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**Universal Mobile Telecommunications System (UMTS);
LTE;
Codec for Enhanced Voice Services (EVS);
ANSI C code (fixed-point)
(3GPP TS 26.442 version 12.1.0 Release 12)**



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Foreword

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Version x.y.z

where:

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document contains an electronic copy of the ANSI-C code for the Enhanced Voice Services (EVS) Codec. The ANSI-C code is necessary for a bit exact implementation of the EVS Codec (3GPP TS 26.445), Voice Activity Detection (VAD) (3GPP TS 26.451), Comfort Noise Generation (CNG) (3GPP TS 26.449), Discontinuous Transmission (DTX) (3GPP TS 26.450), Packet Loss Concealment (PLC) of Lost Packets (3GPP TS 26.447), Jitter Buffer Management (JBM) (3GPP TS 26.448), and AMR-WB Interoperable Function (3GPP TS 26.446). Requirements for any implementation of the EVS codec to be standard compliant are specified in 3GPP TS 26.444 (Test sequences).

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 26.445: "Codec for Enhanced Voice Services (EVS); Detailed Algorithmic Description".
- [3] 3GPP TS 26.451: "Codec for Enhanced Voice Services (EVS); Voice Activity Detection (VAD)".
- [4] 3GPP TS 26.449: "Codec for Enhanced Voice Services (EVS); Comfort Noise Generation (CNG) Aspects".
- [5] 3GPP TS 26.450: "Codec for Enhanced Voice Services (EVS); Discontinuous Transmission (DTX)".
- [6] 3GPP TS 26.447: "Codec for Enhanced Voice Services (EVS); Error Concealment of Lost Packets".
- [7] 3GPP TS 26.448: "Codec for Enhanced Voice Services (EVS); Jitter Buffer Management".
- [8] 3GPP TS 26.446: "Codec for Enhanced Voice Services (EVS); AMR-WB Backward Compatible Functions".
- [9] 3GPP TS 26.444: "Codec for Enhanced Voice Services (EVS); Test Sequences".
- [10] IETF RFC 3550: "RTP: A Transport Protocol for Real-Time Applications".
- [11] Recommendation ITU-T G.191 (03/10): "Software tools for speech and audio coding standardization".
- [12] Recommendation ITU-T G.192: "A common digital parallel interface for speech standardization activities".

3 Definitions and abbreviations

3.1 Definitions

Definition of terms used in the present document, can be found in 3GPP TS 26.445 [2], 3GPP TS 26.451 [3], 3GPP TS 26.449 [4], 3GPP TS 26.450 [5], 3GPP TS 26.447 [6], 3GPP TS 26.448 [7] and 3GPP TS 26.446 [8].

3.2 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].

| | |
|--------|--|
| ACELP | Algebraic Code-Excited Linear Prediction |
| AMR-WB | Adaptive Multi Rate Wideband (codec) |
| CNG | Comfort Noise Generator |
| DTX | Discontinuous Transmission |
| EVS | Enhanced Voice Services |
| FB | Fullband |
| FEC | Frame Erasure Concealment |
| IP | Internet Protocol |
| JBM | Jitter Buffer Management |
| MSB | Most Significant Bit |
| MTSI | Multimedia Telephony Service for IMS |
| NB | Narrowband |
| PS | Packet Switched |
| PSTN | Public Switched Telephone Network |
| SAD | Sound Activity Detection |
| SC-VBR | Source Controlled - Variable Bit Rate |
| SID | Silence Insertion Descriptor |
| SWB | Super Wideband |
| VAD | Voice Activity Detection |
| WB | Wideband |
| WMOPS | Weighted Millions of Operations Per Second |

4 C code structure

This clause gives an overview of the structure of the bit-exact C code and provides an overview of the contents and organization of the C code attached to the present document.

The C code has been verified on the following systems:

- IBM PC compatible computers with Windows 7 or 8 operating system and Microsoft Visual C++ 2010 compiler, 32 bit builds.
- IBM PC compatible computers with Linux operating system and GNU gcc compiler version 4.3.x, 32 bit builds.

ANSI-C was selected as the programming language because portability was desirable.

4.1 Contents of the C source code

The C code distribution is organized as follows:

Table 1: Source code directory structure

| Directory | Description |
|-----------------|---|
| README.txt | information on how to compile |
| Makefile | UNIX style encoder Makefile |
| Workspace_msvc/ | Directory for the MSVC 2010 project files |
| basic_op/ | Source code files containing all ITU-T fixed-point basic operators. |
| basic_math/ | Source code files contains mathematical fixed-point functions |
| lib_com/ | Source code files used in encoder and decoder |
| lib_dec/ | Source code files used solely in the decoder |
| lib_enc/ | Source code files used solely in the encoder |

The distributed files with suffix "c" contain the source code and the files with suffix "h" are the header files. The ROM data is contained in files named "rom_xxx" with suffix "c".

Makefiles are provided for the platforms in which the C code has been verified (listed above). Once the software is installed, this directory will have a compiled version of the encoder (named EVS_cod) and the decoder (named EVS_dec).

4.2 Program execution

The codec for Enhanced Voice Services is implemented in two programs:

- EVS_cod: speech/audio encoder;
- EVS_dec: speech/audio decoder.

The programs should be called like:

- EVS_cod [encoder options] <speech/audio input file> <parameter file>;
- EVS_dec [decoder options]<parameter file> <speech/audio output file>.

The speech/audio files contain 16-bit linear encoded PCM speech/audio samples and the parameter files contain encoded speech/audio data.

The encoder and decoder options will be explained by running the applications without input arguments. See the file readme.txt for more information on how to run the *encoder* and *decoder* programs.

5 File formats

This clause describes the file formats used by the encoder and decoder programs. The test sequences defined in [1] also use the file formats described here.

5.1 Speech file (encoder input / decoder output)

Speech files read by the encoder and written by the decoder consist of 16-bit words speech/audio sample. The byte order depends on the host architecture (e.g. LSByte first on PCs, etc.). Both the encoder and the decoder program process complete frames (corresponding to 20 ms, for example, 640 samples at 32 kHz sampling frequency) only.

This means that the encoder will only process n frames if the length of the input file is $n*320 + k$ words, while the files produced by the decoder will always have a length of $n*320$ words.

5.2 Rate switching profile (encoder input)

The encoder program can optionally read in a rate switching profile which specifies the encoding bitrate for each frame of speech processed. The file is a binary file, generated by 'gen-rate-profile', which is part of STL 2009, as contained in ITU-T G.191 [11].

5.3 Parameter bitstream file (encoder output / decoder input)

The files produced by the speech/audio encoder/expected by the speech decoder contain an arbitrary number of frames in the following available formats.

5.3.1 ITU-T G.192 compliant format

| | | | | | |
|-----------|-------------|----|----|-----|-----|
| SYNC_WORD | DATA_LENGTH | B1 | B2 | ... | Bnn |
|-----------|-------------|----|----|-----|-----|

Each box corresponds to one `Word16` value in the bitstream file, for a total of $2+nn$ words or $4+2nn$ bytes per frame, where nn is the number of encoded bits in the frame. Each encoded bit is represented as follows: Bit 0 = 0x007f, Bit 1 = 0x0081. The fields have the following meaning:

- **SYNC_WORD**: Word to ensure correct frame synchronization between the encoder and the decoder. It is also used to indicate the occurrences of bad frames.
 - In the encoder output: (0x6b21)
 - In the decoder input:
 - Good frames (0x6b21)
 - Bad frames (0x6b20)
- **DATA_LENGTH**: Length of the speech data. Codec mode and frame type is extracted in the decoder using this parameter

5.4 VoIP parameter bitstream file (decoder input)

| | | | |
|-------------|--------------|------------|--------------------------|
| Packet size | Arrival time | RTP header | G.192 format (see 5.3.1) |
|-------------|--------------|------------|--------------------------|

The fields have the following size and meaning:

- Packet size: 32 bit unsigned integer. ($= 12 + 2 + \text{DATA_LENGTH}$)
- Arrival time: 32 bit unsigned integer. in ms.
- RTP header: 96 bits (see RFC 3550 [10]), including RTP timestamp and SSRC.

Annex A (informative): Change history

| Change history | | | | | | | |
|----------------|-------|-----------|------|-----|---|--------|--------|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| 2014-09 | 65 | SP-140458 | | | Presented at TSG SA#65 foir approval | | 1.0.0 |
| 2014-09 | 65 | | | | Approved at TSG SA#65 | 1.0.0 | 12.0.0 |
| 2014-12 | 66 | SP-140724 | 0001 | | Cleanup of EVS Fixed Point Source Code | 12.0.0 | 12.1.0 |
| 2014-12 | 66 | SP-140724 | 0002 | | Bugfixes to EVS Fixed Point Source Code | 12.0.0 | 12.1.0 |
| 2014-12 | 66 | SP-140724 | 0003 | 1 | Update of Scope | 12.0.0 | 12.1.0 |

History

| Document history | | |
|-------------------------|--------------|-------------|
| V12.0.0 | October 2014 | Publication |
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