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ANSI-C code

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Foreword

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1 Scope

The present document contains an electronic copy of the ANSI-C code for the Floating-point Adaptive Multi-Rate Wideband codec. This floating-point codec specification is mainly targeted to be used in multimedia applications or in packet-based applications. The bit-exact fixed-point ANSI-C code in 3GPP TS 26.173 remains the preferred implementation for all applications, but the floating-point codec may be used instead of the fixed-point codec when the implementation platform is better suited for a floating-point implementation. It has been verified that the fixed-point and floating-point codecs interoperate with each other without any artifacts.

The floating-point ANSI-C code in the present document is the only standard conforming non-bit-exact implementation of the Adaptive Multi-Rate Wideband speech transcoder (3GPP TS 26.190 [2]), Voice Activity Detection (3GPP TS 26.194 [6]), comfort noise generation (3GPP TS 26.192 [4]), and source controlled rate operation (3GPP TS 26.193 [5]). The floating-point code also contains example solutions for substituting and muting of lost frames (3GPP TS 26.191 [3]).

The fixed-point specification in 26.173 shall remain the only allowed implementation for the 3G AMR-WB speech service and the use of the floating-point codec is strictly limited to other services.

The floating-point encoder in the present document is a non-bit-exact implementation of the fixed-point encoder producing quality indistinguishable from that of the fixed-point encoder. The decoder in the present document is functionally a bit-exact implementation of the fixed-point decoder, but the code has been optimized for speed and the standard fixed-point libraries are not used as such.

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.
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- 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 26.174: "AMR speech codec, wideband; Test sequences".
- [2] 3GPP TS 26.190: "Mandatory Speech Codec speech processing functions AMR Wideband speech codec; Transcoding functions".
- [3] 3GPP TS 26.191: "AMR speech codec, wideband; Error concealment of lost frames".
- [4] 3GPP TS 26.192: "Mandatory Speech Codec speech processing functions AMR Wideband Speech Codec; Comfort noise aspects".
- [5] 3GPP TS 26.193: "AMR speech codec, wideband; Source controlled rate operation".
- [6] 3GPP TS 26.194: "Mandatory Speech Codec speech processing functions AMR Wideband speech codec; Voice Activity Detector (VAD)".
- [7] RFC 3267 "A Real-Time Transport Protocol (RTP) Payload Format and File Storage Format for Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs, June 2002.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 26.190 [2], TS 26.191 [3], TS 26.192 [4], TS 26.193 [5] and TS 26.194 [6].

3.2 Abbreviations

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

AMR-WB Adaptive Multi-Rate WideBand
ANSI American National Standards Institute
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 NT40 and Microsoft Visual C++ v.6.0 compiler.
- IBM PC/AT compatible computers with Windows NT40 and Intel C/C++ v.4.0 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 all files in the root level.

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 "rom" files 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 encoder and decoder and all the object files.

4.2 Program execution

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

- (encoder) speech encoder;
- (decoder) speech decoder.

The programs should be called like:

- encoder [encoder options] <speech input file> <parameter file>;
- decoder <parameter file> <speech output file>.

The speech files contain 16-bit linear encoded PCM speech samples and the parameter files contain encoded speech data and some additional flags.

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.

4.3 Code hierarchy

Tables 1 and 2 are call graphs that show the functions used in the speech codec, including the functions of VAD, DTX, and comfort noise generation.

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: memcpy(), fwrite(), etc. have been omitted. The initialization of the static RAM (i.e. calling the _init functions) is also omitted.

Table 1: Speech encoder call structure

MAIN_encode E_UTIL_decim_12/8 E_UTIL_down_samp E_UTIL_interpol					=
E_UTIL_tp60_1288 E_UTIL_tp60_1289 E_UTIL	E_MAIN_encode	E_UTIL_decim_12k8	E_UTIL_down_samp	E_UTIL_interpol	
E_UTIL_ippo_1248 E_UTIL_ipremph E_DTX_vad E_DTX_inter_bank E_DTX_decision E_DTX_decision E_DTX_lection E_DTX_two e_calculation E_DTX_speech_esimate E_DTX_inter_bank E_DTX_inter					
E_DTX_learner E_DTX_vad E_DTX_filter_bank E_DTX_filterS E_DTX_filterS E_DTX_filterS E_DTX_typed_calculation E_DTX_speech_estimate E_DTX_typed_calculation E_DTX_speech_estimate E_DTX_typed_calculation E_DTX_speech_estimate E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_speech_estimate E_DTX_typed_calculation E_DTX_speech_estimate E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_hangover_addition E_DTX_hangover_addition E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_hangover_addition E_DTX_hangover_addition E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_hangover_addition E_DTX_hangover_addition E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_typed_calculation E_DTX_hangover_addition E_DTX_hangover_addition E_DTX_ppd_calculation E_DTX_typed_calculation E_DTX_ppd_calculation E_DTX_					
E_DTX_titles E_DTX_titles E_DT					
E_DTX_level_calculation E_DTX_plevel_calculation E_DTX_plevel_calculati		E_UTIL_f_preemph			
E_DTX_test up E_DTX_update_cntrl E_DTX_test		E_DTX_vad	E_DTX_filter_bank	E_DTX_filter5	7
E_DTX_test up E_DTX_update_cntrl E_DTX_test				E DTX filter3	1
E_DTX_tx_handler E_DTX_peech_estimate E_DTX_hangover_addition E_DTX_peech_estimate E_DTX_hangover_addition E_DTX_peech_estimate E_DTX_hangover_addition E_DTX_peech_estimate E_DTX_hangover_addition E_DTX_peech_estimate E_DTX_hangover_addition E_DTX_peech_estimate E_DTX_peech_estimat					1
E_DTX_tx_handler E_DTX_reset			E DTV decision		E DTV update cotrl
E_DTX_thander E_DTX_reset E_DTX_reset E_MAIN_parm_store E_UTIL_autocorr E_UTIL_autocorr E_UTIL_autocorr E_UTIL_subject E_UPC_ist_yend E_UPC_lev_dur E_UPC_lev_dur E_UPC_lev_dur E_UPC_lev_dur E_UPC_lint_isp_find E_UPC_ist_pis_conversion E_UPC_ist_pis_conversion E_UPC_ist_pis_conversion E_UPC_ist_pis_conversion E_UTIL_tesidu E_UTIL_tesidu E_UTIL_tesidu E_DTX_pitch_tore_detection E_GANN_log_median E_DTX_pitch_tore_detection E_UTIL_residu E_DTX_pitch_tore_detection E_UTIL_residu E_DTX_titch_tore_detection E_UTIL_residu E_UTIL_lextract E			E_DTA_decision		E_DTA_update_critii
E_DTX_tshandler E_DTX_reset					
E_DTX_reset E_LPC_isf_init E_DTX_reset E_MAIN_parm_store E_UTIL_autocorr E_LPC_lag_wind E_LPC_lev_dur E_LPC_s_lay_conversion E_LPC_linf_sp_find E_LPC_linf_sp_find E_LPC_linf_sp_find E_LPC_linf_sp_find E_LPC_linf_sp_find E_LPC_linf_sp_find E_LPC_linf_sp_a_conversion E_GAIN_clip_isf_lest E_LPC_a_weight E_UTIL_residu E_UTIL_residu E_DTX_pitch_tone_defection E_GAIN_clag_median E_DTX_pitch_tone_defection E_UTIL_residu E_DTX_st_find E_DT			E DTV analytic actionals	E_DTA_nangover_addition	
E_DTX_reset		E BTV / I	E_DTX_speecn_estimate	<u></u>	
E. MAIN_parm_store E. UTIL_autocorr E. LPC_lev_dur E. LPC_lev_dur E. LPC_sev_dur				٦	
E_UPC_lag_wind E_LPC_lag_wind E_LPC_lag_wind E_LPC_lag_wind E_LPC_lag_wind E_LPC_lag_soconversion E_LPC_linL!sp_find E_LPC_lisp_a_conversi E_LPC_lisp_soconversion E_GAIN_clip_sil_sest E_LPC_sep_ist_conversion E_GAIN_clip_sil_sest E_UTIL_residu E_UTIL_residu E_UTIL_deemph E_GAIN_lag_median E_DTX_pitch_lone_detection E_DTX_pitch_lone_detection E_DTX_pitch_lone_detection E_DTX_bitch_lone_detection E_DTX_bitch_lone_detection E_DTX_bitch_lone_detection E_DTX_sitch_lone_detection E_LPC_ist_2s3s_quantise E_LPC_ist_lone_detection E_LPC_ist_lone_d			E_LPC_isf_init		
E_LPC_lay_und E_LPC_a lsp_conversion E_LPC_int_lsp_find E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LPC_isp_isf_conversion E_LTL_residu E_UTIL_residu E_UTIL_deemph E_GANN_open_loop_search E_GANN_open_loop_search E_GANN_open_loop_search E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_vee E_DTX_isf_nistory_aver E_DTX_isf_noise_d E_LPC_isf_sub_vq E_LPC_isf_sub_v					
E_LPC_lsn_conversion E_LPC_int_lsp_find E_LPC_isp_isf_conversion E_LPC_lsp_isf_conversion E_LPC_lsp_isf_conversion E_ANN_clip_isf_test E_LPC_a_weight E_UTIL_residu E_UTIL_leemph E_GAIN_lode_lode_search E_GAIN_lode_lode_lode_lode_lode_lode_lode_lode		E_UTIL_autocorr			
E_LPC_sisp_conversion		E_LPC_lag_wind			
E_LPC_sisp_conversion		E_LPC_lev_dur			
E_LPC_int_isp_find			E LPC chebyshev		
on E_GAIN_clp_isf_test E_LPC_a_weight E_UTIL_deemph E_GAIN_D_deeimpl E_GAIN_D_deeimpl E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_isf_nistory_aver E_DTX_lsf_q E_DTX_isf_nistory_aver E_DTX_dithering_control E_UTIL_residu E_DTX_dithering_control E_UTIL_residu E_DTX_dithering_control E_UTIL_residu E_DTX_dithering_control E_UTIL_residu E_DTX_dithering_control E_UTIL_residu E_DTX_dithering_control E_UTIL_residu E_LPC_isf_sub_vq E_LPC_isf_sub_vq				F LPC f isp pol get	1
E_LPC_isp_isf_conversion E_GAIN_clip_isf_test E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_GAIN_lop_decind2 E_GAIN_lop_en_loop_search E_GAIN_lop_en_loop_search E_GAIN_lone_loop_search E_DTX_isf_nistory_aver E_DTX_lone_loop_search E_DTX_lone_loop_loop_search E_DTX_lone_loop_loop_search E_DTX_lone_loop_loop_loop_loop_loop_loop_loop_loo				got	
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E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_GAIN_open_loop_search E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_search E_DTX_sit_history_aver E_DTX_ist_q E_DTX_ist_noise_d E_DTX_ist_noise_d E_DTX_ist_noise_d E_DTX_ist_noise_d E_LPC_ist_search E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_ist_sas_quantise E_LPC_staget_ist_vq E_LPC_staget_ist_vq E_LPC_staget_ist_vq E_LPC_ist_sas_decode E_LPC_i					
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E_DTX_pitch_tone_detection E_GAIN_open_loop_search E_GAIN_olag_median E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_buffer E_DTX_isf_history_aver E_DTX_isf_natione_d E_LPC_isf_noise_d E_LPC_f_isf_reorder E_DTX_dithering_control E_UTIL_random E_MAIN_reset E_GAIN_clip_init E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq		E_GAIN_open_loop_search		_	
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E_GAIN_open_loop_search E_GAIN_open_loop_search E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_buffer E_DTX_ist_nistory_aver E_LPC_ist_seat_E_LPC_ist_noise_d E_LPC_ist_reorder E_DTX_reset E_DTX_reset E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_ist_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_seat_seat_vad_E_LPC_ist_s		E_DTX_pitch_tone_detection		=	
E_GAIN_olag_median E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_buffer E_DTX_buffer E_DTX_buffer E_DTX_isf_initory_aver E_DTX_isf_initory_ave					
E_DTX_pitch_tone_detection E_UTIL_residu E_DTX_buffer E_DTX_exe			1		
E_UTIL_residu E_DTX_buffer E_DTX_left E_DTX_left history_aver E_DTX_lisf_nistory_aver E_DTX_lisf_noise_d E_LPC_f_isf_reorder E_DTX_dithering_control E_UTIL_random E_MAIN_reset E_GAIN_clip_init E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq E_LPC_lisf_sub_vq E_LPC_lisf_sub_vq E_LPC_lisf_sub_vq E_LPC_lisf_sub_vq E_LPC_isf_sub_vq E_UTIL_isp_find E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_mpy_32_16 E_UTIL_residu			+		
E_DTX_buffer E_DTX_exe E_DTX_isf_nistory_aver E_DTX_dithering_control E_UTIL_random E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq E_LPC_isf_reorder E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_lextract E_UTIL_mpy_32_16			+		
E_DTX_frame_indices_fin d			+		
d E_DTX_isf_q E_LPC_isf_sub_vq E_LPC_isf_noise_d E_LPC_f_isf_reorder			E DTV frame indices for	٦	
E_DTX_isf_q		E_DIX_exe			
E_DTX_isf_q					
E_DTX_dithering_control E_UTIL_random E_MAIN_reset E_GAIN_clip_init E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_DTC_isf_sub_vq E_LPC_isf_sub_vq E_UTIL_isp_find E_UTIL_extract E_UTIL_mpy_32_16 E_UTIL_mexidu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_deemph E_UTIL_fpreemph E_UTIL_fpreemph E_UTIL_fpreemph E_UTIL_fpreemph E_UTIL_fpreemph E_UTIL_fpreemph E_UTIL_fpreemph					7
E_DTX_dithering_control E_UTIL_random E_GAIN_clip_init E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sp_conversion E_LPC_int_isp_find E_LPC_int_isp_find E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_aweight E_UTIL_demph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIC_a_weight			E_DTX_ist_q		
E_MAIN_reset E_AIN_clip_init E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq E_LPC_isf_reorder E_LPC_isf_sub_vq E_LPC				E_LPC_isf_noise_d	E_LPC_f_isf_reorder
E_MAIN_reset E_GAIN_clip_init E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_sub_vq E_LPC_i					
E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_2s3s_quantise E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_2s3s_decode E_LPC_isf_sub_vq E					
E_DTX_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_DTX_vad_reset E_LPC_isf_2s1_isf_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_2s3s_decode E_LPC_isf_reorder E_LPC_isf_2s5s_quantise E_LPC_isf_sub_vq		E_MAIN_reset	E_GAIN_clip_init		
E_LPC_isf_2s3s_quantise E_LPC_isf_sub_vq E_LPC_isf_reorder E_UPC_isf_reorder E_UPC_isf_sub_vq E_UTIL_l_extract E_UTIL_l_extract E_UTIL_l_extract E_UTIL_mppy_32_16 E_UTIL_mpy_32_16 E_UTIL_mpy_32_16 E_UTIL_synthesis E_UPC_aweight E_UTIL_deemph E_UTIL_deemph E_UTIL_deemph E_UTIL_feremph E_UTIL_feremph			E_DTX_reset		
E_LPC_isf_2s3s_quantise E_LPC_stage1_isf_vq E_LPC_stage1_isf_vq E_LPC_isf_sub_vq E_LPC_isf_reorder E_UPC_isf_sub_vq E_UPC_isf_reorder E_UTIL_I_extract E_UTIL_I_extract E_UTIL_I_extract E_UTIL_I_mpy_32_16 E_UTIL_i_m				7	
E_LPC_isf_sub_vq E_LPC_isf_reorder E_UPC_isf_sub_vq E_UPC		E LPC isf 2s3s quantise		1	
E_LPC_isf_sub_vq E_LPC_isf_sab_vq E_LPC_isf_sab_vq E_LPC_isf_sab_vq E_LPC_isf_sab_vq E_LPC_isf_sab_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sab_vq E_UTIL_I_extract E_UTIL_I_extract E_UTIL_I_extract E_UTIL_I_extract E_UTIL_I_extract E_UTIL_mpy_32_16 E_UTIL_mpy_32_16 E_UTIL_mpy_32_16 E_UTIL_synthesis E_UTIL_synthesis E_UTIL_sesidu E_UTIL_deemph E_UTIL_deemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_LPC_a_weight		05/_2555_quai 11155		1	
E_LPC_isf_sub_vq E_LPC_isf_2s3s_decode E_LPC_isf_reorder E_LPC_isf_2s5s_quantise E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_sub_vq E_LPC_isf_soub_vq E_LPC_isf_soub_vq E_LPC_isf_soub_vq E_LPC_isf_soub_vq E_LPC_isf_reorder E_LPC_isf_reorder E_LPC_isf_reorder E_UPC_isf_reorder E_UPC_isf_sub_vq E_UPC_isf_sub_v				4	
E_LPC_isf_2s3s_decode				-	
E_LPC_isf_2s5s_quantise E_LPC_isf_sub_vq E_LPC_isf_isp_conversion E_LPC_int_isp_find E_LPC_isp_a_conversion E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_aweight E_UTIL_deemph E_UTIL_f_preemph E_UTIL_f_preemph E_UTIL_f_preemph E_LPC_aweight				E I DO int monator	٦
E_LPC_isf_sub_vq E_LPC_isf_2s5s_decode		=		E_LPC_ist_reorder	_
E_LPC_isf_isp_conversion E_LPC_isf_isp_conversion E_LPC_int_isp_find E_LPC_isp_a_conversion E_LPC_isp_pol_get E_UTIL_l_extract E_UTIL_l_extract E_UTIL_mpy_32_16 E_UTIL_mpy_32_16 E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_deemph E_UTIL_f_preemph E_UTIL_f_preemph E_LPC_a_weight		E_LPC_isf_2s5s_quantise			
E_LPC_isf_isp_conversion E_LPC_int_isp_find E_LPC_isp_a_conversion E_LPC_isp_pol_get E_UTIL_l_extract E_UTIL_mpy_32_16 E_UTIL_mpy_32_16 E_UTIL_residu E_DTX_buffer E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_deemph E_UTIL_f_preemph E_UTIL_f_preemph E_LPC_a_weight					=
E_LPC_isp_a_conversion			E_LPC_isf_2s5s_decode	E_LPC_isf_reorder	
E_LPC_isp_a_conversion		E_LPC_isf_isp_conversion			
E_UTIL_mpy_32_16 E_UTIL_residu E_DTX_buffer E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_fepreemph E_UTIL_fepreemph E_LPC_a_weight		E_LPC_int_isp_find	E_LPC_isp_a_conversion	E_LPC_isp_pol_get	E_UTIL_I_extract
E_UTIL_I_extract E_UTIL_residu E_DTX_buffer E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_residu E_UTIL_deemph E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight		-	·		E_UTIL_mpy_32 16
E_UTIL_residu E_DTX_buffer E_UTIL_residu E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight				E UTIL I extract	
E_UTIL_residu E_DTX_buffer E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_residu E_UTIL_deemph E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight					1
E_DTX_buffer E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight		F UTII residu			J
E_UTIL_residu E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight			1		
E_UTIL_synthesis E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight			4		
E_LPC_a_weight E_UTIL_residu E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight					
E_UTIL_residu E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight			1		
E_UTIL_deemph E_UTIL_f_preemph E_LPC_a_weight					
E_UTIL_f_preemph E_LPC_a_weight					
E_UTIL_f_preemph E_LPC_a_weight					
E_LPC_a_weight			1		
			†		
oriz_syntholic			=		
			_		

I	7		
E_UTIL_residu			
E_LPC_a_weight			
E_UTIL_synthesis			
E_UTIL_deemph			_
E_GAIN_closed_loop_search	E_GAIN_norm_corr	E_UTIL_f_convolve	
	E_GAIN_norm_corr_inter		-
	polate		
E_GAIN_clip_test		_	
E_GAIN_adaptive_codebook_	1		
excitation			
E_UTIL_convolve	1		
E_ACELP_xy1_corr	1		
E_ACELP_codebook_target_u	1		
pdate			
E_UTIL_convolve	1		
E_ACELP_xy1_corr	1		
E_ACELP_codebook_target_u	-		
pdate			
E_UTIL_f_preemph	-		
	-		
E_GAIN_f_pitch_sharpening	4		
E_ACELP_xh_corr	1		
E_ACELP_2t		-	
E_ACELP_4t	E_ACELP_h_vec_corr1]	
	E_ACELP_h_vec_corr2		
	E_ACELP_2pulse_search		
	E_ACELP_quant_1p_N1	1	
	E ACELP quant 2p 2N1	1	
	= = 1 = 1 =	E_ACELP_quant_2p_2N1	1
		E_ACELP_quant_1p_N1	1
	E_ACELP_quant_4p_4N	E_ACELP_quant_4p_4N1	E_ACELP_quant_2p_2N
	E_ACELP_quant_4p_4N	E_ACELP_quant_4p_4N1	E_ACELP_quant_zp_zn
		E ACELD quent in Ni	'
		E_ACELP_quant_1p_N1	4
		E_ACELP_quant_3p_3N1	
		E_ACELP_quant_2p_2N1	
		E_ACELP_quant_3p_3N1	
	E_ACELP_quant_5p_5N	E_ACELP_quant_3p_3N1	
		E_ACELP_quant_2p_2N1	1
	E_ACELP_quant_6p_6N_		1
	2		
		E_ACELP_quant_1p_N1	1
		E_ACELP_quant_4p_4N	1
		E_ACELP_quant_2p_2N1	1
		E_ACELP_quant_3p_3N1	1
E LITH management		L_ACLEF_quant_3p_3ivi	J
E_UTIL_preemph	4		
E_GAIN_pitch_sharpening			
E_ACELP_xy2_corr			7
E_ACELP_gains_quantise	E_UTIL_dot_product12	E_UTIL_saturate_31	
		E_UTIL_norm_I	
	E_UTIL_normalized_inver		
	se_sqrt		
	E_UTIL_I_extract		
	E_UTIL_saturate	1	
	E_UTIL_mpy_32_16		
	E_UTIL_log2_32	E_UTIL_norm_I]
		E_UTIL_normalized_log2	1
E_UTIL_signal_up_scale			J
E_UTIL_signal_down_scale	1		
	4		
E_GAIN_clip_pit_test	4		
E_UTIL_signal_down_scale		7	
E_GAIN_voice_factor	E_UTIL_dot_product12		
	E_UTIL_norm_I]	
	E_UTIL_norm_s]	
E_UTIL_norm_s		_	
E_UTIL_synthesis	1		
E_UTIL_enc_synthesis	E_UTIL_synthesis	1	
	E_UTIL_deemph	†	
	E_UTIL_hp50_12k8	1	
		-	
	E_UTIL_random	-	
	E_UTIL_hp400_12k8	J	

E_LPC_a_weight
E_UTIL_synthesis
E_UTIL_bp_6k_7k
E_UTIL_bp_6k_7k

Table 2: Speech decoder call structure

D. MAINL decede	D DTV and be added	D 100 14 miles d	D I DO 'st manufact	1
D_MAIN_decode	D_DTX_rx_handler	D_LPC_isf_noise_d	D_LPC_isf_reorder	
	D_DTX_exe	D_DTX_cn_dithering	D_UTIL_random	
		D_UTIL_pow2	4	
		D_UTIL_norm_I	4	
		D_UTIL_random	D_UTIL_norm_I]
		D_UTIL_dot_product12 D_UTIL_normalized_inver		
		D_UTIL_normalized_inver se_sqrt		
	D_LPC_isf_isp_conversio	30_3q1t	J	
	n			
	D_LPC_isp_a_conversion	D_LPC_isp_pol_get	D_UTIL_I_extract	
			D_UTIL_mpy_32_16	
		D_UTIL_I_extract		
	D. LITIL Idea avesticacia	D_UTIL_mpy_32_16	-	
		D_UTIL_synthesis_32 D_UTIL_deemph_32	D_UTIL_saturate	1
		D_UTIL_hp50_12k8	D_UTIL_I_extract	
		D_UTIL_oversamp_16k	D_UTIL_up_samp	D_UTIL_interpol
		D_UTIL_random	D_011L_up_samp	D_0 HZ_IIIterpoi
		D_UTIL_signal_down_sca		
		le		
		D_UTIL_dot_product12		
		D_UTIL_normalized_inver		
		se_sqrt		1
		D_UTIL_hp400_12k8	D_UTIL_I_extract	
		D_UTIL_norm_I	D. LITH.	1
		D_LPC_isf_extrapolation	D_UTIL_norm_s	
			D_UTIL_I_extract	
			D_UTIL_mpy_32 D_LPC_isf_isp_conversio	
			In	
		D_LPC_isp_a_conversion		ı
		D_LPC_a_weight		
		D_UTIL_synthesis	1	
		D_LPC_a_weight		
		D_UTIL_synthesis		
		D_UTIL_bp_6k_7k		
		D_UTIL_hp_7k		
	D_MAIN_reset	D_GAIN_init	-	
		D_GAIN_lag_concealmen		
		t_init D_DTX_reset	-	
	D_LPC_isf_2s3s_decode		-	
	D_LPC_isf_2s5s_decode		-	
	D_LPC_isf_isp_conversio		_	
	nn		_	
	D_LPC_int_isp_find	D_LPC_isp_a_conversion		1
	D_GAIN_lag_concealmen	D_GAIN_sort_lag	D_GAIN_insert_lag	
	l .	D_UTIL_random		I
	D_GAIN_adaptive_codeb	D_UTIL_IAIIUUIII	J	
	ook_excitation			
	D_UTIL_random			
	D_ACELP_decode_2t			
	D_ACELP_decode_4t	D_ACELP_decode_1p_N		
		1		
		D_ACELP_add_pulse	-	
		D_ACELP_decode_2p_2 N1		
			D_ACELP_decode_2p_2	
		N1	N1	
			D_ACELP_decode_1p_N	
		D 4051D 1 1 4 4	1	D 4051 D 1 1 0 0 1
		D_ACELP_decode_4p_4 N		D_ACELP_decode_2p_2
		IN .	N1	N1 D_ACELP_decode_2p_2
				N1
			D_ACELP_decode_1p_N	
			1	
			D_ACELP_decode_3p_3	
1	1	ļ	N1	I

			D_ACELP_decode_2p_2 N1
		D_ACELP_decode_5p_5 N	D_ACELP_decode_3p_3 N1
			D_ACELP_decode_2p_2 N1
		D_ACELP_decode_6p_6	D_ACELP_decode_5p_5
		N_2	N D_ACELP_decode_1p_N
			1 D_ACELP_decode_4p_4
			N D_ACELP_decode_2p_2
			N1 D_ACELP_decode_3p_3
			N1
	D_UTIL_preemph		
	D_GAIN_pitch_sharpenin		
	D_GAIN_decode	D_UTIL_dot_product12	
		D_UTIL_normalized_inver	
		se_sqrt	
		D_GAIN_median	
		D_UTIL_I_extract	
		D_UTIL_pow2	
		D_UTIL_mpy_32_16	
		D_UTIL_log2	D_UTIL_norm_I
			D_UTIL_normalized_log2
	D_UTIL_signal_up_scale	D_UTIL_saturate	
	D_UTIL_signal_down_sca le		
	D_GAIN_find_voice_facto	D_UTIL_dot_product12	
		D_UTIL_norm_I	
		D_UTIL_norm_s	
	D_UTIL_norm_s		I .
	D_UTIL_I_extract		
	D_ACELP_phase_disper		
	D_UTIL_mpy_32_16		
	D_UTIL_I_extract		
,	D_GAIN_adaptive_control	D_UTIL_norm_I	
		D_UTIL_inverse_sqrt	
	D_UTIL_dec_synthesis	D_UTIL_saturate	
	D_UTIL_signal_down_sca le		1
	D_DTX_activity_update	D_UTIL_log2	
			•

4.4 Variables, constants and tables

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

Word8 8 bit variable

UWord8 8 bit unsigned variable

Word16 16 bit variable

Word16 16 bit unsigned variable

Word32 32 bit variable

Floating-point numbers use the IEEE (Institute of Electrical and Electronics Engineers) format:

Float32 8 bit exponent, 23 bit mantissa, 1 bit sign **Float64** 11 bit exponent, 52 bit mantissa, 1 bit sign

4.4.1 Description of fixed tables used in the C-code

This clause contains a listing of all fixed tables declared in enc_rom.c and dec_rom.c files.

Table 3: Encoder fixed tables

Format	Table name	Size	Description
Word16	E_ROM_cdown_unusable	7	Attenuation factors for codebook gain in lost frames
Word16	E_ROM_cdown_usable	7	Attenuation factors for codebook gain in bad frames
Float32.	E_ROM_corrweight	199	Weighting of the correlation function in open loop LTP search
Word16	E_ROM_cos	129	Table of cos(x)
Float32	E_ROM_dico1_isf	9*256	1st ISF quantizer of the 1st stage
Float32	E_ROM_dico1_isf_noise	2*64	1st ISF quantizer for comfort noise
Float32	E_ROM_dico21_isf	3*64	1st ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Float32	E_ROM_dico21_isf_36b	5*128	1st ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Float32	E_ROM_dico22_isf	3*128	2nd ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Float32	E_ROM_dico22_isf_36b	4*128	2nd ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Float32	E_ROM_dico23_isf	3*128	3rd ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Float32	E_ROM_dico23_isf_36b	7*64	3rd ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Float32	E_ROM_dico24_isf	3*32	4th ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Float32	E_ROM_dico25_isf	4*32	5th ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Float32	E_ROM_dico2_isf	7*256	2nd ISF quantizer of the 1st stage
Float32	E_ROM_dico2_isf_noise	3*64	2nd ISF quantizer for comfort noise
Float32	E_ROM_dico3_isf_noise	3*64	3rd LSF quantizer for comfort noise
Float32	E_ROM_dico4_isf_noise	4*32	4th LSF quantizer for comfort noise
Float32	E_ROM_dico5_isf_noise	4*32	5th LSF quantizer for comfort noise
Float32	E_ROM_en_adjust	9	Energy scaling factor for each mode during comfort noise
Float32	E_ROM_f_interpol_frac	4	LPC interpolation coefficients
Float32	E_ROM_fir_6k_7k	31	Bandpass FIR filter coefficients for higher band generation
Word16	E_ROM_fir_down	120	Downsample FIR filter coefficients
Float32	E_ROM_fir_ipol	61	Interpol FIR filter coefficients
Word16	E_ROM_fir_up	120	Upsample FIR filter coefficients
Float32	E_ROM_grid	101	Chebyshev polynomial grid points
Float32	E_ROM_hamming_cos	384	LP analysis window
Float32	E_ROM_hp_gain	16	High band gain table for 23.85 kbit/s mode
Float32	E_ROM_inter4_1	4*2*4	Interpolation filter coefficients
Word16	E_ROM_inter4_2	4*2*16	Interpolation filter coefficients
Word16	E_ROM_interpol_frac	4	Interpolation filter coefficients
Float32	E_ROM_isf	16	ISF table for initialization
Word16	E_ROM_isp	16	ISP table for initialization
Word16	E_ROM_isqrt	49	Table used in inverse square root computation
Float32	E_ROM_lag_window	16	Lag window table
Word16	E_ROM_log2	33	Table used in logarithm computation
Float32	E_ROM_f_mean_isf	16	ISF mean
Word16	E_ROM_mean_isf	16	ISF mean
Float32	E_ROM_mean_isf_noise	16	ISF mean for comfort noise
Word16	E_ROM_pdown_unusable	7	Attenuation factors for adaptive codebook gain in lost frames
Word16	E_ROM_pdown_usable	7	Attenuation factors for adaptive codebook gain in bad frames
Word16	E_ROM_pow2	33	Table used in power of two computation
Float32	E_ROM_qua_gain6b	2*64	Gain quantization table for 6-bit gain quantization
Float32	E_ROM_qua_gain7b	2*128	Gain quantization table for 7-bit gain quantization
Uword8	E_ROM_tipos	36	Starting point for codebook search

Table 4: Decoder fixed tables

Format	Table name	Size	Description
Word16	D_ROM_cdown_unusable	7	Attenuation factors for codebook gain in lost frames
Word16	D_ROM_cdown_usable	7	Attenuation factors for codebook gain in bad frames
Word16	D_ROM_cos	129	Table of cos(x)
Word16	D_ROM_dico1_isf	9*256	1st ISF quantizer of the 1st stage
Word16	D_ROM_dico1_isf_noise	2*64	1st ISF quantizer for comfort noise
Word16	D_ROM_dico21_isf	3*64	1st ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Word16	D_ROM_dico21_isf_36b	5*128	1st ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Word16	D_ROM_dico22_isf	3*128	2nd ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Word16	D_ROM_dico22_isf_36b	4*128	2nd ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Word16	D_ROM_dico23_isf	3*128	3rd ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Word16	D_ROM_dico23_isf_36b	7*64	3rd ISF quantizer of the 2nd stage (the 6.60 kbit/s mode)
Word16	D_ROM_dico24_isf	3*32	4th ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Word16	D_ROM_dico25_isf	5*32	5th ISF quantizer of the 2nd stage (not the 6.60 kbit/s mode)
Word16	D_ROM_dico2_isf	7*256	2nd ISF quantizer of the 1st stage
Word16	D_ROM_dico2_isf_noise	3*64	2nd ISF quantizer for comfort noise
Word16	D_ROM_dico3_isf_noise	3*64	3rd LSF quantizer for comfort noise
Word16	D_ROM_dico4_isf_noise	4*32	4th LSF quantizer for comfort noise
Word16	D_ROM_dico5_isf_noise	4*32	5th LSF quantizer for comfort noise
Word16	D_ROM_fir_6k_7k	31	Bandpass FIR filter coefficients for higher band generation
Word16	D_ROM_fir_7k	31	Bandpass FIR filter coefficients for higher band in 23.85 kbit/s mode
Word16	D_ROM_fir_down	120	Downsample FIR filter coefficients
Word16	D_ROM_fir_up	120	Upsample FIR filter coefficients
Word16	D_ROM_hp_gain	16	High band gain table for 23.85 kbit/s mode
Word16	D_ROM_inter4_2	4*2*16	Interpolation filter coefficients
Word16	D_ROM_interpol_frac	4	LPC interpolation coefficients
Word16	D_ROM_isf	16	ISF table for initialization
Word16	D_ROM_isp	16	ISP table for initialization
Word16	D_ROM_isqrt	49	Table used in inverse square root computation
Word16	D_ROM_log2	33	Table used in logarithm computation
Word16	D_ROM_mean_isf	16	ISF mean
Word16	D_ROM_mean_isf_noise	16	ISF mean for comfort noise
Word16	D_ROM_pdown_unusable	7	Attenuation factors for adaptive codebook gain in lost frames
Word16	D_ROM_pdown_usable	7	Attenuation factors for adaptive codebook gain in bad frames
Word16	D_ROM_ph_imp_low	64	Phase dispersion impulse response
Word16	D_ROM_ph_imp_mid	64	Phase dispersion impulse response
Word16	D_ROM_pow2	33	Table used in power of two computation
Word16	D_ROM_qua_gain6b	2*64	Gain quantization table for 6-bit gain quantization
Word16	D_ROM_qua_gain7b	2*128	Gain quantization table for 7-bit gain quantization

4.4.2 Static variables used in the C-code

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

Table 5: Speech encoder static variables

Struct name	Variable	Туре	Length	Description
Coder_State	mem_speech	Float32	384	speech buffer
	mem_wsp	Float32	371	buffer holding spectral weighted speech
	mem_hp_wsp	Float32	243	highpass wsp
	mem_decim	Float32	30	Open-loop LTP decimation filter memory
	_			Estimated BP filter memory (23.85 kbit/s
	mem_hf	Float32	30	mode)
				Input BP filter memory (23.85 kbit/s
	mem_hf2	Float32	30	mode)
				Input LP filter memory (23.85 kbit/s
	mem_hf3	Float32	30	mode)
	mem_isp	Float32	16	Old ISP vector
	mem_syn	Float32	16	synthesis filter memory
	mem_syn2	Float32	16	modified synthesis memory
	mem_syn_hf	Float32	16	Higher band synthesis filter memory
	mem_isf	Float32	16	Old ISF vector
	mem_hf_wsp	Float32	9	Open-loop lag gain filter memory
	mem_sig_in	Float32	4	Prefilter memory
	mem_sig_out	Float32	4	HP filter memory in the synthesis
	mem_hp400	Float32	4	HP filter memory
	mem_decim2	Float32	3	Open-loop LTP decimation filter memory
	mem_gp_clip	Float32	2	Memory of pitch clipping
	mem_preemph	Float32	1	Preemphasis filter memory
	mem_deemph	Float32	1	Deemphasis filter memory
	mem_deempn	1100102	'	Open-loop LTP deemphasis filter
	mem_wsp_df	Float32	1	memory
	mem_wsp_a	1100102	'	Weighting filter memory (applied to error
	mem_w0	Float32	1	signal)
	mem_ol_gain	Float32	1	Open-loop gain
	<u></u> ga		•	Weighting level depeding on open loop
	mem_ada_w	Float32	1	pitch gain
	mem_gc_threshold	Float32	1	Noise enhancer threshold
				Higher band gain weighting factor (23.85
	mem_gain_alpha	Float32	1	kbit/s mode)
	mem_ol_lag	Word32	5	Open loop lag history
	mem_T0_med	Word32	1	Weighted open loop pitch lag
	mem_exc	Word16	505	Excitation vector
	mem_isp_q	Word16	16	Old ISP vector
	mem_isf_q	Word16	16	Past quantized ISF prediction error
	mem_gain_q	Word16	4	Gain quantization memory
	mem_subfr_q	Word16	4	Scaling factor history
	mem_tilt_code	Word16	1	Preemhasis filter memory
	mem_q	Word16	1	Old scaling factor
	mem_seed	Word16	1	Random generation seed
		E_DTX_Vad_State	1	See below in this table
	*dtx_encSt	E_DTX_State	1	See below in this table
	mem_first_frame	UWord8	1	First frame indicator
	mem_ol_wght_flg	UWord8	1	Switches lag weighting on and off
· ·	mem_vad_hist	UWord8	1	VAD history
E_DTX_State	mem_isf	Float32	128	LSP history
	mem_distance	Float32	28	ISF history distance matrix
	mem_distance_sum	Float32	8	Sum of ISF history distances
	mem_log_en	Float32	8	Logarithmic frame energy history
	mem_hist_ptr	Word16	1	Pointer to the cyclic history vectors
	mem_log_en_index	Word16	1	Index for logarithmic energy Comfort noise excitation seed
	mem_cng_seed	Word16	1	
	mem_dtx_hangover_count	Word16	1	DTX hangover period Counter for elapsed speech frames in
	mem_dec_ana_elapsed_count	Word16	1	DTX
E_DTX_Vad_State	mem_pow_sum	Float64	1	Power of previous frame
L_DIA_vau_State	mem_bckr_est	Float32	12	Background noise estimate
	mom_boki_est	1 IOUIOZ	12	Averaged input components for
	mem_ave_level	Float32	12	stationary estimation
	mem_leve	Float32	12	Input levels of the previous frame
		53.52		Input levels calculated at the end of a
	mem_sub_level	Float32	12	frame (lookahead)
•		· · · · · · · · · · · · · · · · · · ·		

Struct name	Variable	Туре	Length	Description
	mem_a_data5	Float32	10	Memory for the filter bank
	mem_a_data3	Float32	6	Memory for the filter bank
	mem_sp_max	Float32	1	Maximum level
	mem_speech_level	Float32	1	Estimated speech level
	mem_burst_count	Word16	1	Counts length of a speech burst
	mem_hang_count	Word16	1	Hangover counter
	mem_stat_count	Word16	1	Stationary counter
	mem_vadreg	Word16	1	Flags for intermediate VAD decisions
	mem_pitch_tone	Word16	1	Flags for pitch and tone detection
	mem_sp_est_cnt	Word16	1	Counter for speech level estimation
	mem_sp_max_cnt	Word16	1	Counts frames that contains speech

Table 6: Speech decoder static variables

Struct name	Variable	Type	Length	Description
Decoder_State	mem_gc_thres	Word32	1	Threshold for noise enhancer
	mem_exc	Word16	505	INTERPOL]; /* old excitation vector
	mem_isf_buf	Word16	48	ISF buffer(frequency domain)
	mem_hf	Word16	30	HF band-pass filter memory
	mem_hf2	Word16	30	HF band-pass filter memory
	mem_hf3	Word16	30	HF band-pass filter memory
	mem_oversamp	Word16	24	Synthesis oversampled filter memory
	mem_gain ·	Word16	23	Gain decoder memory
	mem_syn_hf	Word16	20	HF synthesis memory
	mem_isp	Word16	16	Old ISP (immittance spectral pairs)
	mem isf	Word16	16	Old ISF (frequency domain)
	mem_isf_q	Word16	16	Past ISF quantizer
	mem_syn_hi	Word16	16	Modified synthesis memory (MSB)
	mem_syn_lo	Word16	16	Modified synthesis memory (LSB)
	mem_ph_disp	Word16	8	Phase dispersion memory
	mem_sig_out	Word16	6	Hp50 filter memory for synthesis
	mem_hp400	Word16	6	Hp400 filter memory for synthesis
	mem_lag	Word16	5	LTP lag history
	mem_subfr_q	Word16	4	Old maximum scaling factor
	mem_tilt_code	Word16	1	Tilt of code
	mem_q	Word16	1 1	Old scaling factor
	mem_deemph	Word16	1 1	Speech deemph filter memory
	mem_seed	Word16		Random memory for frame erasure
	mem_seed2	Word16	1 1	Random memory for HF generation
	mem_seed3	Word16	1 1	Random memory for lag concealment
	mem_T0	Word16	1 1	Old pitch lag
	mem_T0_frac	Word16	1	Old pitch fraction lag
	mem_vad_hist	UWord16		VAD history
	dtx_decSt	D_DTX_State	1 1	See below in this table
	mem_bfi	UWord8	1 1	Previous BFI
	mem_state	UWord8	1 1	BGH state machine memory
	mem_first_frame	UWord8	1	First frame indicator
dtx_decState	mem_isf_buf	Word16	128	ISF vector history (8 frames)
dix_decolate	mem_isf	Word16	16	ISF vector
	mem_isf_prev	Word16	16	Previous ISF vector
	mem_log_en_buf	Word16	8	Logarithmic frame energy history
	mem_true_sid_period_inv	Word16	1	Inverse of true SID update rate
	mem_log_en	Word16	1	Logarithmic frame energy
	mem_log_en_prev	Word16		Previous logarithmic frame energy
		Word16		Comfort noise excitation seed
	mem_cng_seed mem_hist_ptr	Word16	1	Index to beginning of LSF history
	mem_dither_seed	Word16	1	Comfort noise dithering seed
			1	
	mem_cn_dith	Word16 Word16		Background noise stationarity information Number of frames since last SID frame
	mem_since_last_sid		1 1	Counts elapsed speech frames after DTX
	mem_dec_ana_elapsed_count		1	
	mem_dtx_global_state	UWord8	1 1	DTX state flags
	mem_data_updated	UWord8		Flags CNI updates
	mem_dtx_hangover_count	UWord8	1 1	Counts down in hangover period
	mem_sid_frame	UWord8	1 1	Flags SID frames
	mem_valid_data	UWord8	1 1	Flags SID frames containing valid data
	mem_dtx_hangover_added	UWord8	1	Flags hangover period at end of speech

5 Homing procedure

The principles of the homing procedures are described in [2]. The present document only includes a description of the 9 decoder homing frames. For each AMR-WB codec mode, the corresponding decoder homing frame has a fixed set of speech parameters. Table 7 shows the homing frame speech parameters for different modes.

Table 7: Table values for the decoder homing frame parameters for different modes

Mode	Speech Parameters
0	0, 49, 131, 84, 5, 50, 29, 2015, 8,0, 2061, 8,1, 3560, 8,0, 2981, 8
1	0, 49, 131,55, 49, 38,26, 29, 29,3, 15, 7,15, 8, 16,13, 7, 17,16, 8, 0,16, 20, 16,27, 8, 23,0, 27, 0,27, 8
2	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 7, 63,127, 15, 70, 37, 1, 209, 210, 224, 96, 31, 7, 1, 256, 260, 271, 443, 31, 47, 0, 400, 238, 436, 347, 31
3	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 3847, 3845, 63, 127, 70, 34, 0, 3128, 4517, 192, 96, 0, 2, 1, 4160, 8036, 267, 443, 31, 46, 0, 3840, 7091, 432, 395, 31
4	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 3847, 3845, 3847, 3843, 70, 31, 0, 3648, 4764, 824, 2864, 0, 6, 1, 4160, 5220, 4319, 7131, 31, 47, 0, 112, 3764, 219, 211, 31
5	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 3, 2, 3, 2, 7223, 703, 7223, 703, 70, 0, 1, 3, 2, 2, 3, 9475, 9483, 3090, 8737, 0, 0, 1, 0, 0, 2, 0, 4112, 4400, 8415, 14047, 31, 38, 0, 2, 1, 3, 1, 91, 426, 13545, 12955, 0
6	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 161, 759, 3, 2, 127, 516, 6167, 447, 70, 11, 1, 264, 641, 2, 3, 123, 562, 8347, 4354, 0, 1, 1, 264, 408, 3, 0, 256, 308, 9487, 14047, 31, 46, 0, 320, 885, 2, 2, 464, 439, 11347, 12739, 0
7	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 1154, 1729, 1154, 1761, 447, 1519, 959, 495, 70, 27, 1, 1800, 1253, 665, 1960, 546, 164, 1043, 335, 0, 28, 1, 580, 196, 1187, 383, 1031, 1052, 359, 1531, 31, 45, 1, 1024, 893, 1272, 1920, 101, 876, 203, 1119, 31
8	0, 49, 131, 55, 49, 38, 26, 29, 58, 1, 1729, 1154, 1761, 1154, 1519, 959, 495, 447, 70, 3, 42, 1, 580, 1436, 1362, 1250, 901, 714, 24, 45, 0, 0, 0, 1, 68, 708, 1212, 383, 1048, 1611, 1756, 1467, 31, 1, 23, 0, 1536, 1460, 861, 1554, 410, 1368, 1008, 594, 31, 0

6 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.

6.1 Speech file (encoder input/decoder output)

Speech files read by the encoder and written by the decoder consist of 16-bit words where each word contains a 14-bit, left aligned speech sample. The byte order depends on the host architecture (e.g. MSByte first on SUN workstations, LSByte first on PCs etc.). Both the encoder and the decoder program process complete frames (of 320 samples) 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.

6.2 Mode control file (encoder input)

The encoder program can optionally read in a mode control file which specifies the encoding mode for each frame of speech processed. The file is a text file containing one number per speech frame. Each line contains one of the mode numbers 0-8.

6.3 Parameter bitstream file (encoder output/decoder input)

The files produced by the speech encoder/expected by the speech decoder are described in RFC 3267 [7], sections 5.1 and 5.3.

By using a preprocessor definition encoder/decoder can optionally use format described in TS26.201 that defines an octet-aligned frame format (Interface format 2) for the AMR-WB codec.

Annex A (informative): Change history

	Change history								
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New		
2002-03	15	SP-020073			Presented at TSG SA#15 for approval	2.0.0	5.0.0		
2003-03	19	SP-030090	001	1	Correction to log(0) error in VAD decision with low SNR input signals	5.0.0	5.1.0		
2003-03	19	SP-030090	002	1	Correction to decoder with input of long sequence of NO_DATA frames	5.0.0	5.1.0		
2003-03	19	SP-030090	003	1	Correction to "D_UTIL_pow2" function to be bitexact with TS26.173 counterpart	5.0.0	5.1.0		
2003-03	19	SP-030090	004	1	MMS compatible i/o format option	5.0.0	5.1.0		
2003-03	19	SP-030090	005		Correction for handling of RX_NO_DATA frames	5.0.0	5.1.0		
2003-03	19	SP-030090	006	1	Ambiguous expressions in the AMR-WB Floating-point C-Code	5.0.0	5.1.0		
2003-09	21	SP-030447	008		Possible decoder LPC coefficients overflow	5.1.0	5.2.0		
2004-12	26	SP-040844	009	1	Incorrect definition of vector nb_of_bits	5.2.0	6.0.0		
2007-03	35	SP-070029	0011		Maintaining bit-exactness with TS 26.173 after Correction in AMR decoder to avoid division by zero in RX-DTX Handling	6.0.0	7.0.0		
2007-03	35	SP-070029	0012		Bug fix to SID frame signaling in decoder	6.0.0	7.0.0		
2007-09	37	SP-070626	0015	1	Robust operation of AMRWB-decoder	7.0.0	7.1.0		
2008-12	42				Version for Release 8	7.1.0	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		
2015-03	67	SP-150094	0016	1	Correction on AMR-WB (noise energy initialization)	12.0.0	12.1.0		
2015-12	70				Version for Release 13	12.1.0	13.0.0		
2016-03	71	SP-160077	0017	1	Correction of AMR-WB	13.0.0	13.1.0		

Change history								
Date	Meeting	TDoc	CR	Rev	Cat		New version	
2017-03	75					Version for Release 14	14.0.0	

History

Document history						
V14.0.0	April 2017	Publication				