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ETSI

Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Internet
secretariat@etsi.fr
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Foreword

This European Standard (Telecommunications series) has been produced by the Special Mobile Group (SMG).

The present document defines a frame substitution and muting procedure which shall be used by the Receive (RX) Discontinuous Transmission (DTX) handler for the half rate speech traffic channels within the digital cellular telecommunications system. The present document is part of a series covering the half rate speech traffic channels as described below:

GSM 06.02 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Half rate speech processing functions".

GSM 06.20 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Half rate speech transcoding".

GSM 06.21 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Substitution and muting of lost frames for half rate speech traffic channels".

GSM 06.22 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Comfort noise aspects for half rate speech traffic channels".

GSM 06.41 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Discontinuous Transmission (DTX) for half rate speech traffic channels".

GSM 06.42 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Voice Activity Detector (VAD) for half rate speech traffic channels".

GSM 06.06 "Digital cellular telecommunications system (Phase 2+); Half rate speech; ANSI-C code for the GSM half rate speech codec".

GSM 06.07 "Digital cellular telecommunications system (Phase 2+); Half rate speech; Test sequences for the GSM half rate speech codec".

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The contents of the present document is subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of the present document it will be re-released with an identifying change of release date and an increase in version number as follows:

Version 7.x.y

where:

7 indicates Release 1998 of GSM Phase 2+.

x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated in the specification.

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1 Scope

The present document defines a frame substitution and muting procedure which shall be used by the Receive (RX) Discontinuous Transmission (DTX) handler when one or more lost or unreliable speech or SIlence Descriptor (SID) frames are received from the Radio Sub System (RSS).

The requirements of the present document are mandatory for implementation in all GSM Base Station Systems (BSS)s and Mobile Stations (MS)s capable of supporting the half rate speech traffic channel.

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.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

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[1] GSM 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".

[2] GSM 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".

[3] GSM 06.20: "Digital cellular telecommunications system (Phase 2+); Half rate speech; Half rate speech transcoding".

[4] GSM 06.41: "Digital cellular telecommunications system (Phase 2+); Half rate speech; Discontinuous Transmission (DTX) for half rate speech traffic channels".

[5] GSM 06.06: "Digital cellular telecommunications system (Phase 2+); Half rate speech; ANSI-C code for the GSM half rate speech codec".

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3 Definitions and abbreviations

3.1 Definitions

The definitions of terms used in the present document can be found in GSM 06.20 [3], GSM 06.41 [4], GSM 05.03 [2].

3.2 Abbreviations

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

BFI	Bad Frame Indication
BSS	Base Station System
DTX	Discontinuous Transmission
GSM	Global System for Mobile communications
LPC	Linear Predictive Coding
MS	Mobile Station
RX	Receive
RSS	Radio Sub System

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SID	SIlence Descriptor
UFI	Unreliable Frame Indication

For abbreviations not given in this subclause, see GSM 01.04 [1].

4 General

The RSS indicates lost speech or SID frames by setting the Bad Frame Indication (BFI) flag and unreliably decoded speech or SID frames by setting the Unreliable Frame Indication (UFI) flag.

If the BFI flag is set, the speech decoder performs frame substitution and muting of the speech output. The purpose of frame substitution is to conceal the effect of lost frames. The purpose of muting the speech output in case of several lost frames is to indicate the breakdown of the channel to the Mobile Station (MS) user in a way that avoids excessively unpleasant sounds.

If the UFI flag is set, the speech decoder performs a plausibility analysis of the received frame parameters and of the output signal aiming at the detection and concealment of erroneous frames which are not marked with the BFI flag.

5 Requirements

5.1 Error detection and concealment in case of unreliable speech or SID frames

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A cleared BFI flag (BFI= "0") and a set UFI flag (UFI="1") indicate a probably erroneous speech or SID frame. To improve the subjective quality, the probability of decoding erroneous frames shall be decreased by additional error detection which is based on both the exploitation of the frame parameters' properties and the decoder output signal's properties.

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5.1.1 Error detection

By investigating the frame parameter properties, it shall be decided whether the frame is to be considered as usable or unusable. In the latter case, the BFI flag is set and substitution and muting is performed (subclause 5.2). Subclause 6.1 gives an example solution for error detection in case of unreliable frames.

5.1.2 Output signal concealment

If the frame is considered as usable, properties of the decoder output signal shall be compared to the corresponding signal properties of the previous valid frames. In case of large differences, the output signal shall be modified such that these differences are limited. Subclause 6.2 gives an example solution for output signal concealment in case of unreliable frames.

5.2 Frame substitution and muting in case of lost speech or SID frames

A set BFI flag (BFI="1") indicates a lost speech or SID frame. Normal decoding of these frames would result in a degradation of the subjective quality of the speech. To improve the subjective quality of the speech, the frame parameters shall be appropriately modified prior to the execution of the speech decoder functions.

5.2.1 First and second lost speech frame

The first and second lost speech frame shall be partly or completely substituted with the last valid speech frame. For the first and second lost speech frame, the output shall not be muted directly.