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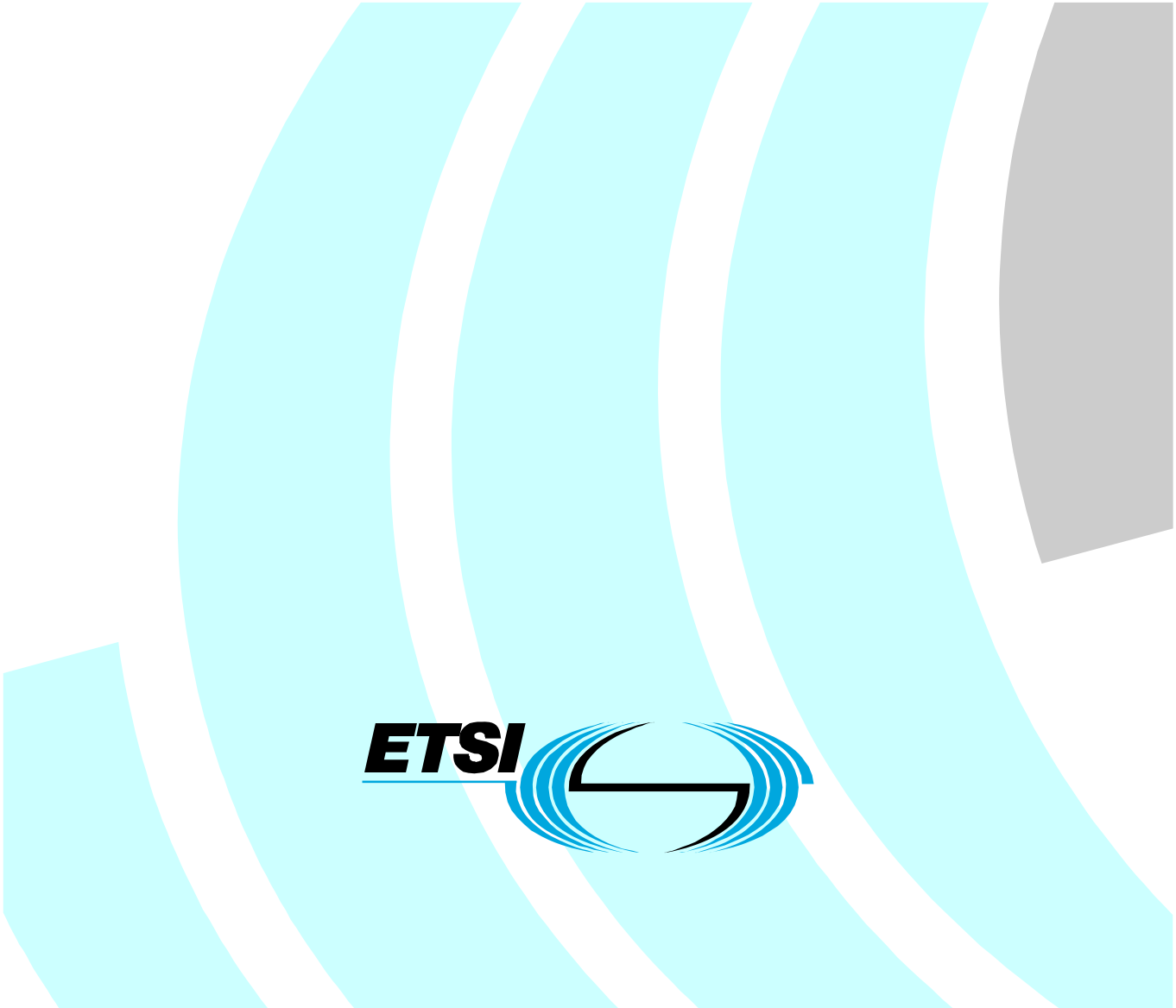
*Technical Specification*

**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**



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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:

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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 (Release 2); General 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 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 GMPRS-1 01.201 [9].

# 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

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.

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

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] 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".

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

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

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

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

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

[7] ETSI TS 101 376-5-6: "GEO-Mobile Radio Interface Specifications (Release 1); Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 05.008".

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

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

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

## 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 and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in GMPRS-1 01.201 [9] 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

NOTE: 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 neighbouring 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

NOTE: 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 at the MES that has to be satisfied 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 (Olthresh):** the parameter Olthresh is the threshold on the LQI estimate before activating open loop power control

**Open Loop Gain (Olgain):** 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:** number by which the difference between SQT and SQI is multiplied to derive the power correction value.

Two loop gains are defined:

- **GainDn:** used as the loop gain if the difference between SQT and SQI is negative;
- **GainUp:** used as the loop gain otherwise (i.e. if the difference between SQT and SQI is not negative).

NOTE: 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

NOTE: 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) or Signal Quality Measurement (SQM):** 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 1: The terms SQI and SQM are used interchangeably in the present document. The term SQI is used for the descriptions related to circuit-switched operation, whereas the term SQM is used for the packet-data-related descriptions in the present document.

NOTE 2: This estimate, averaged over one burst, is denoted here as SQIj or $SQM_j$ (estimate for jth burst). For the power control algorithm in the circuit-switched operation, MES averages this estimate is averaged over six frames and the averaged estimate 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 given in GMPRS-1 01.004 [1] and the following apply:

| | |
|---|---|
| APU | Average Power Used |
| CQM | Call Quality Metric |
| Olgain | Open Loop Gain |
| Olthresh | Open Loop Threshold |
| PCTO | Power Control Topped Out |
| SQIR | Signal Quality Indicator Report |
| SQISDR | Signal Quality Standard Deviation |
| UTLQR | UT Link Quality Report |

# 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 in packet transfer mode:

- 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 for terminal type A and type D, and below 3,0 dB for terminal type C. 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.
- In case of the radio link failure detection, the MES shall perform the procedure specified in GMPRS-1 04.060 [8].

# 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 (SI).

### 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 of GMR-1 05.008 [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 of GMR-1 05.008 [7]. 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, of GMR-1 05.008 [7], 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 to terminal type A, 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 from terminal type A, 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.

For the forward link transmission to terminal type C, the code rate of the encoder at the GS may be adaptively controlled during the 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 from terminal type C, the code rate of the encoder and the initial TX power level of the MES are determined at the TBF initialization. Subsequently, the GS may adaptively change both the code rate and the TX power level during a TBF.

For the forward link transmission to terminal type D, the code rate of the encoder at the GS may be adaptively controlled during the 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 from terminal type D, the code rate of the encoder and the initial TX power level of the MES are determined at the TBF initialization. Subsequently, the GS may adaptively change both the code rate and the TX power level during a 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 of GMR-1 05.008 [7]. The variables, PAR and PAN, are quantized to 6 bits as described in clause 5.3.3 of GMR-1 05.008 [7].

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].

### 12.3.5.1 Open-loop power control at a terminal type C MES

A terminal type C MES receiving PDCH(2,6) shall perform open-loop power control, as described in this clause. The open-loop power control is performed on every 400 ms basis.

#### 12.3.5.1.1 Signal quality estimation

The MES shall estimate the signal quality of the received downlink bursts for the purpose of open-loop power control at MES.

For a given SQI measurement period T, estimation of the signal quality is performed as follows:

$$SQM_{avg} = \frac{1}{N}\sum_{j=1}^{N} SQM_j ,$$

$$SQM_{dev} = \sqrt{\frac{1}{N-1}\left(\sum_{j=1}^{N} SQM_j^2\right) - \frac{N}{N-1} SQM_{avg}^2} ,$$

$$SQM'_{avg} = SQM_{avg} - SQIfactor \times SQM_{dev}$$

Where N is the number of PNBs that the MES receives and SQMj is the SQM measurement of the j-th received burst during the measurement period T. See clause 12.3.5.1.2 for measurement period for open loop power control. The $SQM'_{avg}$ is calculated only when the number of received PNBs during measurement period T is no less than 4.

#### 12.3.5.1.2 Open-loop power control procedure

This clause is identical to clause 5.4 in GMR-1 05.008 [7], with the following changes:

1) Step 1.1 shall be removed.

2) Step 2 shall be removed.

3) Step 3 shall be replaced with: The PAR value is extracted from RLC/MAC header of the latest burst received.

4) Step 4 shall be removed.

5) Step 5.1.1 shall be replaced with: PANbasic = decoded PAR value.

6) Step 6 shall be replaced with: Suppose the current 400 ms period as nth period, then the open loop control described in step 6 shall be performed only when the following two conditions are both met:

   a) The number of PNB received by the MES during nth 400 ms period is no less than 4.

   b) The number of PNB received by the MES during (n-n2)th 400 ms period to (n-n1)th 400 ms period is no less than 4.

7) Step 6.1 and 6.2 shall be replaced with the following:

   6.1) With the $SQM'_{avg}$ corresponding to the current T = 400 ms period (the nth period) denoted as $SQM'_{avg,(n-1)T,nT}$, and the $SQM'_{avg}$ corresponding to the period from (n-n2)th 400 ms period to (n-n1)th 400 ms period as $SQM'_{avg,(n-n2-1)T,(n-n1)T}$, the MES shall calculate $SQM'_{avg,(n-1)T,nT}$ and $SQM'_{avg,(n-n2-1)T,(n-n1)T}$ as specified in clause 12.3.5.1.1.

   6.2) Open_loop_power_deficit = $SQM'_{avg,(n-n2-1)T,(n-n1)T}$ - $SQM'_{avg,(n-1)T,nT}$.

8) In step 6.3 and 6.4, "open_loop_step" shall be removed.

9) Step 9 shall be replaced with: This value of PAN is then coded and used to form the PUI.

### 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 the GS shall achieve the measurement accuracy in estimating SQM for PDCH(4,3) and PDCH(5,3) as shown in table 12.1(a). For PDCH(2,6), the MES shall achieve the measurement accuracy as shown in table 12.1(b).

**Table 12.1(a): SQM measurement accuracy for PDCH(4,3), PDCH(5,3), and PDCH(5,12)**

| 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 |

**Table 12.1(b): SQM measurement accuracy for PDCH(2,6)**

| Actual $E_{bt}/N_o$ (dB) | Standard deviation of measurement error (dB) |
|---|---|
| 0 | 1,3 |
| 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 SQM estimation $E_{bt}/N_o$ of 0 dB shall not exceed 0,6 dB for PDCH(4,3) and PDCH(5,3). For PDCH(2,6), the SQM estimation bias at $E_{bt}/N_o$ of 0 dB shall not exceed 0,6 dB for code rate 3/5, 0,9 dB for code rate 7/10 and 1,2 dB for code rate 4/5.

### 12.3.8 Signal Quality Indicator Report (SQIR) and Signal Quality Standard Deviation (SQISDR) transmissions

The MES shall compute a parameter Signal Quality Indicator Report (SQIR) based on monitoring of the forward link PDCH. The SQIR indicates an average of received $E_{bt}/N_o$ over multiple bursts. Additionally, a terminal type C MES on the downlink shall also compute a parameter SQISDR, which indicates the standard deviation of the ($E_{bt}/N_o$). A terminal type D MES shall use the Es/No to compute the SQIR and SQISDR. The following is the procedure to calculate the SQIR and SQISDR which is applicable to all burst types (including PKAB):

- For SQIR value sent to the network, the MES measures the average signal quality of the burst, $SQM_{avg}$.
- In order to calculate $SQM_{avg}$, the MES takes 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 4 seconds.
- The MES encodes the average SQM, $SQM_{avg,}$ to an SQIR value. 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 |
| $0,5 \le SQM_{avg} < 0,7$ | 1 |
| $0,7 \le SQM_{avg} < 0,9$ | 2 |
| $0,9 \le SQM_{avg} < 1,1$ | 3 |
| $1,1 \le SQM_{avg} < 1,3$ | 4 |
| $1,3 \le SQM_{avg} < 1,5$ | 5 |
| $1,5 \le SQM_{avg} < 1,7$ | 6 |
| ……. | |
| $11,7 \le SQM_{avg} < 11,9$ | 57 |
| $11,9 \le SQM_{avg} < 12,1$ | 58 |
| $12,1 \le SQM_{avg} < 12,3$ | 59 |
| $12,3 \le SQM_{avg} < 12,5$ | 60 |
| $12,5 \le SQM_{avg}$ | 61 |
| Reserved | 62 |
| No Meaningful Value | 63 |

- A terminal type C and D MES, in addition to SQIR, shall send to the network an additional parameter SQISDR.
- In order to calculate the parameter SQISDR, the terminal type C and D MES computes standard deviation, $SQM_{dev}$, of individual SQM measurements collected during the period $T_{sqir}$.
- The parameter SQISDR is obtained after a six-bit quantization of $SQM_{dev}$, the unquantized standard deviation measure. The specification of the encoding is shown in table 12.3.

**Table 12.3: SQISDR encoding**

| SQM deviation, SQMdev, (dB) | Code value |
|---|---|
| $SQM_{dev} < 0,1$ | 0 |
| $0,1 \le SQM_{dev} < 0,2$ | 1 |
| $0,2 \le SQM_{dev} < 0,3$ | 2 |
| $0,3 \le SQM_{dev} < 0,4$ | 3 |
| $0,4 \le SQM_{dev} < 0,5$ | 4 |
| $0,5 \le SQM_{dev} < 0,6$ | 5 |
| $0,6 \le SQM_{dev} < 0,7$ | 6 |
| ……. | |
| $5,7 \le SQM_{dev} < 5,8$ | 57 |
| $5,8 \le SQM_{dev} < 5,9$ | 58 |
| $5,9 \le SQM_{dev} < 6,0$ | 59 |
| $6,0 \le SQM_{dev} < 6,1$ | 60 |
| $6,1 \le SQM_{dev}$ | 61 |
| Reserved | 62 |
| No Meaningful Value | 63 |

- The value of $T_{sqir,}$ is 8 seconds for a terminal type A MES. For a terminal type C MES, the value of $T_{sqir}$ is 4 seconds (with the actual value in the range [2 seconds, 16 seconds]).

For terminal type C and D MES, the parameters $SQM_{avg}$ and $SQM_{dev}$ are calculated as follows:

$$SQM_{avg,n} = \beta_n \cdot SQM_n + (1-\beta_n) \cdot SQM_{avg,n-1}$$

$$SQM_{dev,n} = \sqrt{\beta_n \cdot (SQM_n - SQM_{avg,n})^2 + (1-\beta_n) \cdot SQM^2_{dev,n-1}}$$

Where n = 2,3,… denotes the index of received PNB bursts since the establishment of the TBF, and the forgetting factor $\beta_n$ is given by:

$$\beta_n = \begin{cases} \frac{1}{2^{n-1}} & if \quad 1 < n \leq 8 \\ \frac{1}{256} & if \quad n > 8 \end{cases}$$

and the initial $SQM_{avg}$ and $SQM_{dev}$ values are:

$$SQM_{avg,1} = SQM_1$$
$$SQM_{dev,1} = 0$$

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 SQIR, or SQIR and SQISDR shall be $T_{sqir}$ 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 or SQISDR value of 63 indicates that no meaningful link adaptation SQIR or SQISDR value is present. The MES shall send this value when transmitting a message during a forward TBF in which the link adaptation SQIR or SQISDR information element is mandatory but the duration since the previous transmission of a link adaptation SQIR or SQISDR is less than $T_{sqir}$ seconds.

Refer to GMPRS-1 04.060 [8] for the mechanism by which the MES conveys the parameters SQIR and SQISDR to the network.

## 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.

### 12.3.9.1 Terminal type A

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 GMPRS-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.

### 12.3.9.2 Terminal type C

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. The code rate may be changed during the TBF transmission.

When the MES applies the new code rate in response to the code rate change message received during a TBF to its transmit burst, the MES shall use the latest PAR value and shall not use any PAR value received prior to the reception of the code rate change message. See clause 12.5 for PAR response time.

MES's code rate change response time during a TBF shall be the same as the $T_{RESP-2}$ (refer to GMPRS-1 05.010 [6] for definition of $T_{RESP-2}$).

The code rate for each forward link burst received by the MES is specified in the PUI of the received burst according to GMPRS-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 may 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 = 3/5.

#### 12.3.9.3 Terminal type D

The code rate and modulation 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 and modulation for the TBF associated with the initialization. The code rate and modulation may be changed during the TBF transmission.

When the MES applies the new code rate in response to the code rate change message received during a TBF to its transmit burst, the MES shall use the latest PAR value and shall not use any PAR value received prior to the reception of the code rate change message. See clause 12.5 for PAR response time.

When the MES applies the new modulation in response to the modulation change message received during a TBF to its transmit burst, the MES shall use the latest PAR value and shall not use any PAR value received prior to the reception of the modulation change message. See clause 12.5 for PAR response time.

MES's code rate and modulation change response time during a TBF shall be the same as the $T_{RESP-1}$ (refer to GMPRS-1 05.010 [6] for definition of $T_{RESP-1}$).

The code rate and modulation for each forward link burst received by the MES is specified in the PUI of the received burst according to GMPRS-1 05.003 [4]. The MES shall decode the payload portion of the burst using this code rate. The code rate and modulation of the forward link may be changed during the TBF transmission.

In case a MES sends PNB2 bursts on return link direction without establishing a return link TBF, the modulation and code rate for the burst shall correspond to π/4 QPSK rate ½ or an MCS value of $(0011)_{binary}$ (Refer to GMPRS-1 04.060 [8] for the MCS definition).

## 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's PAR response time shall be the same as the $T_{RESP-1}$ or $T_{RESP-2}$ depending on channel type (refer to GMPRS-1 05.010 [6] for definitions of $T_{RESP-1}$ and $T_{RESP-2}$). The PAR response time is defined as the time between the end of the downlink burst containing the PAR and the time at which the PAR is applied to the uplink burst ready for transmission.

# 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

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.

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".

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

ETSI TS 101 376-5-2: "GEO-Mobile Radio Interface Specifications (Release 2); General Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 2: Multiplexing and Multiple Access; Stage 2 Service Description; GMPRS-1 05.002".

ETSI TS 101 376-6-4: "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 4: Vocoder: Comfort Noise Aspects; GMR-1 06.012".

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

ETSI TS 101 376-6-5: "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 5: Vocoder: Discontinuous Transmission (DTX); GMR-1 06.031".

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

ETSI TS 101 376-6-6: "GEO-Mobile Radio Interface Specifications; Part 6: Speech coding specifications; Sub-part 6: Vocoder: Voice Activity Detection (VAD); GMR-1 06.032".

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

# History

| Document history | | |
|---|---|---|
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