



SLOVENSKI STANDARD

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Digital cellular telecommunications system (Phase 2+) (GSM); Substitution and muting of lost frames for Enhanced Full Rate (EFR) speech traffic channels (GSM 06.61 version 8.0.1 Release 1999)

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European Standard (Telecommunications series)

**Digital cellular telecommunications system (Phase 2+);
Substitution and muting of lost frames for Enhanced
Full Rate (EFR) speech traffic channels
(GSM 06.61 version 8.0.1 Release 1999)**

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Foreword

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

The present document defines a frame substitution and muting procedure which is used by the Receive (RX) Discontinuous Transmission (DTX) handler when one or more lost speech or Silence Descriptor (SID) frames are received from the Radio Sub System (RSS) within the digital cellular telecommunications system.

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 8.x.y

where:

- 8 indicates Release 1999 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.

National transposition dates

Date of adoption of this EN:	3 November 2000
Date of latest announcement of this EN (doa):	28 February 2001
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2001
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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 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 enhanced Full Rate speech traffic channel. It is not mandatory to follow the bit exact implementation outlined in the present document and the corresponding C-source code.

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 1999 document, references to GSM documents are for Release 1999 versions (version 8.x.y).

- [1] GSM 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".
- [2] GSM 06.60: "Digital cellular telecommunications system (Phase 2+); Enhanced Full Rate (EFR) speech transcoding".
- [3] GSM 06.81: "Digital cellular telecommunications system (Phase 2+); Discontinuous transmission (DTX) for Enhanced Full Rate (EFR) speech traffic channels".
- [4] GSM 08.60: "Digital cellular telecommunications system (Phase 2+); Inband control of remote transcoders and rate adaptors for Enhanced Full Rate (EFR) and full rate traffic channels".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following term and definition applies:

5-point median operation: consists of sorting the 5 elements belonging to the set for which the median operation is to be performed in an ascending order according to their values, and selecting the third largest value of the sorted set as the median value.

Further definitions of terms used in the present document can be found in GSM 06.60 [2], GSM 06.81 [3], GSM 05.03 [1] and GSM 08.60 [4].

3.2 Abbreviations

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

BFI	Bad Frame Indication from Radio Sub System
BSI_Abis	Bad Sub-block Indication obtained from A-bis CRC checks
CCU	Channel Coding Unit
CRC	Cyclic Redundancy Check
DTX	Discontinuous transmission
median5	5-point median operation
PrevBFI	Bad Frame Indication of Previous frame
RSS	Radio Sub System
RX	Receive
SID	Silence Descriptor frame
TRAU	Transcoding Rate Adaptation Unit

4 General

The purpose of frame substitution is to conceal the effect of lost frames. The purpose of muting the output in the case of several lost frames is to indicate the breakdown of the channel to the user and to avoid generating possible annoying sounds as a result from frame substitution procedure.

The RSS indicates lost speech or SID frames by setting its Bad Frame Indication flag (BFI) based on its 3-bit and 8-bit CRCs and possibly other error detection mechanisms. The TRAU calculates from the CRCs inserted by the CCU in the TRAU frames one BSI_Abis flag for every sub-block of speech parameters. If either one or more of these flags is set, the speech decoder shall either perform frame substitution or subframe substitution.

The example solution provided in clause 6 applies only for bad frame handling on a complete speech frame basis. However some parts could be modified for substitution of bad sub-blocks.

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5 Requirements

5.1 Error detection

An error is detected and the BFI-flag is set-by the RSS according to the principle described in clause 4.

5.2 Lost speech frames

Normal decoding of lost speech frames would result in very unpleasant noise effects. In order to improve the subjective quality, lost speech frames shall be substituted with either a repetition or an extrapolation of the previous good speech frame(s). This substitution is done so that it will gradually decrease the output level, resulting in silencing of the output. Clause 6.1 gives an example solution.

5.3 First lost SID frame

A single lost SID frame shall be substituted by the last valid SID frame and the procedure for valid SID frames be applied as described in GSM 06.81 [3].

5.4 Subsequent lost SID frames

For the second lost SID frame, a muting technique shall be used on the comfort noise that will gradually decrease the output level (-3 dB/frame), resulting in silencing of the output of the decoder.

For subsequent lost SID frames, the muting of the output shall be maintained. Clause 6.2 gives an example solution.

6 Example solution

The C-code of the following example is embedded in the bit exact software of the enhanced full rate codec.

6.1 Example solution for substitution and muting of lost speech frames

This example solution for substitution and muting is based on a state machine with seven states (figure 1).

The system starts in state 0. Each time a bad frame is detected, the state counter is incremented by one and is saturated when it reaches 6. Each time a good speech frame is detected, the state counter is reset to zero, except when we are in state 6, where we set the state counter to 5. The state indicates the quality of the channel: the bigger the state counter, the worse the channel quality is. The control flow of the state machine can be described with the following C-code (**BFI** = bad frame indicator, **State** = state variable):

```
if(BFI != 0 )
    State = State + 1;
else if(State == 6)
    State = 5;
else
    State = 0;
if(State > 6 )
    State = 6;
```

In addition to this state machine, the **Bad Frame Flag** from the previous frame is checked (**PrevBFI**). The processing depends on the value of the **State**-variable. In states 0 and 5, the processing depends also on the two flags **BFI** and **PrevBFI**.

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