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Universal Mobile Telecommunications System (UMTS);
LTE;
5G;
Mandatory speech codec speech processing functions;
Adaptive Multi-Rate (AMR) speech codec test sequences
(3GPP TS 26.074 version 17.0.1 Release 17)**

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Contents

Foreword

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1 Scope

The present document specifies the digital test sequences for the adaptive multi-rate (AMR) speech codec. These sequences test for a bit exact implementation of the adaptive multi-rate speech transcoder (TS 26.090 [2]), voice activity detection (TS 26.094 [5]), comfort noise (TS 26.092 [3]), and source controlled rate operation (TS 26.093 [4]).

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.
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[1] 3GPP TS 26.071: "AMR Speech Codec; General Description".

[2] 3GPP TS 26.090: "AMR Speech Codec; Speech Transcoding Functions".

[3] 3GPP TS 26.092: "AMR Speech Codec; Comfort Noise Aspects".

[4] 3GPP TS 26.093: "AMR Speech Codec; Source Controlled Rate Operation".

[5] 3GPP TS 26.094: "AMR Speech Codec; Voice Activity Detector".

[6] 3GPP TS 26.091: "AMR Speech Codec; Error Concealment of Lost Frames".

[7] 3GPP TS 26.073: "AMR Speech Codec; ANSI C-code".

[8] 3GPP TS 46.054: "Test sequences for the GSM Enhanced Full Rate (EFR) speech codec".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 26.090 [2], TS 26.091 [6], TS 26.092 [3], TS 26.093 [4] and TS 26.094 [5] apply.

3.2 Abbreviations

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

[T.B.A]

4 General

Digital test sequences are necessary to test for a bit exact implementation of the adaptive multi-rate speech transcoder (TS 26.090 [2]), voice activity detection (TS 26.094 [5]), comfort noise generation (TS 26.092 [3]), and source controlled rate operation (TS 26.093 [4]).

The test sequences may also be used to verify installations of the ANSI C code in TS 26.073 [7].

Clause 5 describes the format of the files which contain the digital test sequences. Clause 6 describes the test sequences for the speech transcoder. Clause 7 describes the test sequences for the VAD, comfort noise and source controlled rate operation.

Clause 8 describes the method by which synchronisation is obtained between the test sequences and the speech codec under test.

[Clause 9 describes the alternative acceptance testing of the speech encoder and decoder in the TRAU by means of 8 bit A- or μ-law compressed test sequences on the A-Interface.]

5 Test sequence format

This clause provides information on the format of the digital test sequences for the GSM adaptive multi-rate speech transcoder (TS 26.090 [2]), voice activity detection (TS 26.094 [5]), comfort noise generation (TS 26.092 [3]), and source controlled rate operation (TS 26.093 [4]).

5.1 File format

The test sequence files in PC (little-endian) byte order are provided in archive files (ZIP format) which accompany the present document.

Following decompression, three types of file are provided:

- Files for input to the speech encoder: *.INP
- Files for comparison with the encoder output and for input to the speech decoder: *.COD
- Files for comparison with the decoder output: *.OUT
- One mode control file for the mode switching test T21.MOD

All file formats are described in TS 26.073 [7].

5.2 Codec homing

Each *.INP file includes two homing frames (see TS 26.073 [7]) at the start of the test sequence. The function of these frames is to reset the speech encoder state variables to their initial value. In the case of a correct installation of the ANSI-C simulation (TS 26.073 [7]), all speech encoder output frames shall be identical to the corresponding frame in the *.COD file. In the case of a correct hardware implementation undergoing testing, the first speech encoder output frame is undefined and need not be identical to the first frame in the *.COD file, but all remaining speech encoder output frames shall be identical to the corresponding frames in the *.COD file.

The function of the two homing frames in the *.COD files is to reset the speech decoder state variables to their initial value. In the case of a correct installation of the ANSI-C simulation (TS 26.073 [7]), all speech decoder output frames shall be identical to the corresponding frame in the *.OUT file. In the case of a correct hardware implementation undergoing testing, the first speech decoder output frame is undefined and need not be identical to first frame in the *.OUT file, but all remaining speech decoder output frames shall be identical to the corresponding frames in the *.OUT file.

6 Speech codec test sequences

This clause describes the test sequences designed to exercise the adaptive multi-rate speech transcoder (TS 26.090 [2]).

6.1 Codec configuration

The speech encoder shall be configured not to operate in the source controlled rate mode.

6.2 Speech codec test sequences

6.2.1 Speech encoder test sequences

Twenty-two encoder input sequences are provided. Note that for the input sequences T00.INP to T03.INP, the amplitude figures are given in 13-bit precision. The active speech levels are given in dBov.

- T00.INP - Synthetic harmonic signal. The pitch delay varies slowly from 18 to 143.5 samples. The minimum and maximum amplitudes are -997 and +971.
- T01.INP - Synthetic harmonic signal. The pitch delay varies slowly from 144 down to 18.5 samples. Amplitudes at saturation point -4096 and +4095.
- T02.INP - Sinusoidal sweep varying from 150 Hz to 3400 Hz. Amplitudes ± 1250.
- T03.INP - Sinusoidal sweep varying from 150 Hz to 3400 Hz. Amplitudes ± 4000.
- T04.INP - Female speech, active speech level: -19.4 dBov, flat frequency response.
- T05.INP - Male speech, active speech level: -18.7 dBov, flat frequency response.
- T06.INP - Female speech, ambient noise, active speech level: -35.0 dBov, flat frequency response.
- T07.INP - Female speech, ambient noise, active speech level: -25.0 dBov, flat frequency response.
- T08.INP - Female speech, ambient noise, active speech level: -15.6 dBov, flat frequency response.
- T09.INP - Female speech, car noise, active speech level: -35.5 dBov, flat frequency response.
- T10.INP - Female speech, car noise, active speech level: -26.1 dBov, flat frequency response.
- T11.INP - Female speech, car noise, active speech level: -15.8 dBov, flat frequency response.
- T12.INP - Male speech, ambient noise, active speech level: -34.9 dBov, flat frequency response.
- T13.INP - Male speech, ambient noise, active speech level: -24.8 dBov, flat frequency response.
- T14.INP - Male speech, ambient noise, active speech level: -15.0 dBov, flat frequency response.
- T15.INP - Male speech, babble noise, active speech level: -34.1 dBov, flat frequency response.
- T16.INP - Male speech, babble noise, active speech level: -24.3 dBov, flat frequency response.
- T17.INP - Male speech, babble noise, active speech level: -14.4 dBov, flat frequency response.
- T18.INP - Female speech, ambient noise, active speech level: -26.0 dBov, modified IRS frequency response, with many zero frames.
- T19.INP - Male speech, ambient noise, active speech level: -36.0 dBov, modified IRS frequency response, with many zero frames.
- T20.INP - Sequence for exercising the LPC vector quantisation codebooks and ROM tables of the codec.
- T21.INP - Speech sequence for mode switching test.

The output using these input sequences will be different depending on the tested adaptive multi-rate mode. In the notation used below <mode> should be changed to the number of the tested mode, i.e. one of 122, 102, 795, 74, 67, 59, 515, or 475.

The T00.INP and T01.INP sequences were designed to test the pitch lag of the GSM adaptive multi-rate speech encoder. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the T00_<mode>.COD and T01_<mode>.COD sequences, respectively.

The T02.INP and T03.INP sequences are particularly suited for testing the LPC analysis, as well as for finding saturation problems. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the T02_<mode>.COD and T03_<mode>.COD sequences, respectively.

The T04.INP and T05.INP sequences contain a lot of low-frequency components. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the T04_<mode>.COD and T05_<mode>.COD sequences, respectively.

The T18.INP and T19.INP sequences contain some "all zeros" frames (silence) in between segments of speech. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the T18_<mode>.COD and T19_<mode>.COD sequences, respectively.

The T20.INP sequence was designed to exercise the LPC code indices and the ROM table indices of the codec.

The sequences T06.INP to T17.INP were selected on the basis of bringing various input characteristics (background noise) and levels to the test sequence set. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the T06_<mode>.COD to T17_<mode>.COD sequences, respectively.

The T21.INP sequence was designed to test mode switching in the encoder. For testing mode switching this sequence is used together with the mode control file T21.MOD. See TS 26.073 [7] for the format of the mode control file. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the sequence T21.COD. Note that T21.COD contains parameter frames in different codec modes.

6.2.2 Speech decoder test sequences

Twenty-one times eight speech decoder input sequences TXX_<mode>.COD (XX = 00..20, <mode> = {122, 102, 795, 74, 67, 59, 515, or 475}) are provided for the static mode tests. These are the output of the corresponding TXX.INP sequences, one set per mode. In a correct implementation, the resulting speech decoder output shall be identical to the corresponding TXX_<mode>.OUT sequences.

The switching test decoder input T21.COD shall result in decoder output identical to the T21.OUT sequence. For the decoder switching test no special mode control file is needed since the mode information is included in the .COD file according to the file format (see TS 26.073 [7]).

6.2.3 Codec homing sequence

In addition to the test sequences described above, the homing sequences are provided to assist in codec testing. T22.INP contains one encoder-homing-frame. The sequences T22_<mode>.COD (<mode> = {122, 102, 795, 74, 67, 59, 515, or 475}) contain one decoder-homing-frame each for the corresponding mode. The use of these sequences is described in TS 26.071 [1].

All files are contained in the archive T.TGZ which accompanies the present document.

7 Test sequences for source controlled rate operation

This clause describes the test sequences designed to exercise the VAD algorithm options 1 and 2 (TS 26.094 [5]), comfort noise (TS 26.092 [3]), and source controlled rate operation (TS 26.093 [4]).

Test sequences DTX*.* are to be used with VAD option 1. DTX1.*, DTX2.*, and DTX4.* shall be run only with speech codec mode MR122. Test sequence DTX3.* shall be run for all the speech codec modes (MR122, MR102, MR795, MR67, MR59, MR515 and MR475).

Test sequencesDT2.*.* are to be used with VAD option 2. DT21.*, DT23.*, and DT24.* shall be run only with speech codec mode MR122. Test sequence DT22.* shall be run for all the speech codec modes (MR122, MR102, MR795, MR67, MR59, MR515 and MR475).

7.1 Codec configuration

The VAD, comfort noise and source controlled rate operation shall be tested in conjunction with the speech coder (TS 26.090 [2]). The speech encoder shall be configured to operate in the source controlled rate mode, with either VAD option1 or VAD option 2.

7.2 Test Sequences

Each DTX test sequence consists of three files:

- Files for input to the speech encoder: *.INP
- Files for comparison with the encoder output and input to the speech decoder: *.COD
- Files for comparison with the decoder output: *.OUT

The *.COD and *.OUT file names has the format DTxA_<mode>.*, where "x" is the VAD option (X for option 1 and 2 for option 2), "A" is the test case number (1, 2, 3 or 4) and <mode> is the speech codec mode.

In a correct implementation, the speech encoder parameters generated by the *.INP file shall be identical to those specified in the *.COD file; and the speech decoder output generated by the *.COD file shall be identical to that specified in the *.OUT file.

Sequence name	No. of frames	Size (bytes)		
		*.INP	*.COD	*.OUT
DTX1	710	227 200	355 000	227 200
DTX2	898	287 360	449 000	287 360
DTX3	1620	518 400	810 000	518 400
DTX4	1188	380 160	594 000	380 160
DT21	938	300 160	469 000	300 160
DT22	616	197 280	308 000	197 120
DT23	938	300 320	469 000	300 160
DT24	1188	380 160	594 000	380 160

7.2.1 Test sequences for background noise estimation

Background noise estimation algorithm is tested by the following test sequences:

DTX1.*

DTX2.*

DT21.*

DT22.*