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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 3: Channel Coding;
GMPRS-1 05.003

Reference

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Contents

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Foreword

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The present document is part 5, sub-part 3 of a multi-part deliverable c 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 [2].

1 Scope

The present document specifies the data blocks given to the encryption unit and the mapping onto the free bits of a burst. It includes the specifications for encoding, reordering, interleaving, and detailed mapping onto the burst. It does not specify the channel decoding method. The definition is given for each kind of logical channel, starting with the data provided to the channel encoder by the speech coder, the data terminal equipment, or the controller of the Mobile Earth Station (MES).

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.

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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 101 376-1-2: "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".

[3] ETSI TS 101 376-5-3 (V1.2.1): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-1 05.003".

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

[4] 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".

[5] 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".

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 [2] apply.

3.2 Abbreviations

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

4 General

4.1 General organization

Same as clause 4.1 in GMR-1 05.003 [3].

4.2 Naming convention

Same as clause 4.2 in GMR-1 05.003 [3].

Table 4.1: Void

4.3 Parity checking

Same as clause 4.3 in GMR-1 05.003 [3], except table 4.2.

Table 4.2 indicates the CRC polynomials used in GMR-1 channels.

Table 4.2: CRC polynomials used in GMR-1

Channel	$g_8(D)$	$g_{12}(D)$	$g_{16}(D)$
BCCH			X
PCH			X
AGCH			X
RACH	X	X	
CBCH			X
SDCCH			X
SACCH			X
FACCH3			X
FACCH6			X
FACCH9			X
TACCH			X
GBCH			X
PDCH	X		X
PRACH	X		
Downlink PDCH (5,12) Extended PUI	X		

4.4 Convolutional coding

4.4.1 Convolutional encoding (all channels except TCH3)

Same as clause 4.4.1 in GMR-1 05.003 [3] with the following additions.

4.4.1.1 Rate 1/2 convolutional code

Same as clause 4.4.1.1 in GMR-1 05.003 [3].

4.4.1.2 Rate 1/4 convolutional code

Same as clause 4.4.1.2 in GMR-1 05.003 [3].

4.4.1.3 Rate 1/3 convolutional code

Same as clause 4.4.1.3 in GMR-1 05.003 [3].

4.4.1.4 Rate 1/5 convolutional code

Same as clause 4.4.1.4 in GMR-1 05.003 [3].

4.4.1.5 Rate 1/2 convolutional code (constraint length 9)

The Rate 1/2 convolutional code of constraint length 9 is defined by the following generator polynomials:

$$g_0(D) = 1 + D^2 + D^3 + D^4 + D^8;$$

$$g_1(D) = 1 + D + D^2 + D^3 + D^5 + D^7 + D^8.$$

The input data block {u(0), u(1), ..., u(K-1)} to be encoded is first extended with tail bits so that u(k) = 0 for k =K, K+1,…, K+7. The coded bits are then defined by the following set of linear equations:

For k = 0, 1, …, K+7

$c(2k) = u(k) \oplus u(k-2) \oplus u(k-3)) \oplus u(k-4) \oplus u(k-8)$

$c(2k+1) = u(k) \oplus u(k-1) \oplus u(k-2) \oplus u(k-3)) \oplus u(k-5) \oplus u(k-7) \oplus u(k-8)$

This results in a block of coded bits *{c(0), c(1), c(2), ..., c(2K+15)}*.

4.4.2 Convolutional encoding for TCH3

Same as clause 4.4.2 in GMR-1 05.003 [3].

4.4.3 Viterbi decoder for TCH3

Same as clause 4.4.3 in GMR-1 05.003 [3].

4.4.4 Convolutional encoding for Extended PUI

Same as clause 4.4.2 in GMR-1 05.003 [3], except that a rate 1/4 convolutional code of constraint length 6 is used. The code is defined by the following generator polynomials:

$$g_0(D) = 1 + D^2 + D^5$$

$$g_1(D) = 1 + D^2 + D^3 + D^5$$

$$g_2(D) = 1 + D + D^3 + D^4 + D^5$$

$$g_3(D) = 1 + D + D^2 + D^3 + D^4 + D^5$$

The encoder is initialized with bits {u(K-1), u(K-2), …, u(K-5)} from the input data block {u(0), u(1), …, u(K-1)} to be encoded; bit u(K-1) is placed in the register D1 and bit u(K-6) is placed in the register D5. The coded bits are then defined by the following set of linear equation:

For k = 0, 1, …, K-1

$$c(4k) = u(k) \oplus u(k-2) \oplus u(k-5)$$

$$c(4k+1) = u(k) \oplus u(k-2) \oplus u(k-3) \oplus u(k-5)$$

$$c(4k+2) = u(k) \oplus u(k-1) \oplus u(k-3) \oplus u(k-4) \oplus u(k-5)$$

$$c(4k+3) = u(k) \oplus u(k-1) \oplus u(k-2) \oplus u(k-3) \oplus u(k-4) \oplus u(k-5)$$

This results in a block of coded bits {c(0), c(1), …c(4K-1)}.

4.5 Puncturing and repetition

The number of available free bits on a burst may not equal the number of coded bits output by the convolutional encoder. In this case, selected coded bits are either punctured (not processed for transmission) or repeated (transmitted twice) as needed to match the coded output to the available payload. The coded bits to be punctured and/or repeated are specified by channel-dependent puncturing and repetition masks. These masks take the form of an $n \times L$ integer array, in which the i^{th} row applies to the coded bits produced by the $g_i(D)$ generator polynomial, $i = 0, \ldots, n-1$, and each entry specifies the number of times that the corresponding coded bit is to be transmitted. The parameter L denotes the period of the pattern. If the period is less than the total number of encoder input (information plus tail bits), the mask is reapplied on a periodic basis. If the number of encoder input is not divisible by L, the mask applies on all the encoder input and stops at the end of the encoder input. In some instances, prefix and suffix masks are applied at the beginning and end of the burst, respectively, to facilitate the rate matching.

The puncturing and repetition masks used in GMR-1 for the Rate 1/2, Rate 1/3, and Rate 1/5 convolutional code (K = 5) are listed in tables 4.3, 4.4 and 4.5 respectively. The puncturing masks used for Rate 1/2 convolutional code with constraint length K = 7 are listed in table 4.6. The puncturing masks used for Rate 1/2 convolutional code with constraint length K = 9 are listed in table 4.7. The puncturing masks used for Rate 1/4 convolutional code with constraint length K = 6 are listed in table 4.7a. The identifier P(r;L) denotes the preferred puncturing mask used for circuit-switched services in which r coded bits are punctured every L input bits to the convolutional encoder. The time-reversed version of this mask is denoted by P*(r;L).