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Technical Specification

3rd Generation Partnership Project;

Technical Specification Group Services and System Aspects;

ANSI-C code for the fixed-point   
Extended Adaptive Multi-Rate - Wideband (AMR-WB+)   
speech codec

(Release 16)

** 

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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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

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where:

x the first digit:

1 presented to TSG for information;

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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 Fixed-point Extended Adaptive Multi‑Rate Wideband codec. Alternatively, floating-point ANSI-C code is specified in 3GPP TS 26.304 [1]. The fixed-point codec/encoder/decoder specified in the present document or the floating-point codec/encoder/decoder specified in 3GPP TS 26.304 [1] may be used depending on if the implementation platform is better suited for a floating-point or a fixed-point implementation. It has been verified that the fixed-point and floating-point codecs interoperate with each other without any artifacts.

The fixed-point ANSI‑C code in the present document defines, besides the floating-point c-code specified in 3GPP TS 26.304 [1], one valid reference implementation of the Extended Adaptive Multi-Rate Wideband transcoder (3GPP TS 26.290 [2]). Standard conformance it is enforced by meeting the conformance criteria defined in 3GPP TS 26.274 [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.

- 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 TS 26.304: "Extended Adaptive Multi-Rate - Wideband (AMR-WB+) codec; Floating-point ANSI-C code".

[2] 3GPP TS 26.290: "Audio codec processing functions; Extended Adaptive Multi-Rate - Wideband (AMR-WB+) codec; Transcoding functions".

[3] 3GPP TS 26.274: "Speech codec speech processing functions; Extended Adaptive Multi-Rate - Wideband (AMR-WB+) speech codec; Conformance testing".

[4] 3GPP TS 26.244: "Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (3GP)".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions are given in 3GPP TS 26.290 [1].

## 3.2 Abbreviations

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

AMR-WB+ Extended Adaptive Multi-Rate WideBand

ANSI American National Standards Institute

ETS European Telecommunication Standard

GSM Global System for Mobile communications

I/O Input/Output

RAM Random Access Memory

ROM Read Only Memory

# 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/AT compatible computers with Windows 2000 SP4 and Microsoft Visual C++ v.6.0 compiler.

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

## 4.1 Contents of the C source code

The C code distribution has the files divided in six different directories, all present in the directory *c-code*. The directories are: *common\_fx, decoder\_fx, encoder\_fx, lib\_amr\_fx* *include\_fx* and *basic\_op*. The distributed files with suffix "c" contain the source code and the files with suffix "h" are the header files.

Project and workspace files are provided in the directory *MSVC*.

## 4.2 Program execution

The Extended Adaptive Multi-Rate Wideband codec is implemented in two programs:

*-* (*encoder*) audio encoder;

*-* (*decoder*) audio decoder.

The programs should be called like:

- encoder [encoder options] -if <audio input file> -of <parameter file>;

- decoder [decoder options] -if <parameter file> -of <audio output file>.

The input files contain one or two channels of 16-bit linear encoded PCM audio samples stored in the *wav* file format and the parameter files contain encoded audio data and some additional flags.

The encoder and decoder options will be explained by running the applications without input arguments. Detailed information explaining the use of the AMR-WB+ encoder and decoder programs is provided in the user's guide in Annex A of [1]. See also the file readme.txt for condensed information on how to run the *encoder* and *decoder* programs.

## 4.3 Code hierarchy

Tables 1 and 2 are call graphs that show the functions used in the audio codec.

Each column represents a call level and each cell a function. The functions contain calls to the functions in rightwards neighbouring cells. The time order in the call graphs is from the top downwards as the processing of a frame advances. All standard C functions: printf(), fwrite(), etc. have been omitted. Also, no basic operations (add(), L\_add(), mac(), etc.) or double precision extended operations (e.g. L\_Extract(), Copy() or Set\_zero()) appear in the graphs. The initialization of the static RAM (i.e. calling the \_init functions) is also omitted.

The basic operations are not counted as extending the depth, therefore the deepest level in this software is level 6.

Table 1: Encoder call structure

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| coder\_amrwb\_plus\_stereo |  |  |  |  |  |  |  |  |
|  | Scale\_speech\_st |  |  |  |  |  |  |  |
|  | Rescale\_enc\_mem\_st |  |  |  |  |  |  |  |
|  |  | Scale\_sig |  |  |  |  |  |  |
|  | Decim\_12k8\_p |  |  |  |  |  |  |  |
|  |  | Interpol |  |  |  |  |  |  |
|  | HP50\_12k8\_p |  |  |  |  |  |  |  |
|  | Mix\_ch |  |  |  |  |  |  |  |
|  | Preemph\_scaled |  |  |  |  |  |  |  |
|  | Rescale\_enc\_mem\_st |  |  |  |  |  |  |  |
|  | Coder\_lf |  |  |  |  |  |  |  |
|  |  | AutocorrPlus |  |  |  |  |  |  |
|  |  | Lag\_window\_p |  |  |  |  |  |  |
|  |  | Levinson |  |  |  |  |  |  |
|  |  | Az\_isp |  |  |  |  |  |  |
|  |  |  | Chebps2 |  |  |  |  |  |
|  |  | Int\_lpc |  |  |  |  |  |  |
|  |  |  | Isp\_Az |  |  |  |  |  |
|  |  |  |  | Get\_isp\_pol |  |  |  |  |
|  |  | Find\_wsp |  |  |  |  |  |  |
|  |  |  | Weight\_a |  |  |  |  |  |
|  |  |  | Residu2 |  |  |  |  |  |
|  |  |  | Deemph |  |  |  |  |  |
|  |  | LP\_Decim2 |  |  |  |  |  |  |
|  |  | Scale\_sig |  |  |  |  |  |  |
|  |  | scale\_mem\_Hp\_wsp |  |  |  |  |  |  |
|  |  | Pitch\_med\_ol |  |  |  |  |  |  |
|  |  |  | Hp\_wsp |  |  |  |  |  |
|  |  | Isp\_isf |  |  |  |  |  |  |
|  |  | Qpisf\_2s\_46b |  |  |  |  |  |  |
|  |  |  | VQ\_stage1 |  |  |  |  |  |
|  |  |  | Sub\_VQ |  |  |  |  |  |
|  |  |  | Dpisf\_2s\_46b |  |  |  |  |  |
|  |  |  |  | Reorder\_isf |  |  |  |  |
|  |  | coder\_acelp |  |  |  |  |  |  |
|  |  |  | Scale\_sig |  |  |  |  |  |
|  |  |  | Residu |  |  |  |  |  |
|  |  |  | Weight\_a |  |  |  |  |  |
|  |  |  | Syn\_filt |  |  |  |  |  |
|  |  |  | Deemph2 |  |  |  |  |  |
|  |  |  | Preemph |  |  |  |  |  |
|  |  |  | Syn\_filt\_s |  |  |  |  |  |
|  |  |  | Pitch\_fr4 |  |  |  |  |  |
|  |  |  |  | Norm\_Corr |  |  |  |  |
|  |  |  |  |  | Convolve |  |  |  |
|  |  |  |  | Interpol\_4 |  |  |  |  |
|  |  |  | Pred\_lt4 |  |  |  |  |  |
|  |  |  | Convolve |  |  |  |  |  |
|  |  |  | G\_pitch |  |  |  |  |  |
|  |  |  | Updt\_tar |  |  |  |  |  |
|  |  |  | Pit\_shrp |  |  |  |  |  |
|  |  |  | cor\_h\_x |  |  |  |  |  |
|  |  |  | ACELP\_4t64\_fx |  |  |  |  |  |
|  |  |  |  | cor\_h\_vec |  |  |  |  |
|  |  |  |  | search\_ixiy |  |  |  |  |
|  |  |  |  | Quant\_2p\_2N1 |  |  |  |  |
|  |  |  |  | Quant\_1p\_N1 |  |  |  |  |
|  |  |  |  | Quant\_3p\_3N1 |  |  |  |  |
|  |  |  |  |  | Quant\_2p\_2N1 |  |  |  |
|  |  |  |  | Quant\_4p\_4N |  |  |  |  |
|  |  |  |  |  | Quant\_4p\_4N1 |  |  |  |
|  |  |  |  |  |  | Quant\_2p\_2N1 |  |  |
|  |  |  |  | Quant\_5p\_5N |  |  |  |  |
|  |  |  |  |  | Quant\_3p\_3N1 |  |  |  |
|  |  |  |  |  |  | Quant\_2p\_2N1 |  |  |
|  |  |  |  | Quant\_6p\_6N\_2 |  |  |  |  |
|  |  |  |  |  | Quant\_5p\_5N |  |  |  |
|  |  |  |  |  |  | Quant\_3p\_3N1 |  |  |
|  |  |  |  |  |  |  | Quant\_2p\_2N1 |  |
|  |  |  |  |  | Quant\_4p\_4N |  |  |  |
|  |  |  |  |  |  | Quant\_4p\_4N1 |  |  |
|  |  |  |  |  |  |  | Quant\_2p\_2N1 |  |
|  |  |  |  |  | Quant\_3p\_3N1 |  |  |  |
|  |  |  |  |  |  | Quant\_2p\_2N1 |  |  |
|  |  |  |  |  | Quant\_2p\_2N1 |  |  |  |
|  |  |  |  |  | Quant\_1p\_N1 |  |  |  |
|  |  |  | Q\_gain2\_plus |  |  |  |  |  |
|  |  | Segsnr |  |  |  |  |  |  |
|  |  | Coder\_tcx |  |  |  |  |  |  |
|  |  |  | Cos\_window |  |  |  |  |  |
|  |  |  | Weight\_a |  |  |  |  |  |
|  |  |  | Residu2 |  |  |  |  |  |
|  |  |  | Deemph |  |  |  |  |  |
|  |  |  | fft9\_fx |  |  |  |  |  |
|  |  |  |  | init\_r\_fft\_fx |  |  |  |  |
|  |  |  |  | r\_fft\_fx |  |  |  |  |
|  |  |  | FFT\_reorder |  |  |  |  |  |
|  |  |  | Adap\_low\_freq\_emph |  |  |  |  |  |
|  |  |  |  | SpPeak1k6 |  |  |  |  |
|  |  |  | AVQ\_Cod |  |  |  |  |  |
|  |  |  |  | RE8\_PPV\_FX |  |  |  |  |
|  |  |  |  |  | Nearest\_neighbor\_2D8 |  |  |  |
|  |  |  | Scale\_tcx\_ifft |  |  |  |  |  |
|  |  |  |  | Scale\_sig |  |  |  |  |
|  |  |  | Adap\_low\_freq\_deemph |  |  |  |  |  |
|  |  |  |  | SpPeak1k6 |  |  |  |  |
|  |  |  |  | Deemph1k6 |  |  |  |  |
|  |  |  | Ifft\_reorder |  |  |  |  |  |
|  |  |  | ifft9\_fx |  |  |  |  |  |
|  |  |  |  | r\_fft\_fx |  |  |  |  |
|  |  |  | Get\_gain |  |  |  |  |  |
|  |  |  | Q\_gain\_tcx |  |  |  |  |  |
|  |  |  | Preemph |  |  |  |  |  |
|  |  |  | Scale\_sig |  |  |  |  |  |
|  |  |  | Syn\_filt\_s |  |  |  |  |  |
|  | Scale\_speech |  |  |  |  |  |  |  |
|  | Rescale\_enc\_mem\_hf |  |  |  |  |  |  |  |
|  | coder\_hf |  |  |  |  |  |  |  |
|  |  | AutocorrPlus |  |  |  |  |  |  |
|  |  | Lag\_window\_p |  |  |  |  |  |  |
|  |  | Levinson\_p |  |  |  |  |  |  |
|  |  | Az\_isp\_p |  |  |  |  |  |  |
|  |  |  | Chebps2 |  |  |  |  |  |
|  |  | Int\_lpc |  |  |  |  |  |  |
|  |  |  | Isp\_Az |  |  |  |  |  |
|  |  |  |  | Get\_isp\_pol |  |  |  |  |
|  |  | Isp\_isf |  |  |  |  |  |  |
|  |  | Q\_isf\_hf |  |  |  |  |  |  |
|  |  |  | Sub\_VQ |  |  |  |  |  |
|  |  |  | Reorder\_isf |  |  |  |  |  |
|  |  | Isf\_isp |  |  |  |  |  |  |
|  |  | Match\_gain\_6k4 |  |  |  |  |  |  |
|  |  |  | Residu |  |  |  |  |  |
|  |  |  | Syn\_filt |  |  |  |  |  |
|  |  |  | Scale\_sig |  |  |  |  |  |
|  |  | Int\_gain |  |  |  |  |  |  |
|  |  | Residu2 |  |  |  |  |  |  |
|  |  | Syn\_filt\_s |  |  |  |  |  |  |
|  |  | E\_LPC\_a\_weight |  |  |  |  |  |  |
|  |  | Weight\_a |  |  |  |  |  |  |
|  |  | Q\_gain\_hf |  |  |  |  |  |  |
|  | Band\_split\_taligned\_2k |  |  |  |  |  |  |  |
|  |  | Decim\_2k |  |  |  |  |  |  |
|  |  |  | Interpol\_st |  |  |  |  |  |
|  |  | Oversamp\_2k |  |  |  |  |  |  |
|  |  |  | Interpol\_st |  |  |  |  |  |
|  | Coder\_stereo\_x |  |  |  |  |  |  |  |
|  |  | Cod\_hi\_stereo |  |  |  |  |  |  |
|  |  |  | Residu2 |  |  |  |  |  |
|  |  |  | Compute\_exc\_side |  |  |  |  |  |
|  |  |  | Compute\_cross\_corr\_vector |  |  |  |  |  |
|  |  |  | Cholsolc |  |  |  |  |  |
|  |  |  | Cholsolc\_repair |  |  |  |  |  |
|  |  |  | Smooth\_ener\_filter |  |  |  |  |  |
|  |  |  | quant\_filt |  |  |  |  |  |
|  |  |  |  | Pmsvq2 |  |  |  |  |
|  |  |  |  |  | Msvq2 |  |  |  |
|  |  |  |  |  |  | M\_cbcod |  |  |
|  |  |  | Fir\_filt |  |  |  |  |  |
|  |  |  | Compute\_gain\_match |  |  |  |  |  |
|  |  |  | Quant\_gain |  |  |  |  |  |
|  |  | Cod\_tcx\_stereo |  |  |  |  |  |  |
|  |  |  | Ctcx\_stereo |  |  |  |  |  |
|  |  |  |  | Cos\_window |  |  |  |  |
|  |  |  |  | Windowing |  |  |  |  |
|  |  |  |  | Comp\_gain\_shap\_cod |  |  |  |  |
|  |  |  |  | Apply\_gain\_shap |  |  |  |  |
|  |  |  |  | Get\_gain |  |  |  |  |
|  |  |  |  | Q\_gain\_pan |  |  |  |  |
|  |  |  |  | Compute\_xn\_target |  |  |  |  |
|  |  |  |  | Fft3 |  |  |  |  |
|  |  |  |  |  | r\_fft\_fx |  |  |  |
|  |  |  |  | FFT\_reorder |  |  |  |  |
|  |  |  |  | Adap\_low\_freq\_emph |  |  |  |  |
|  |  |  |  |  | SpPeak1k6 |  |  |  |
|  |  |  |  | AVQ\_Cod |  |  |  |  |
|  |  |  |  |  | RE8\_PPV\_FX |  |  |  |
|  |  |  |  |  |  | Nearest\_neighbor\_2D8 |  |  |
|  |  |  |  | Scale\_tcx\_ifft |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | Adap\_low\_freq\_deemph |  |  |  |  |
|  |  |  |  |  | SpPeak1k6 |  |  |  |
|  |  |  |  |  | Deemph1k6 |  |  |  |
|  |  |  |  | Ifft\_reorder |  |  |  |  |
|  |  |  |  | Ifft3 |  |  |  |  |
|  |  |  |  |  | r\_fft\_fx |  |  |  |
|  |  |  |  | Q\_gain\_tcx |  |  |  |  |
|  |  |  |  | Apply\_tcx\_overlap |  |  |  |  |
|  |  |  | Segsnr |  |  |  |  |  |
|  | Int2bin |  |  |  |  |  |  |  |
|  | Enc\_prm |  |  |  |  |  |  |  |
|  |  | Int2bin |  |  |  |  |  |  |
|  |  | AVQ\_encmux |  |  |  |  |  |  |
|  |  |  | split\_idx\_noovf |  |  |  |  |  |
|  |  |  |  | sort(avq\_cod.c) |  |  |  |  |
|  |  |  |  | RE8\_cod |  |  |  |  |
|  |  |  |  |  | RE8\_vor |  |  |  |
|  |  |  |  |  |  | Re8\_identify\_absolute | Leader |  |
|  |  |  |  |  |  | Re8\_coord |  |  |
|  |  |  |  |  |  | Re8\_k2y |  |  |
|  |  |  |  |  |  |  | RE8\_PPV\_FX |  |
|  |  |  |  |  |  |  |  | Nearest\_neighbor\_2D8 |
|  |  |  |  |  | Re8\_compute\_base\_index |  |  |  |
|  |  |  |  |  |  | Re8\_compute\_rank\_of\_permutation\_and\_s |  |  |
|  |  |  |  | calc\_bits |  |  |  |  |
|  |  |  | writ\_all\_nq |  |  |  |  |  |
|  |  |  |  | calc\_bits |  |  |  |  |
|  |  |  | writ\_all\_i |  |  |  |  |  |
|  |  |  |  | init\_pos\_i\_ovf |  |  |  |  |
|  |  |  |  |  | chk\_ovf |  |  |  |
|  |  |  |  | chk\_ovf |  |  |  |  |
|  |  |  |  | writ\_I |  |  |  |  |
|  |  |  |  | writ\_k |  |  |  |  |
|  |  |  |  | writ\_ovf |  |  |  |  |
|  |  | Unpack4bits |  |  |  |  |  |  |
|  |  |  | Int2bin |  |  |  |  |  |
|  | Enc\_prm\_stereo\_x |  |  |  |  |  |  |  |
|  |  | Iint2bin |  |  |  |  |  |  |
|  |  | AVQ\_encmux |  |  |  |  |  |  |
|  |  |  | split\_idx\_noovf |  |  |  |  |  |
|  |  |  |  | sort(avq\_cod.c) |  |  |  |  |
|  |  |  |  | RE8\_cod |  |  |  |  |
|  |  |  |  |  | RE8\_vor |  |  |  |
|  |  |  |  |  |  | re8\_identify\_absolute | Leader |  |
|  |  |  |  |  |  | re8\_coord |  |  |
|  |  |  |  |  |  | re8\_k2y |  |  |
|  |  |  |  |  |  |  | RE8\_PPV\_FX |  |
|  |  |  |  |  |  |  |  | nearest\_neighbor\_2D8 |
|  |  |  |  |  | re8\_compute\_base\_index |  |  |  |
|  |  |  |  |  |  | re8\_compute\_rank\_of\_permutation\_and\_s |  |  |
|  |  |  |  | calc\_bits |  |  |  |  |
|  |  |  | writ\_all\_nq |  |  |  |  |  |
|  |  |  |  | calc\_bits |  |  |  |  |
|  |  |  | writ\_all\_i |  |  |  |  |  |
|  |  |  |  | init\_pos\_i\_ovf |  |  |  |  |
|  |  |  |  |  | chk\_ovf |  |  |  |
|  |  |  |  | chk\_ovf |  |  |  |  |
|  |  |  |  | writ\_I |  |  |  |  |
|  |  |  |  | writ\_ovf |  |  |  |  |
|  |  |  |  | writ\_k |  |  |  |  |
|  |  | unpack4bits\_d |  |  |  |  |  |  |
|  |  |  | int2bin |  |  |  |  |  |
|  | Enc\_prm\_hf |  |  |  |  |  |  |  |
|  |  | int2bin |  |  |  |  |  |  |

Table 2: Decoder call structure

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Decoder\_amrwb\_plus |  |  |  |  |  |  |  |  |
|  | Bin2int |  |  |  |  |  |  |  |
|  | Dec\_prm |  |  |  |  |  |  |  |
|  |  | Bin2int |  |  |  |  |  |  |
|  |  | Pack4bits |  |  |  |  |  |  |
|  |  |  | Bin2int |  |  |  |  |  |
|  | Dec\_prm\_stereo\_x |  |  |  |  |  |  |  |
|  |  | Bin2int |  |  |  |  |  |  |
|  |  | Pack4bits\_d |  |  |  |  |  |  |
|  |  |  | Bin2int |  |  |  |  |  |
|  |  | AVQ\_Demuxdec |  |  |  |  |  |  |
|  |  |  | Read\_all\_nq |  |  |  |  |  |
|  |  |  |  | Read\_nq |  |  |  |  |
|  |  |  | Read\_all\_i |  |  |  |  |  |
|  |  |  |  | Init\_pos\_i\_ovf |  |  |  |  |
|  |  |  |  |  | Chk\_ovf |  |  |  |
|  |  |  |  | Split\_n |  |  |  |  |
|  |  |  |  | Chk\_ovf |  |  |  |  |
|  |  |  |  | Read\_I |  |  |  |  |
|  |  |  |  | Read\_ovf |  |  |  |  |
|  |  |  |  | Read\_k |  |  |  |  |
|  |  |  | RE8\_Dec |  |  |  |  |  |
|  |  |  |  | Re8\_decode\_base\_index |  |  |  |  |
|  |  |  |  |  | Re8\_decode\_rank\_of\_permutation |  |  |  |
|  |  |  |  | Re8\_k2y |  |  |  |  |
|  |  |  |  |  | RE8\_PPV\_FX |  |  |  |
|  |  |  |  |  |  | Nearest\_neighbor\_2D8 |  |  |
|  | Dec\_prm\_hf |  |  |  |  |  |  |  |
|  |  | Bin2int |  |  |  |  |  |  |
|  | Decoder\_amrwb\_plus\_1 |  |  |  |  |  |  |  |
|  |  | Decoder\_lf |  |  |  |  |  |  |
|  |  |  | Dpisf\_2s\_46b\_2 |  |  |  |  |  |
|  |  |  |  | Reorder\_isf |  |  |  |  |
|  |  |  | Isf\_isp |  |  |  |  |  |
|  |  |  | Int\_lpc |  |  |  |  |  |
|  |  |  |  | Isp\_Az |  |  |  |  |
|  |  |  |  |  | Get\_isp\_pol |  |  |  |
|  |  |  | decoder\_tcx |  |  |  |  |  |
|  |  |  |  | AVQ\_Demuxdec |  |  |  |  |
|  |  |  |  |  | Read\_all\_nq |  |  |  |
|  |  |  |  |  |  | Read\_nq |  |  |
|  |  |  |  |  | Read\_all\_i |  |  |  |
|  |  |  |  |  |  | Init\_pos\_i\_ovf |  |  |
|  |  |  |  |  |  |  | Chk\_ovf |  |
|  |  |  |  |  |  | Split\_n |  |  |
|  |  |  |  |  |  | Chk\_ovf |  |  |
|  |  |  |  |  |  | Read\_I |  |  |
|  |  |  |  |  |  | Read\_k |  |  |
|  |  |  |  |  |  | Read\_ovf |  |  |
|  |  |  |  |  | RE8\_dec |  |  |  |
|  |  |  |  |  |  | Re8\_decode\_base\_index |  |  |
|  |  |  |  |  |  |  | Re8\_decode\_rank\_of\_permutation |  |
|  |  |  |  |  |  | Re8\_k2y |  |  |
|  |  |  |  |  |  |  | RE8\_PPV\_FX |  |
|  |  |  |  |  |  |  |  | Nearest\_neighbor\_2D8 |
|  |  |  |  | Scale\_tcx\_ifft |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | NoiseFill |  |  |  |  |
|  |  |  |  |  | Rnd\_ph16 |  |  |  |
|  |  |  |  |  |  | Random |  |  |
|  |  |  |  | Adap\_low\_freq\_deemph |  |  |  |  |
|  |  |  |  |  | SpPeak1k6 |  |  |  |
|  |  |  |  |  | Deemph1k6 |  |  |  |
|  |  |  |  | Find\_mpitch |  |  |  |  |
|  |  |  |  | Ifft\_reorder |  |  |  |  |
|  |  |  |  | ifft9\_fx |  |  |  |  |
|  |  |  |  |  | r\_fft\_fx |  |  |  |
|  |  |  |  | Cos\_window |  |  |  |  |
|  |  |  |  | D\_gain\_tcx |  |  |  |  |
|  |  |  |  | Scale\_mem\_tcx |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | Preemph |  |  |  |  |
|  |  |  |  | Weight\_a |  |  |  |  |
|  |  |  |  | Syn\_filt\_s |  |  |  |  |
|  |  |  |  | Residu2 |  |  |  |  |
|  |  |  | Decoder\_acelp |  |  |  |  |  |
|  |  |  |  | Pred\_lt4 |  |  |  |  |
|  |  |  |  | DEC\_ACELP\_4t64\_fx |  |  |  |  |
|  |  |  |  |  | Dec\_1p\_N1 |  |  |  |
|  |  |  |  |  | Dec\_2p\_2N1 |  |  |  |
|  |  |  |  |  | Dec\_3p\_3N1 |  |  |  |
|  |  |  |  |  |  | Dec\_2p\_2N1 |  |  |
|  |  |  |  |  |  | Dec\_1p\_N1 |  |  |
|  |  |  |  |  | Dec\_4p\_4N |  |  |  |
|  |  |  |  |  |  | Dec\_4p\_4N1 |  |  |
|  |  |  |  |  |  |  | Dec\_1p\_N1 |  |
|  |  |  |  |  |  | Dec\_1p\_N1 |  |  |
|  |  |  |  |  |  | Dec\_2p\_2N1 |  |  |
|  |  |  |  |  |  | Dec\_3p\_3N1 |  |  |
|  |  |  |  |  |  |  | Dec\_2p\_2N1 |  |
|  |  |  |  |  |  |  | Dec\_1p\_N1 |  |
|  |  |  |  |  | Dec\_5p\_5N |  |  |  |
|  |  |  |  |  |  | Dec\_2p\_2N1 |  |  |
|  |  |  |  |  |  | Dec\_3p\_3N1 |  |  |
|  |  |  |  |  |  |  | Dec\_2p\_2N1 |  |
|  |  |  |  |  |  |  | Dec\_1p\_N1 |  |
|  |  |  |  |  | Dec\_6p\_6N\_2 |  |  |  |
|  |  |  |  |  |  | Dec\_1p\_N1 |  |  |
|  |  |  |  |  |  | Dec\_2p\_2N1 |  |  |
|  |  |  |  |  |  | Dec\_3p\_3N1 |  |  |
|  |  |  |  |  |  |  | Dec\_2p\_2N1 |  |
|  |  |  |  |  |  |  | Dec\_1p\_N1 |  |
|  |  |  |  |  |  | Dec\_4p\_4N |  |  |
|  |  |  |  |  |  |  | Dec\_4p\_4N1 |  |
|  |  |  |  |  |  |  |  | Dec\_1p\_N1 |
|  |  |  |  |  |  | Dec\_5p\_5N |  |  |
|  |  |  |  |  |  |  | Dec\_2p\_2N1 |  |
|  |  |  |  |  |  |  | Dec\_3p\_3N1 |  |
|  |  |  |  |  |  |  |  | Dec\_2p\_2N1 |
|  |  |  |  |  |  |  |  | Dec\_1p\_N1 |
|  |  |  |  |  | add\_pulses |  |  |  |
|  |  |  |  | Preemph |  |  |  |  |
|  |  |  |  | Pit\_shrp |  |  |  |  |
|  |  |  |  | D\_gain2\_plus |  |  |  |  |
|  |  |  |  | Scale\_exc |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | Scale\_sig |  |  |  |  |
|  |  |  |  | voice\_factor |  |  |  |  |
|  |  |  |  | Rescale\_mem |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | Syn\_filt\_s |  |  |  |  |
|  |  |  |  | Weight\_a |  |  |  |  |
|  |  |  |  | Residu |  |  |  |  |
|  |  |  |  | Deemph2 |  |  |  |  |
|  |  |  | Updt\_mem\_q |  |  |  |  |  |
|  |  | Scale\_mem2 |  |  |  |  |  |  |
|  |  |  | Scale\_sig |  |  |  |  |  |
|  |  | Deemph |  |  |  |  |  |  |
|  |  | Bass\_postfilter |  |  |  |  |  |  |
|  |  |  | Scale\_sig |  |  |  |  |  |
|  |  |  | Short\_pitch\_tracker |  |  |  |  |  |
|  |  | Decoder\_hf |  |  |  |  |  |  |
|  |  |  | D\_isf\_hf |  |  |  |  |  |
|  |  |  |  | Reorder\_isf |  |  |  |  |
|  |  |  | Isf\_isp |  |  |  |  |  |
|  |  |  | Int\_lpc |  |  |  |  |  |
|  |  |  |  | Isp\_Az |  |  |  |  |
|  |  |  |  |  | Get\_isp\_pol |  |  |  |
|  |  |  | Match\_gain\_6k4 |  |  |  |  |  |
|  |  |  |  | Residu |  |  |  |  |
|  |  |  |  | Syn\_filt |  |  |  |  |
|  |  |  |  | Scale\_sig |  |  |  |  |
|  |  |  | Int\_gain |  |  |  |  |  |
|  |  |  | D\_gain\_chan |  |  |  |  |  |
|  |  |  | D\_gain\_hf |  |  |  |  |  |
|  |  |  | Soft\_exc\_hf |  |  |  |  |  |
|  |  |  | Syn\_filt\_s |  |  |  |  |  |
|  |  |  | Smooth\_ener\_hf |  |  |  |  |  |
|  |  | Delay |  |  |  |  |  |  |
|  |  | Oversamp\_12k8 |  |  |  |  |  |  |
|  |  |  | Interpol |  |  |  |  |  |
|  | Decoder\_stereo\_x |  |  |  |  |  |  |  |
|  |  | Band\_split\_taligned\_2k |  |  |  |  |  |  |
|  |  |  | Decim\_2k |  |  |  |  |  |
|  |  |  |  | Interpol\_st |  |  |  |  |
|  |  |  | Oversamp\_2k |  |  |  |  |  |
|  |  |  |  | Interpol\_st |  |  |  |  |
|  |  | Dec\_tcx\_stereo |  |  |  |  |  |  |
|  |  |  | Dtcx\_stereo |  |  |  |  |  |
|  |  |  |  | Cos\_window |  |  |  |  |
|  |  |  |  | Scale\_tcx\_ifft |  |  |  |  |
|  |  |  |  |  | Scale\_sig |  |  |  |
|  |  |  |  | Windowing |  |  |  |  |
|  |  |  |  | Comp\_gain\_shap |  |  |  |  |
|  |  |  |  | adap\_lo\_freq\_deemph |  |  |  |  |
|  |  |  |  |  | SpPeak1k6 |  |  |  |
|  |  |  |  |  | Deemph1k6 |  |  |  |
|  |  |  |  | Ifft\_reorder |  |  |  |  |
|  |  |  |  | Ifft3 |  |  |  |  |
|  |  |  |  |  | ifft\_rel |  |  |  |
|  |  |  |  | Balance |  |  |  |  |
|  |  |  |  |  | D\_Balance |  |  |  |
|  |  |  |  | D\_gain\_tcx |  |  |  |  |
|  |  |  |  | Apply\_xnq\_gain2 |  |  |  |  |
|  |  |  |  | Apply\_wien\_filt |  |  |  |  |
|  |  |  |  | Crosscorr\_2 |  |  |  |  |
|  |  |  |  | Glev\_s |  |  |  |  |
|  |  |  |  | Apply\_tcx\_overlap |  |  |  |  |
|  |  | Get\_alpha |  |  |  |  |  |  |
|  |  | Ch\_sep |  |  |  |  |  |  |
|  | Dec\_hi\_stereo |  |  |  |  |  |  |  |
|  |  | Dec\_filt |  |  |  |  |  |  |
|  |  | Dec\_gain |  |  |  |  |  |  |
|  |  | Residu |  |  |  |  |  |  |
|  |  | Fir\_filt |  |  |  |  |  |  |
|  |  | Get\_exc\_win |  |  |  |  |  |  |
|  |  | Get\_exc |  |  |  |  |  |  |
|  |  | Syn\_filt\_s |  |  |  |  |  |  |
|  | Delay |  |  |  |  |  |  |  |
|  | Band\_join\_2k |  |  |  |  |  |  |  |
|  |  | Interpol\_st |  |  |  |  |  |  |
|  | HP50\_12k8 |  |  |  |  |  |  |  |
|  | Oversamp\_12k8 |  |  |  |  |  |  |  |
|  |  | Interpol |  |  |  |  |  |  |

## 4.5 Variables, constants and tables

The data types of variables and tables used in the fixed point implementation are signed integers in 2's complement representation, defined by:

- **Word16** 16 bit variable;

- **Word32** 32 bit variable.

### 4.5.1 Description of fixed tables used in the C-code

This clause contains a listing of all fixed tables sorted by source file name and table name. All table data is declared as **Word16**.

Table 3: Encoder fixed tables

| Format | Table name | Size | Description | Format |
| --- | --- | --- | --- | --- |
| Word16 | MonoRate | 54 | Predefined mono rate | Q6/Q0/Q0 |
| Word16 | StereoRate | 81 | Predefined stereo rate | Q6/Q0/Q0 |
| Word16 | NBITS\_CORE\_AMR\_WB\_FX | 9 miMode\_fx | AMR WB Core bits | Q0 |
| Word16 | miMode\_fx | 48 | Stereo Mode Index | Q0 |
| Word16 | isfIndex\_fx | 14 | Internal sampling Frequency | Q0 |
| Word16 | NBITS\_CORE\_FX | 8 | Core bit-rates | Q0 |
| Word16 | t\_sinFxS4 | 1440 | FFT Sine&Cos table | Q13 |
| Word16 | Filter\_32k | 61 | FIR table for decimation/oversampling | Q13 |
| Word16 | Filter\_32k\_hf | 61 | FIR table for decimation/oversampling | Q13 |
| Word16 | Filter\_32k\_7k | 61 | FIR table for decimation/oversampling | Q13 |
| Word16 | Filter\_48k | 185 | FIR table for decimation/oversampling | Q13 |
| Word16 | Filter\_48k\_hf | 185 | FIR table for decimation/oversampling | Q13 |
| Word16 | Filter\_8k | 61 | FIR table for decimation/oversampling | Q13 |
| Word16 | Isf\_init | 16 | Initial ISF memory |  |
| Word16 | Isp\_init | 16 | Initial ISP memory | Q15 |
| Word16 | Isp\_init\_HF | 8 | HF Initial ISP memory | Q15 |
| Word16 | Mean\_isf | 16 | Means of ISFs |  |
| Word16 | Dico1\_isf | 2304 | 1st stage codebook, isf0 to isf8 |  |
| Word16 | Dico2\_isf | 1792 | 1st stage codebook, isf9 to isf15 |  |
| Word16 | Dico21\_isf | 192 | 2nd stage codebook, isf2\_0 to isf 2\_2 |  |
| Word16 | Dico22\_isf | 384 | 2nd stage codebook, isf2\_3 to isf 2\_5 |  |
| Word16 | Dico23\_isf | 384 | 2nd stage codebook, isf2\_6 to isf 2\_8 |  |
| Word16 | Dico24\_isf | 96 | 2nd stage codebook, isf2\_9 to isf 2\_11 |  |
| Word16 | Dico25\_isf | 128 | 2nd stage codebook, isf2\_12 to isf 2\_15 |  |
| Word16 | Dico21\_isf\_36b | 640 | 1st stage codebook, (36b) split 1 |  |
| Word16 | Dico22\_isf\_36b | 512 | 1st stage codebook, (36b) split 2 |  |
| Word16 | Dico23\_isf\_36b | 448 | 1st stage codebook, (36b) split 3 |  |
| Word16 | Dico\_gain\_hf | 512 | Quantization table for one-stage HF gain | Q8 |
| Word16 | Mean\_isf\_hf\_12k8 | 8 | Means of ISFs (full band) |  |
| Word16 | Dico1\_isf\_hf\_12k8 | 32 | 1st stage isf codebook (full band) |  |
| Word16 | Mean\_isf\_hf\_low\_rate | 8 | Means of isfs |  |
| Word16 | Dico1\_isf\_hf\_low\_rate | 32 | 1st stage isf codebook |  |
| Word16 | Dico2\_isf\_hf | 1024 | 2nd stage isf codebook |  |
| Word16 | Filt\_lp | 13 | Low-pass fir filter for bass post filter | Q15 |
| Word16 | Sin20 | 20 | Random phase | Q15 |
| Word16 | Inter4\_2 | 128 | 1/4 resolution interpolation filter | Q14 |
| Word16 | VadFiltBandFreqs | 12 | Open-loop classifier | Q0 |
| Word16 | Bw\_inv | 12 | Open-loop classifier | Q22 |
| Word16 | Lwg | 8 | Open-loop claissifier | Q15 |
| Word16 | Gain\_hf\_ramp | 64 | HF gain ramp for wb->wb+ switiching | Q15 |
| Word16 | Inter2\_coef | 12 | Filter coefficients for band join/split | Q13 |
| Word16 | Filter\_LP180 | 2341 | Filter for 48 kHz interpolation | Q14 |
| Word16 | StereoNbits\_FX | 18 | Stereo bit-rates | Q0 |
| Word16 | Filter\_2k\_fxQ14\_32 | 321 | 2k decimation filter | Q14 |
| Word16 | Filter\_2k\_fxQ14\_5 | 321 | 2k decimation filter | Q14 |
| Word16 | cb\_filt\_hi\_mean\_fx | 9 | Average filter | Q14 |
| Word16 | Filt\_hi\_mscb\_4a\_fx | 16\*9 |  | Q14 |
| Word16 | Filt\_hi\_mscb\_7a\_fx | 16\*9 |  | Q14 |
| Word16 | Filt\_hi\_mscb\_7b\_fx | 8\*9 |  | Q14 |
| Word16 | Cb\_gain\_hi\_mean\_fx | 2 | Average gain vector | Q10 |
| Word16 | Gain\_hi\_mscb\_2a\_fx | 4\*2 |  | Q10 |
| Word16 | Gain\_hi\_mscb\_5a\_fx | 32\*2 |  | Q10 |
| Word16 | Dico1\_isf\_hf\_high\_rate | 32 | 1st stage isf codebook |  |
| Word16 | Mean\_isf\_hf\_high\_rate | 8 | Means of isfs |  |
| Word16 | Filter\_LP45 | 586 | Filter for 48 kHz interpolation | Q14 |
| Word16 | t\_qua\_gain6b | 128 | Gain pitch and gain code | Q14/Q11 |
| Word16 t\_qua\_gain7b | t\_qua\_gain7b | 256 | Gain pitch and gain code | Q14/Q11 |
| Word16 | Overlap\_wind | 63 | Overlap window | Q15 |
| Word16 | Cos\_wind | 128 | Cos window | Q15 |
| Word16 | Cos\_wind\_LR | 224 | Cos \_window (Low rate) | Q15 |
| Word16 | TXV | 31 | Arctan piece table | Q15 |
| Word16 | Len\_tbl | 6 | Inverse length | Q15 |
| Word16 | interpol\_frac4 | 4 | Interpolation Window 4 sub-frame | Q15 |
| Word16 | interpol\_frac8 | 8 | Interpolation Window 8 sub-frame | Q15 |
| Word16 | interpol\_frac16 | 16 | Interpolation Window 16 sub-frame | Q15 |
| Word16 | size\_filt\_hi\_msvq\_4\_fx | 16 | Stereo param |  |
| Word16 | \*cbs\_filt\_hi\_msvq\_4\_fx | 16 | Stereo param |  |
| PMSQ\_fx | filt\_hi\_pmsvq4\_fx |  |  |  |
| Word16 | size\_filt\_hi\_msvq\_7\_fx | 16 | Stereo param |  |
| Word16 | \*cbs\_filt\_hi\_msvq\_7\_fx | 16 | Stereo param |  |
| PMSQ\_fx | filt\_hi\_pmsvq7\_fx |  |  |  |
| Word16 | Size\_gain\_hi\_msvq\_2\_fx | 16 | Stereo param |  |
| Word16 | \*cbs\_gain\_hi\_msvq\_2\_fx | 16 | Stereo param |  |
| PMSQ\_fx | gain\_hi\_pmsvq2\_fx |  |  |  |
| Word16 | size\_gain\_hi\_msvq\_5\_fx | 16 | Stereo param |  |
| Word16 | \*cbs\_gain\_hi\_msvq\_5\_fx | 16 | Stereo param |  |
| PMSQ\_fx | gain\_hi\_pmsvq5\_fx |  |  |  |

Table 4: Decoder fixed tables

| Format | Table name | Size | Description |
| --- | --- | --- | --- |
| Same as encoder  Same as encoder | | | |

### 4.5.2 Static variables used in the C-code

In this clause two tables that specify the static variables for the encoder and decoder respectively are shown. All static variables are declared within a C **struct.**

Table 6: Encoder static variables

| Struct name | Type | Variable | Type[Length] | Description |
| --- | --- | --- | --- | --- |
| Coder\_StState\_fx |  |  |  |  |
|  | Word16 | mem\_decim | 1608 | speech decimated filter memory |
|  | Word16 | decim\_frac | 1 | Fractional decimation factor |
|  | Word16 | mem\_sig\_in | 6 | hp filter memory |
|  | Word16 | mem\_preemph | 1 | speech preemphasis filter mem |
|  | Word16 | mem\_decim\_hf | 46 | HF filter memory |
|  | Word16 | old\_speech\_hf | 528 | HF old speech vector |
|  | Word16 | past\_q\_isf\_hf | 8 | HF past quantized isf |
|  | Word16 | ispold\_hf | 8 | HF old isp |
|  | Word16 | ispold\_q\_hf | 8 | HF quantized old isp |
|  | Word16 | old\_gain; | 1 | HF old gain match |
|  | Word16 | mem\_hf1 | 8 | HF memory for gain 1 |
|  | Word16 | mem\_hf2 | 8 | HF memory for gain 2 |
|  | Word16 | mem\_hf3 | 8 | HF memory for gain 3 |
|  | Word16 | old\_exc | 375 | old excitation |
|  | Word16 | Q\_sp\_hf | 1 | Scaling hf speech |
|  | Word16 | OldQ\_sp\_hf | 2 | old scaling hf speech |
|  | Word16\* | mean\_isf\_hf | 1 | isf codebook mean |
|  | Word16\* | dico1\_isf\_hf | 1 | isf codebook first stage |
| Coder\_State\_Plus\_fx |  |  |  |  |
|  | Coder\_StState\_fx | Left | 2617 | state for left channel |
|  | Coder\_StState\_fx | Right | 2617 | state for right channel |
|  | Word16 | old\_chan | 528 | old left signal |
|  | Word16 | old\_chan\_2k | 140 | old left signal 2 kHz sampl. rate |
|  | Word16 | old\_chan\_hi | 448 | old left signal HB |
|  | Word16 | old\_speech\_2k | 140 | old mono signal 2 kHz sampl. rate |
|  | Word16 | old\_speech\_hi | 448 | old mono signal HB |
|  | Word16 | old\_speech\_pe | 528 | past pre-emphasised mono |
|  | Word16 | old\_wh | 9 | past weighted filter |
|  | Word16 | old\_wh\_q | 9 | past quantized weighted filter |
|  | Word16 | old\_gm\_gain | 2 | past gain matching |
|  | Word16 | old\_exc\_mono | 9 | past mono excitation |
|  | Word16 | filt\_energy\_threshold | 1 | filter energy thershold |
|  | Word16 | w\_window | 64 | weighting window |
|  | PMSVQ\_fx\* | \*filt\_hi\_pmsvq | 1 | MSVQ quantizer |
|  | PMSVQ\_fx\* | \*gain\_hi\_pmsvq | 1 | MSVQ quantizer |
|  | Word16 | mem\_stereo\_ovlp\_size | 1 | past stereo overlap size |
|  | Word16 | mem\_stereo\_ovlp | 32 | past stereo overlap |
|  | NCLASSDATA | \*stClass | 1 | use case B classifier |
|  | VadVars | \*vadSt | 1 | VAD state |
|  | Word16 | vad\_hist | 1 | VAD history |
|  | Word16 | old\_speech | 528 | old speech |
|  | Word16 | old\_synth | 16 | synthesis memory |
|  | Word16 | past\_isfq | 16 | past isf quantizer |
|  | Word16 | old\_wovlp | 128 | last tcx overlap |
|  | Word16 | old\_d\_wsp | 187 | Weighted speech vector |
|  | Word16 | old\_exc | 392 | old excitation vector |
|  | Word16 | old\_mem\_wsyn | 1 | weighted synthesis memory |
|  | Word16 | old\_mem\_w0 | 1 | weighted speech memory |
|  | Word16 | old\_mem\_xnq | 1 | quantized target memory |
|  | Word16 | old\_ovlp\_size | 1 | last tcx overlap size |
|  | Word16 | Isfold | 16 | old isf frequency domain |
|  | Word16 | Ispold | 16 | old isp |
|  | Word16 | ispold\_q | 16 | quantized old isp |
|  | Word16 | mem\_wsp | 1 | wsp vector mem |
|  | Word16 | mem\_lp\_decim2 | 3 | wsp decimator filter mem |
|  | Word16 | ada\_w | 1 | open loop LTP |
|  | Word16 | ol\_gain | 1 | open loop LTP |
|  | Word16 | ol\_wght\_flg | 1 | open loop LTP |
|  | Word16 | old\_ol\_lag | 5 | past openloop lag |
|  | Word16 | old\_T0\_med | 1 | past pitch |
|  | Word16 | hp\_old\_wsp | 699 | past HP weighted speech |
|  | Word16 | hp\_ol\_ltp\_mem | 9 | past HP openloop long term prediction |
|  | Word16 | window | 512 | LP analysis window |
|  | Word16 | SwitchFlagPlusToWB | 1 | flag for switching to AMR-WB |
|  | Word16 | mem\_gain\_code | 4 | past code gain |
|  | Word16 | prev\_mod | 1 | past frame type |
|  | Word16 | Q\_sp | 1 | Scaling of speech |
|  | Word16 | OldQ\_sp | 1 | Old scaling of speech |
|  | Word16 | i\_offset | 1 |  |
|  | Word16 | pit\_max | 1 | Mem of pit\_max |
|  | Word16 | lev\_mem | 18 | Levinson durbin memory |
|  | Word16 | old\_wsp\_max | 4 | Weight speech scaling memory |
|  | Word16 | old\_wsp\_shift | 1 | limit dynamic at 12 bits |
|  | Word16 | scale\_fac | 1 | scaling factor (preemph speech) |
|  | Word16 | Q\_new | 1 | scaling factor of speech |
|  | Word16 | Q\_max | 2 | Q\_new limitation |
|  | Word16 | OldQ\_sp\_deci | 2 | Q\_new memory |
|  | Word16 | Q\_exc | 1 | excitation scaling |
|  | Word16 | Old\_Qexc | 1 | excitation scaling memory |
|  | Word16 | LastQMode | 1 | Last subfr mode (acelp/tcx) |
| Encoder Config |  |  |  |  |
|  | Word16 | mode | 1 | AMR\_WB core mode: 0..8 |
|  | Word16 | extension | 1 | 0=AMRWB, 1=WB+ |
|  | Word16 | st\_mode | 1 | stereo mode |
|  | Word16 | fscale | 1 | frequency scaling |
|  | Word16 | use\_case\_mode | 1 | use case (for AMRWB+ only) |
|  | Word16 | allow\_dtx | 1 | dtx (for AMRWB only) |
|  | Word16 | FileFormat | 1 | 3gp or raw |
|  | Word16 | mode\_index | 1 | index of wb+ mode used |
|  | Word16 | fscale\_index | 1 | index of internal frequency sampling |
|  | Word16 | bc | 1 | Backward compatible file format |

Table 7: Decoder static variables

| Struct name | Type | Variable | Type[Length] | Description |
| --- | --- | --- | --- | --- |
| Decoder\_StState |  |  |  |  |
|  | Word16 | wmem\_oversamp | 72 | Memory oversampling |
|  | Word16 | wover\_frac | 1 | Fractional overcloking factor |
|  | Word16 | wmem\_oversamp\_hf | 24 | memory |
|  | Word16 | wpast\_q\_isf\_hf | 8 | HF past quantized isf |
|  | Word16 | wpast\_q\_isf\_hf\_other | 8 | HF past quantized isf for the other  channel when mono decoding stereo |
|  | Word16 | wpast\_q\_gain\_hf | 1 | HF past quantized gain |
|  | Word16 | wpast\_q\_gain\_hf\_other | 1 | HF past quantized gain for the other  channel when mono decoding stereo |
|  | Word16 | wold\_gain | 1 | HF old gain match |
|  | Word16 | wispold\_hf | 8 | HF old isp |
|  | Word32 | Lthreshold; | 1 | HF memory for smooth ener |
|  | Word16 | wmem\_syn\_hf | 8 | HF synthesis memory |
|  | Word16 | mem\_d\_tcx\_fx | 96 | delay compensation memory |
|  | Word16 | wmem\_d\_nonc | 64 | Non causality delay |
|  | Word16 | mem\_synth\_hi | 16 | High band sunthesis memory |
|  | Word16 | wmem\_sig\_out | 6 | hp filter memory |
|  | Word16 | wold\_synth\_hf | 512 | synch delay memory |
|  | Word32 | Lp\_amp | 1 | memory for soft exc |
|  | Word16\* | mean\_isf\_hf | 1 | isf codebook mean |
|  | Word16\* | dico1\_isf\_hf | 1 | isf codebook first stage |
|  | Word16 | Q\_synHF | 1 | scaling of hf synth |
| Decoder\_State\_Plus |  |  |  |  |
|  | Decoder\_StState | left | 833 | State for left channel |
|  | Decoder\_StState | right | 833 | State for right channel |
|  | Word16 | mem\_left\_2k\_fx | 20 | 2kHz memory on left chan |
|  | Word16 | mem\_right\_2k\_fx | 20 | 2kHz memory on right chan |
|  | Word16 | mem\_left\_hi\_fx | 64 | HB memory left channel |
|  | Word16 | mem\_right\_hi\_fx | 64 | HB memory right channel |
|  | Word16 | my\_old\_synth\_2k\_fx | 35 | old 2kHz synthesis |
|  | Word16 | my\_old\_synth\_hi\_fx | 128 | old HB synthesis |
|  | Word16 | my\_old\_synth\_fx | 148 | old stereo synth |
|  | Word16 | old\_AqLF\_fx | 85 | old quantized LPC |
|  | Word16 | old\_wh\_fx | 9 | old decoded filter |
|  | Word16 | old\_wh2\_fx | 9 | old decoded filter 2 |
|  | Word16 | old\_exc\_mono\_fx | 9 | old mono excitation |
|  | Word16 | old\_gain\_left\_fx | 4 | old gain on left chan |
|  | Word16 | old\_gain\_right\_fx | 4 | old gain on right chan |
|  | Word16 | old\_wh\_q\_fx | 9 | past quantized filter |
|  | Word16 | old\_gm\_gain\_fx | 2 | past gain matching |
|  | Word16 | W\_window | 64 | weighted synthesis window |
|  | PMSVQ | \*filt\_hi\_pmsvq\_fx | 1 | past MSVQ filter |
|  | PMSVQ | \*gain\_hi\_pmsvq\_fx | 1 | past MSVQ gain |
|  | Word16 | mem\_stereo\_ovlp\_size\_fx | 1 | past stereo overlap size |
|  | Word16 | mem\_stereo\_ovlp\_fx | 32 | past stereo overlap |
|  | Word16 | last\_stereo\_mode | 1 | past stereo mode |
|  | Word16 | side\_rms\_fx | 1 | side signal RMS |
|  | Word16 | H\_fx | 9 | current filter |
|  | Word16 | wold\_xri | 1 148 | old spectral coefficeints |
|  | Word16 | last\_mode | 1 | last mode in previous 80ms frame |
|  | Word16 | wmem\_sig\_out | 6 | hp50 filter memory for synthesis |
|  | Word16 | wmem\_deemph | 1 | speech deemph filter memory |
|  | Word16 | prev\_lpc\_lost | 1 | previous lpc is lost when = 1 |
|  | Word16 | wold\_synth | 16 | synthesis memory |
|  | Word16 | wold\_exc | 392 | old excitation vector |
|  | Word16 | wisfold | 16 | old isf (frequency domain) |
|  | Word16 | wispold | 16 | old isp (immittance spectral pairs) |
|  | Word16 | wpast\_isfq | 16 | past isf quantizer |
|  | Word16 | wovlp | 128 | last weighted synthesis for overlap |
|  | Word16 | ovlp\_size | 1 | overlap size |
|  | Word16 | wisf\_buf | 51 | old isf (for frame recovery) |
|  | Word16 | wold\_T0 | 1 | old pitch value (for frame recovery) |
|  | Word16 | wold\_T0\_frac | 1 | old pitch value (for frame recovery) |
|  | Word16 | seed\_ace | 1 | seed memory (for random function) |
|  | Word16 | wmem\_wsyn | 1 | TCX synthesis memory |
|  | Word16 | seed\_tcx | 1 | seed memory (for random function) |
|  | Word16 | wwsyn\_rms | 1 | rms value of weighted synthesis |
|  | Word16 | wpast\_gpit | 1 | past gain of pitch (for frame recovery) |
|  | Word32 | Lpast\_gcode | 1 | past gain of code (for frame recovery) |
|  | Word16 | pitch\_tcx | 1 | for bfi |
|  | Word32 | L\_gc\_threshold | 1 | GC threshold |
|  | Word16 | wold\_synth\_pf | 503 | Bass post-filter: old synthesis |
|  | Word16 | wold\_noise\_pf | 24 | bass post-filter: noise memory |
|  | Word16 | wold\_T\_pf | 2 | bass post-filter: old pitch |
|  | Word16 | wold\_gain\_pf | 2 | Bass post-filter: old pitch gain |
|  | Word16 | \*mean\_isf\_hf | 1 | HF isf codebook in-use |
|  | Word16 | \*dico1\_isf\_hf | 1 | HF isf codebook in-use |
|  | Word16 | wmem\_gain\_code | 4 | past code gain |
|  | Word16 | wmem\_lpc\_hf | 9 | past HF lpc filter |
|  | Word16 | wmem\_gain\_hf | 1 | past HF gain |
|  | Word16 | wramp\_state | 1 | ramp state |
|  | Word16 | cp\_old\_synth | 16 | old synthesis switching memory |
|  | Word16 | Q\_old | 1 | Old scaling |
|  | Word16 | Q\_exc | 1 | excitation scaling |
|  | Word16 | Q\_syn | 1 | synthesis scaling |
|  | Word16 | Old\_Q\_syn | 1 | Old synthesis scaling |
|  | Word16 | Old\_Q\_exc | 1 | Old excitation scaling |
|  | Word16 | prev\_Q\_syn | 1 | Limitation on synthesis scaling |
|  | Word16 | mem\_syn2 | 16 | Switching synthesis memory |
|  | Word16 | Old\_Qxnq | 1 | Old xnq scaling |
|  | Word16 | Old\_QxnqMax | 1 | Old maximum xnq scaling |
|  | Word16 | Old\_Qxri | 1 | Old xri scaling |
|  | Word16 | Old\_bpf\_scale | 1 | noise buf scaling |
|  | Word16 | mem\_subfr\_q | 7 | subfr maximum excitation scaling |
|  | Word16 | old\_subfr\_q | 16 | subfr true excitation scaling |
|  | Word16 | old\_syn\_q | 16 | subfr true synthesis scaling |
|  | Word16 | i\_offset | 1 | offset memory |
| DecoderConfig |  |  |  |  |
|  | Word16 | mode | 1 | AMR\_WB core modes |
|  | Word16 | extension | 1 | 0 = AMR\_WB 1 = WB+ |
|  | Word16 | st\_mode | 1 | Stereo modes |
|  | Word16 | fscale | 1 | Internal Frequency scaling |
|  | Word32 | fs | 1 | Sampling rate |
|  | Word32 | mono\_dec\_stereo | 1 | decode mono a stereo bitstream |
|  | Word32 | limiter\_on | 1 | Limite clipping |
|  | Word16 | Fileformat | 1 | File format used (raw/3gp) |
|  | Word16 | fer\_sim | 1 | Frame erasure simulation |

# 5 File formats

This clause describes the file formats used by the encoder and decoder programs.

## 5.1 Audio file (encoder input/decoder output)

Audio files read by the encoder must be formatted as 16 bits PCM wave (\*.wav) files. The decoder output is written as a 16 bit PCM wave file (\*.wav).

Note that the decoder, with proper command line switch, can produce a mono file from a stereo bit-stream.

## 5.2 Parameter bitstream file (encoder output/decoder input)

For AMR-WB+ operation, the files produced by the audio encoder/expected by the audio decoder are either according to the raw format defined in 3GPP TS 26.290 [2], clause 8.2, or according to the 3GP file format (3GPP TS 26.244 [4]), whereby the storage sample definition is found in 3GPP TS 26.290 [2], clause 8.3.

Annex A (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **TSG SA#** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 2005-03 | 27 | SP-050083 |  |  | Approved at TSG SA#27 Plenary | 2.0.0 | 6.0.0 |
| 2005-06 | 28 | SP-050252 | 001 |  | Prevent an access outside a buffer when simulating frame erasures | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 002 | 1 | Remove unused code | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 003 |  | Remove IF2 header in AMR-WB bitstream | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 004 |  | Prevent an access outside a buffer in Reconst\_spect function | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 005 |  | Decoder synchronization after frame erasures | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 006 |  | Correction of mode switching using configuration file | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 007 |  | Prevent encoding end of wave file information | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 008 |  | Correction of library function for 3GP file format | 6.0.0 | 6.1.0 |
| 2005-06 | 28 | SP-050252 | 009 |  | Support for input files with sampling frequency other than 48 kHz | 6.0.0 | 6.1.0 |
| 2005-09 | 29 | SP-050425 | 0010 |  | Correction to frame erasure concealment | 6.1.0 | 6.2.0 |
| 2005-09 | 29 | SP-050425 | 0011 |  | Correction to threshold value in bandwidth extension | 6.1.0 | 6.2.0 |
| 2005-09 | 29 | SP-050425 | 0012 |  | Removal of copyright statements and unused files | 6.1.0 | 6.2.0 |
| 2005-12 | 30 | SP-050785 | 0013 |  | Correction to scaling of decimation filter memory | 6.2.0 | 6.3.0 |
| 2006-03 | 31 | SP-060012 | 0014 |  | Correction to end-of-file logic and initialisation in AMR-WB modes | 6.3.0 | 6.4.0 |
| 2006-03 | 31 | SP-060012 | 0015 |  | Correction to unnecessary look ahead in encoder | 6.3.0 | 6.4.0 |
| 2006-03 | 31 | SP-060012 | 0016 |  | Correction to memory initialization and memory overwrite when switching between AMR-WB and AMR-WB+ modes | 6.3.0 | 6.4.0 |
| 2006-06 | 32 | SP-060353 | 0017 |  | Correction to switching between AMR-WB and AMR-WB+ modes | 6.4.0 | 6.5.0 |
| 2006-06 | 32 | SP-060353 | 0018 |  | Correction to default stereo codec configurations | 6.4.0 | 6.5.0 |
| 2007-03 | 35 | SP-070029 | 0019 |  | Reference to users guide | 6.5.0 | 7.0.0 |
| 2008-12 | 42 |  |  |  | Version for Release 8 | 7.0.0 | 8.0.0 |
| 2009-12 | 46 |  |  |  | Version for Release 9 | 8.0.0 | 9.0.0 |
| 2011-03 | 51 |  |  |  | Version for Release 10 | 9.0.0 | 10.0.0 |
| 2012-09 | 57 |  |  |  | Version for Release 11 | 10.0.0 | 11.0.0 |
| 2014-09 | 65 |  |  |  | Version for Release 12 | 11.0.0 | 12.0.0 |
| 2015-12 | 70 |  |  |  | Version for Release 13 | 12.0.0 | 13.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2017-03 | 75 |  |  |  |  | Version for Release 14 | 14.0.0 |
| 2018-06 | 80 |  |  |  |  | Version for Release 15 | 15.0.0 |
| 2020-07 | - | - | - | - | - | Update to Rel-16 version (MCC) | **16.0.0** |