12.3 Link adaptation

12.3.1 Objective and overall procedure

The objective of the link adaptation is to optimize the transmission throughput according to each user's channel environment while a reliable transmission is guaranteed.

For the forward link transmission, the code rate of the encoder is determined at the TBF initialization and is unchanged during the corresponding TBF. Note that the TX power level at the GS is not changed for the purpose of the forward link adaptation.

For the return link transmission, the code rate of the encoder and the initial TX power level of the MES are determined at the TBF initialization. While the code rate remains unchanged, the TX power level of the MES is adaptively controlled during the corresponding TBF.

12.3.2 Power control parameters

Power control requires two variables, PAR and PAN, which are defined in clauses 5.3.1 and 5.3.2. The variables, PAR and PAN, are quantized to 6 bits as described in clause 5.3.3.

PAR is created by the GS and sent to the corresponding MES. PAN is created by the MES and sent to the GS.

12.3.3 PAN transmission

The PAN is transmitted on Public Information (PUI). Refer to GMPRS-1 04.060 [8] for radio block and Ieformat. The PAN value shall indicate the actual power level used to send this radio block. The PAN is transmitted on every transmitted radio block.

12.3.4 PAR transmission

A PAR is transmitted on the RLC/MAC header of the radio block. Alternatively, if there is no active forward link TBF, the PAR can be transmitted on MAC/RLC header of any control message.

At the time of channel assignment, a PAR value is transmitted as a part of power control parameters to indicate the power level that the MES should use for its initial transmissions on the uplink PDCH. Refer to GMPRS-1 04.060 [8] for the power control parameter IE format.

12.3.5 MES output power

A PAN shall be transmitted on the PUI of each transmitted radio block on PDCH/U. The PAN value shall represent the actual power level used to transmit the radio block. PAR shall be transmitted on either PACCH/D or on RLC/MAC header of the forward link burst.

In case a MES sends PNB bursts on return link direction without establishing a return link TBF, it uses the known initial power level, P_{init}, to transmit the corresponding burst. The definition of the known initial power level of MES, P_{init}, is shown in GMPRS-1 05.005 [5].

12.3.6 GS output power

GS output power control is not applicable, i.e. MES is not required to send PAR to the GS.

12.3.7 Radio link measurements and accuracy requirements

The MES and GS shall achieve the following measurement accuracy in estimating SQM:

Table 12.1: SQM measurement accuracy

Actual E_{bt}/N_o (dB)	Standard deviation of measurement error (dB)
0	0,9
3	0,4
6	0,4
9	0,4
12	0,4

Where the measurement error of the burst j, *Ej*, is defined as:

$$Ej = True\{E_{bt}/N_o\} - SQMj.$$

The standard deviation of measurement error, STD,

$$STD = \sqrt{\frac{1}{N} \times \sum_{j=1}^{N} E_j^{\,2}}\ .$$

The number *N* of estimates used for averaging shall be any integer number greater than 2 000.

The bias of the SQM is defined as follows:

$$\text{SQM Estimation Bias} = True\{E_{bt}/N_o\} - Mean\{SQM\}.$$

The bias on the SQM estimation at the 0 (dB) of actual E_{bt}/N_o condition shall not exceed 0,6 (dB).

12.3.8 Signal Quality Indicator Report (SQIR) transmission

The MES shall compute the Signal Quality Measure (SQM) on monitoring its own forward link PDCH. The SQM is the average (E_{bt}/N_o) of the received burst. The following is the procedure to calculate the SQIR:

- Receiving a forward link burst MES measures the average signal quality of the burst, SQM.
- In order to calculate the average SQM, SQM_{avg}, the MES take a running average over the bursts collected during the designated period of the time, $T_{sqir,}$ after the previous periodic SQIR report. The value of $T_{sqir,}$ is 8-second.
- The MES encodes the average SQM, $SQM_{avg,}$ to an SQIR. The specification for encoding is shown in table 12.2. The encoded SQIR values are converted into 6-bit wise binary format and transmitted to the GS.

Table 12.2: SQIR encoding

SQM (dB)	Code value of SQIR
$SQM_{avg} < 0,5$	0
$0,5 \leq SQM_{avg} < 0,7$	1
$0,7 \leq SQM_{avg} < 0,9$	2
$0,9 \leq SQM_{avg} < 1,1$	3
$1,1 \leq SQM_{avg} < 1,3$	4
$1,3 \leq SQM_{avg} < 1,5$	5
$1,5 \leq SQM_{avg} < 1,7$	6
…….	
$11,7 \leq SQM_{avg} < 11,9$	57
$11,9 \leq SQM_{avg} < 12,1$	58
$12,1 \leq SQM_{avg} < 12,3$	59
$12,3 \leq SQM_{avg} < 12,5$	60
$12,5 \leq SQM_{avg}$	61
Reserved	62
No Meaningful Value	63

The network shall use a SQIR received from the MES for link adaptation except when the SQIR is within the Link Quality Report message. When a SQIR is received within a Link Quality Report message, the network shall use the SQIR for link performance monitoring only. The requirements relating to the transmission of link performance monitoring SQIRs are described in clause 12.4.

The duration between the transmission by the MES of any two messages containing valid link adaptation SQIRs shall be Tsqir seconds during a forward TBF. The MES shall transmit a valid link adaptation SQIR at forward TBF release regardless of the duration since the last valid link adaptation SQIR transmission.

A SQIR value of 63 indicates that no meaningful link adaptation SQIR value is present. The MES shall send this value when transmitting a message during a forward TBF in which the link adaptation SQIR information element is mandatory but the duration since the previous transmission of a link adaptation SQIR is less than Tsqir seconds.

12.3.9 Code rate adaptation

The physical layer supports multiple coding rates and multiple transmission rates to provide a means to adapt the data transfer rate according to the radio link condition. Refer to GMPRS-1 05.003 [4] for coding schemes available.

The code rate to be used by the MES for the return link is determined by the GS and is made available to the MES upon TBF initialization in either AGCH, PAGCH or PACCH as specified in GMPRS-1 04.008 [3] and GMPRS-1 04.060 [8]. The MES shall apply this code rate for the TBF associated with the initialization and the code rate shall not be changed during the TBF transmission.

The code rate for each forward link burst received by the MES is specified in the PUI of the received burst according to GMR-1 05.003 [4]. The MES shall decode the payload portion of the burst using this code rate. The code rate of the forward link shall not be changed during the TBF transmission.

In case a MES sends PNB bursts on return link direction without establishing a return link TBF, the code rate of the corresponding burst shall be r = 1/2.

12.4 UT Link Quality Report (UTLQR) handling

The MES shall report UTLQR to the GS as described in GMPRS-1 04.060 [8]. The Packet Link Quality Report message is described in GMPRS-1 04.060 [8].

When a MES inserts a SQIR value for UTLQR, it shall use the present SQM_{avg} value in the running averaging filter in the MES. Also, the MES shall include the present TX EIRP value of the corresponding burst in the UTLQR.

The MES shall transmit the Packet Link Quality Report message with the duration described in GMPRS-1 04.060 [8].

12.5 Timing for the power level adjustment

MES shall change its transmit power level within 200 msec after the reception of a requested power change (PAR) from the network. This actual transmit power of the MES shall also be coded as the PAN value and inserted into the PUI field of return link traffic burst.

Annex A (informative): Pseudocode for power control

Same as annex A in GMR-1 05.008 [7].

Annex B (informative): Per-burst SQI estimation

Same as annex B in GMR-1 05.008 [7].

Annex C (informative): Position determination at the MES

Same as annex C in GMR-1 05.008 [7].

Annex D (informative): Bibliography

- 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".
- GMR-1 04.022 (ETSI TS 101 376-4-11): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 11: Radio Link Protocol (RLP) for Data Services; GMR-1 04.022".
- GMPRS-1 05.002 (ETSI TS 101 376-5-2): "GEO-Mobile Radio Interface Specifications (Release 2); Part 5: Radio interface physical layer specifications; Sub-part 2: Multiplexing and Multiple Access; Stage 2 Service Description; GMPRS-1 05.002".
- GMR-1 06.012: (ETSI TS 101 376-6-4): "GEO-Mobile Radio Interface Specifications; Comfort Noise Aspects for Full Rate Speech Traffic Channel; GMR-1 06.012".
- GMR-1 06.031: (ETSI TS 101 376-6-5): "GEO-Mobile Radio Interface Specifications; Discontinuous Transmission (DTX) for Full Rate Speech Traffic Channel; GMR-1 06.031".
- GMR-1 06.032: (ETSI TS 101 376-6-6): "GEO-Mobile Radio Interface Specifications; Voice Activity Detection; GMR-1 06.032".

History

Document history		
V1.1.1	March 2001	Publication
V1.2.1	April 2002	Publication
V2.1.1	March 2003	Publication