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Digital cellular telecommunications system (Phase 2+);
Optimized transmit pulse shape for downlink
Enhanced General Packet Radio Service (EGPRS2-B)
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Contents

Foreword

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Introduction

The EGPRS2-B feature has been included into GERAN Rel-7 with the legacy GMSK pulse shape. This pulse shape yields good performance and can be used without any requirements on the operator network scenario.

Initial analysis have shown that in certain network scenarios, a spectrally wider pulse shape can improve data throughput performance further.

To obtain superior data throughput performance, investigation of a wider pulse shape is needed, including the network scenarios that will benefit from a wider pulse shape. Selection of either the legacy pulse shape or the new pulse shape will be under operator control.

It is not clear to what degree the current spectral mask can be widened without causing a detrimental impact on legacy mobile stations in these networks. It is also not clear if a spectral mask relaxation is dependent on the modulation transmitted or whether it can be assumed to be applicable for all modulations. It is important to continue to improve the GERAN system performance with new features, and as such it is relevant that this topic is carefully and independently studied.

1 Scope

The present document is an output of the 3GPP study item "Optimized Transmit Pulse Shape for Downlink EGPRS2-B" ("WIDER") [2], the objective of which is to optimise pulse shapes based on optimization criteria to be agreed by TSG GERAN WG1, and provide an evaluation of the optimized pulse shapes in a similar manner as was used in the SAIC feasibility study TR 45.903 [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, edition number, version number, etc.) or non-specific.
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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TDoc GP-072026: "WID Optimized Transmit Pulse Shape for Downlink EGPRS2-B".

[3] 3GPP TR 45.903: "Feasibility Study on Single Antenna Interference Cancellation (SAIC) for GSM networks".

[4] "Candidate Pulse Shapes for WIDER", Nokia Siemens Networks & Nokia Corporation, 3GPP GERAN Teleconference #3 on WIDER.

[5] 3GPP TDoc SMG2 EDGE 2E99-017: "Reference Models for Nonlinear Amplifiers and Phase Noise for Evaluation of EDGE Radio Performance", ETSI SMG2 EDGE Workshop, Toulouse (France), 2-4 March 1999.

[6] AHG1-080111: "A link to system interface methodology, Nokia Siemens Networks & Nokia Corporation".

[7] 3GPP TR 45.913 (V1.0.0): "Optimized transmit pulse shape for downlink Enhanced General Packet Radio Service (EGPRS2-B)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

3.2 Symbols

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

μ	mean of the uncoded BER
σ	variance of the uncoded BER
C/I	Carrier to Interference Ratio
C/I1	Carrier to First (Strongest) Interferer Ratio

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

ACI	Adjacent Channel Interference
ACP	Adjacent Channel Protection
AFS	Adaptive Multi-Rate Full Rate Speech
AMR	Adaptive Multi-Rate
AWGN	Average White Gaussian Noise
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BQC	Bad Quality Call
BSS	Base Station Subsystem
BTS	Base Tranceiver Station
CCI	Co-channel Interference
CDF	Cumulative Distribution Function
CIR, C/I	Carrier-to-Interference Ratio
CS	Circuit Switched
DARP	Downlink Advanced Receiver Performance
DL	Downlink
DTS	DARP Test Scenario
DTX	Discontinuous Transmission
EGPRS2	EDGE General Packet Radio Service 2
EGPRS2-B	EGPRS2 Level B
FER	Frame Erasure Rate
FTP	File transfer Protocol
GMSK	Gaussian Minimum Shift Keying
LGMSK	Linearised GMSK
MCL	Minimum Coupling Loss
MS	Mobile Station
MUROS	Multi-User Reusing One Slot
PA	Power Amplifier
PDTCH	Packet Data Traffic Channel
PS	Packet Switched
RRC	Root Raised Cosine
SAIC	Single Antenna Interference Cancellation
SID	Silence Indicator Description
TCH	Traffic Channel
TRX	Transceiver

TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunication System
UL	Uplink

4 Objectives

4.1 Performance objectives

4.1.1 Data throughput improvements

The objective is to further enhance the data throughput of EGPRS2-B on the downlink.

4.2 Compatibility objectives

4.2.1 Maintenance of voice quality

The introduction of the wide bandwidth pulse should not decrease voice quality as perceived by the user.

The criteria for minimum call quality shall be:

1st Criterion: blocked calls < 2 %

2nd Criterion: satisfied user criterion fulfilled:

- average call FER < 1 % for at least 95 % users in case of network scenarios WIDER-2 and WIDER-3 (see section 5.3);
- average call FER < 2 % for at least 95 % users in case of network scenarios WIDER-1 (see section 5.3).

4.2.2 Data throughput

The introduction of the wide bandwidth pulse shall increase overall network throughput.

4.2.3 Implementation impacts to new Mobile Stations

The introduction of the wide bandwidth pulse should change MS hardware as little as possible.

4.2.4 Implementation impacts to BSS

The introduction of the wide bandwidth pulse should change BSS hardware as little as possible.

4.2.5 Impacts to network planning

Criteria for definition of minimum call quality performance for this objective is defined in section 4.2.1.

The study shall take into consideration the usage of wide pulse shape at the band edge, at the edge of an operator''s band allocation and in country border regions where no frequency coordination are in place.

The wide pulse is expected to fulfil the same adjacent channel protection requirements as the linearised GMSK pulse at the 400 kHz offset and higher (see Section 5.2.3).

When EGPRS2-B is used on a frequency which is adjacent (at a 200 kHz offset) to a frequency which is uncoordinated (see above), then the linearised GMSK pulse shall be used.

4.2.6 Compatibility with Multi-User Reusing-One-Slot (MUROS)

The feature Optimized Transmit Pulse Shape for Downlink EGPRS2-B (WIDER) and the feature Multi-User Reusing-One-Slot (MUROS) will be studied independently but that compatibility of both features will be investigated after completion of the feasibility studies and before the corresponding work items are agreed.

5 Study item pre-requisites

5.1 Introduction

Pre-requisites to the study are identified as follows:

- Preliminary boundary conditions for pulse shape optimisation, where more than one set of boundary conditions may be considered in order to derive a selection of pulse shape candidates.
- One or more network configurations for pulse shape evaluation. These shall be representative of the most likely EGPRS2 deployment strategies.
- A legacy Rx filter working assumption.

5.2 Preliminary boundary conditions for pulse shape optimisation

5.2.1 Introduction

Boundary conditions are needed to define the scope of the optimisation. The boundary conditions will also allow a pre-selection at the link level if more than one pulse shape is optimised against the same set of boundary conditions.

Only when the system evaluation is complete will it be known if the boundary conditions were realistically set, therefore it is proposed to denote these as 'preliminary' boundary conditions. If they were set too loose or too tight, then a further iteration of the study might be necessary.

In general, the same procedure will be used for the optimisation of the EGPRS2-B wide pulse shape on the DL as for the EGPRS2-B wide pulse shape on the UL.

5.2.2 Time domain

The length of the optimised pulse shape shall not be longer than 6 reduced symbol periods. This is to avoid an increase in delay spread which the MS equaliser needs to cope with.

5.2.3 Frequency domain

The adjacent channel protection of the optimised pulse shape (including Tx impairments) shall be:

- 50 dB at the 400 kHz offset
- 58 dB at the 600 kHz offset

Measurements performed by network vendors will verify that these criteria can be met for each candidate pulse shape.

For the 200 kHz offset, any criterion may be considered in the pulse shape optimisation given that this criterion will be verified by the System level studies (Section 9).

If an adjacent channel at the 200 kHz offset is used by a different operator (i.e. no guard band exists), then the linearised GMSK pulse would be the default on the allocation's edge channels.

5.3 Network configurations for pulse shape evaluation

The network configurations that shall be used to evaluate the optimised pulse shapes are given in Table 5.1 and 5.2.