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Application Programmers Interface for MPEG-4 BSAC Decoder

ABSTRACT:

Application Programmers Interface for MPEG-4 BSAC Decoder

KEYWORDS:

Multimedia codecs, BSAC

APPROVED:

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Revision History

VERSION	DATE	AUTHOR	CHANGE DESCRIPTION
0.1	17-Mar-2004	Sanjay	Initial Draft
0.2	18-Mar-2004	Sanjay	Added review comments from Venkat
0.3	03-Apr-2004	Vishala	Updated with review comments from WMSG
1.0			PCS comments incorporated
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2.2	12-Dec-2006	Kusuma S	Changed the Callback function prototype
2.3	10-Apr-2008	Baofeng Tian	Add bsac feature to aac
2.4	25-Apr-2008	Bing Song	Add error concealment feature
2.5	20-May-2008	Bing Song	Add version information
2.6	6-Nov-2008	Haiting yin	Remove AAC part

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1 Introduction

1.1 Purpose

This document gives the details of the application programmer's interface of MPEG-4 BSAC Decoder.   The BSAC decoder takes the parsed raw data stream as the input and generates audio PCM samples. The decoder is designed as a set of library routines that read the bit-stream from the input buffers and write the decoded output to the output buffers. The BSAC decoder implementation currently supports single channel ('mono') and two-channels ('stereo') decoding. The decoder's entropy decoding parts provides a 1-kits/sec/ch fine grain scalability. The decoder modules are OS independent and do not assume any underlying drivers.

1.2 Scope

This document describes only the functional interface of the BSAC decoder. It does not describe the internal design of the decoder. Specifically, it describes only those functions by which a software module can use the decoder.

1.3 Audience Description

The intended audience for this document is the development community who wish to use the BSAC decoder in their systems. The reader is expected to have basic understanding of Audio Signal processing and BSAC decoding.

1.4 References

1.4.1 Standards

- ISO/IEC 13818-7:1997 Information technology -- Generic coding of moving pictures and associated audio information -- Part 7 (popularly known as *MPEG-2 AAC*)
- ISO/IEC 13818-4:1997 Information technology -- Generic coding of moving pictures and associated audio information -- Part 4 (compliance testing)
- ISO/IEC 14496-3:1999 Information technology – Coding of audio visual objects -- Part 3 (audio)
- ISO/IEC 14496-14:2003, Information technology -- Coding of audio-visual objects -- Part 14:MP4 file format
- ISO/IEC 14496-12:2005, Information technology -- Coding of audio-visual objects -- Part 12: ISO base media file format

1.4.2 General References

- Ted Painter and Andreas Spanias, "Perceptual Coding of Digital Audio", Proc. IEEE, vol-88, no.4, April 2000

- H.S.Malvar, "Lapped transforms for efficient subband/transform coding", IEEE trans. ASSP, June 1990.
- Seymour Shlien, "The Modulated Lapped Transform, Its Time-Varying Forms and Its Applications to Audio Coding Standards."
- "A Tutorial on MPEG/Audio compression" by Davis Pan

1.4.3 Freescale Multimedia References

- BSAC Decoder Application Programming Interface – bsac_dec_api.doc
- BSAC Decoder Requirements Book - bsac_dec_reqb.doc
- BSAC Decoder Test Plan - bsac_dec_test_plan.doc
- BSAC Decoder Release notes - bsac_dec_release_notes.doc
- BSAC Decoder Test Results – bsac_dec_test_results.doc
- BSAC Decoder Performance Results – bsac_dec_perf_results.doc
- BSAC Decoder Interface header – bsacd_dec_interface.h
- BSAC Decoder Application Code – bsac_main.c

1.5 Definitions, Acronyms, and Abbreviations

TERM/ACRONYM	DEFINITION
AAC	Advanced Audio Coding
ADIF	Audio_Data_Interchange_Format
ADTS	Audio_Data_Transport_Stream
API	Application Programming Interface
ARM	Advanced RISC Machine
FSL	Freescale
IEC	International Electro-technical Commission
ISO	International Standards Organization
LC	Low Complexity
MDCT	Modified Discrete Cosine Transform
MPEG	Moving Pictures Expert Group
OS	Operating System
PCM	Pulse Code Modulation
PNS	Perceptual Noise Substitution
UNIX	Linux PC x/86 C-reference binaries
RVDS	ARM RealView Development Suite
TBD	To be decided
BSAC	Bit sliced arithmetic coding

1.6 Document Location

docs/bsac_dec

2 API Description

This section describes the steps followed by the application to call the AAC decoder. During each step the data structures used and the functions used will be explained. Pseudo code is given at the end of each step. The member variables inside the structures are prefixed as bsacd_ or app_ to indicate if that member variable needs to be initialized by the decoder or application.

Step 1: Allocate memory for Decoder parameter structure

The application allocates memory for the structure mentioned below. This structure contains the decoder parameters and memory information structures.

```
/* Decoder   parameter   structure */
typedef struct {
    AACD_Mem_Alloc_Info    aacd_mem_info;
    void *aacd_decode_info_struct_ptr;
    AACD_INT8(*app_swap_buf) (AACD_UCHAR **new_buf_ptr,
                              AACD_UINT32 *new_buf_len,
                              void* global_struct);
    AACD_UINT8   num_pcm_bits;
    long         *AACD_bno;
    AACD_Block_Params *params;
    AACD_Ch_Info ch_info[Chans];
    AACD_INT32 adts_format;
    AACD_INT32 packet_loss;
} AACD_Decoder_Config;
```

Description of the decoder parameter structure `AACD_Decoder_Config`

_aacd_mem_info_

>   This is a memory information structure. The application needs to call the function aacd_query_dec_mem to get the memory requirements from the decoder. The decoder will fill this structure with its memory requirements. This will be discussed in **Step 2**.

_aacd_decode_info_struct_ptr_

>   This is a void pointer. This will be initialized by the decoder during the   initialization routine. This will then be a pointer to a structure which contains the pointers to tables, buffers and symbols used by the decoder.

_app_swap_buf_

>   _Function pointer to swap buffers. The application has to initialize this pointer._

_num_pcm_bits_

>   The application has to indicate the decoder the output precision required to be outputted. The decoder can output the PCM samples either as 16bit samples or as 24 bit samples.

_AACD_bno_

>   _Point to frame counter._

params

>   This is a pointer to a structure containing the header information. The header is parsed by the application and this structure is filled with the appropriate header information. This structure needs to be updated whenever header is parsed. This will be discussed in **step 4**

_ch_info_

Channel information got from header.

`adts_format`

Used for error concealment to indicate if the stream is adts format.

`packet_loss`

Used for error concealment. If the flag set as AACD_PACKET_LOSS, the decoder will output one frame data based on previous frame data.

Example pseudo code for this step

```
/* Allocate memory for the local array of table pointers */
   void *aptable[58];

/* Allocate memory for the decoder parameter */
   dec_config = (AACD_Decoder_Config *)
                             alloc (sizeof(AACD_Decoder_Config);

/* Initialize aptable with the start address of all the tables used
   for AAC Decoder. The start addresses of all the tables are available
   in the header file aacd_tables.h  */

/* Fill up the Relocated data position */
   dec_config->app_initialized_data_start = (void *) aptable;

/* Request the output PCM samples to be in the 16bit format/24bit format
   dec_config->num_pcm_bits = AACD_24_BIT_OUTPUT;

/* Assign swap-buffer function to the swap buffer function pointer */
   dec_config->app_swap_buf = app_swap_buffers_aac_dec;

/* Get stream type */
if (App_adts_header_present)
{
    dec_config->adts_format = AACD_TRUE;
}
else
{
    dec_config->adts_format = AACD_FALSE;
}
```

Step 2: Get the decoder version information

This function returns the codec library version information details. It can be called at any time and it provides the library's information: Component name, supported ARM family, Version Number, supported OS, build date and time and so on.

The function prototype of *aacd_decode_versionInfo* is :

C prototype:
*const AACD_INT8 * aacd_decode_versionInfo();*

Arguments:
   • None.

Return value:
- const char *   -   The pointer to the constant char string of the version information string.

Example pseudo code for the memory information request

```
{
  // Output the AAC Decoder Version Info
  printf("%s \n", aacd_decode_versionInfo());
}
```

Step 3: Get the decoder memory requirements

The AAC decoder does not do any dynamic memory allocation. The application calls the function *aacd_query_dec_mem* to get the decoder memory requirements. This function must be called before all other decoder functions are invoked.

The function prototype of *aacd_query_dec_mem* is :

C prototype:
```
AACD_RET_TYPE aacd_query_dec_mem (AACD_Decoder_config * dec_config);
```

Arguments:
- dec_config   - Decoder config. pointer.

Return value:
- AACD_OK   - Memory query successful.
- Other codes   - Error (For other error codes refer to appendix).

This function populates the memory information structure, which is described below:

Memory information structure array

```
typedef struct {
      /*  Number of valid memory requests */
      AACD_INT32                     aacd_num_reqs;
      AACD_Mem_Alloc_Info_Sub    mem_info_sub[MAX_NUM_MEM_REQS];
} AACD_Mem_Alloc_Info;
```

Description of the structure `AACD_Mem_Alloc_Info`
aacd_num_reqs
        The number of memory chunks requested by the decoder.
mem_info_sub
        This structure contains each chunks' memory configuration parameters.

```
typedef struct {
      AACD_INT32        aacd_size; /* Size in bytes */
```

```
    AACD_INT32      aacd_type; /* Memory type Fast or Slow */
    AACD_MEM_DESC   aacd_mem_desc;
        /* Flag to indicate Static/Scratch memory */
    AACD_MEM_PRIORITY  aacd_priority;
        /* In case of fast Memory type, specify the priority */
    void *app_base_ptr;
    /* Pointer to the base memory, which will be allocated
        And filled by the application*/
} AACD_Mem_Alloc_Info_sub
```

Description of the structure *AACD_Mem_Alloc_Info_sub*

_aacd_size_

   The size of each chunk in bytes.

_aacd_type_

   The type of the memory indicates if the requested chunk of memory needs to be allocated in external or internal memory. The type of memory can be SLOW_MEMORY or external memory, FAST_MEMORY or internal memory. In targets where there is no internal memory, the application can allocate memory in external memory. (Note: If the decoder requests for a FAST_MEMORY for which the application allocates a SLOW_MEMORY, the decoder will still decode, but the performance (MHz) will suffer.)

_aacd_mem_des_

   The memory description field indicates whether requested chunk of memory is static or scratch.

_aacd_priority_

   In case, if the decoder requests for multiple memory chunks in the fast memory, the priority indicates the order in which the application has to prioritize placing the requested chunks in Fast memory

_app_base_ptr_

   This will be initialized by the application. The application will allocate the memory for each chunk depending on the requested size and the type, and then assign the base address of this chunk of memory to *app_base_ptr*. The application should allocate the memory that is aligned to a 4 byte boundary in any case.

Example pseudo code for the memory information request

```
/* Query for memory */
retval = aacd_query_dec_mem (&dec_config);

if (retval != AACD_OK)
    return 1;
```

Step 4: Allocate Data Memory for the decoder

In this step the application allocates the memory as required by the AAC Decoder and fills up the base memory pointer *'app_base_ptr' of 'AACD_Mem_Alloc_Info_sub'* structure for each chunk of memory requested by the decoder.

Example pseudo code for the memory allocation and filling the base memory pointer by the application.

```
AACD_Mem_Alloc_Info_sub *mem;

/* Number of memory chunks requested by the decoder */
nr = dec_config->aacd_mem_info.aacd_num_reqs;

for(i = 0; i < nr; i++)
{
      mem = &(dec_config-> aacd_mem_info.mem_info_sub[i]);
      if (mem->aacd_type == FAST_MEMORY)
      {
            /* This function allocates memory in internal memory */
            mem->app_base_ptr = alloc_fast(mem->aacd_size);
      }
      else
      {
            This function allocates memory in external memory */
            mem->app_base_ptr = alloc_slow(mem->aacd_size);
      }
}
```

The functions alloc_fast and alloc_slow are required to allocate the memory aligned to 4 byte boundary.

Step 5: Get the header information

The application does the parsing of the header. The header structure which is required by the decoder to process the raw data is updated by the application. Please refer to [**Error! Reference source not found.**] for more details about the structures given below.

Header information structure:

```
typedef struct
{
      AACD_INT32          num_pce;
      AACD_ProgConfig *pce;

      AACD_INT32 ChannelConfig;
      AACD_INT32 SamplingFreqIndex;
      AACD_INT32 BitstreamType;
      AACD_INT32 BitRate;
      AACD_INT32 BufferFullness;
            /*No. of bits in decoder buffer after decoding
            First raw_data_block */
      AACD_INT32 ProtectionAbsent;
      AACD_INT32 CrcCheck;
      AACD_INT32 frame_length;

#ifdef OLD_FORMAT_ADTS_HEADER
      AACD_INT32 Flush_LEN_EMPHASIS_Bits;
#endif
      AACD_INT32 scalOutObjectType;
      AACD_INT32 scalOutNumChannels;
      AACD_INT32 sampleRate;
      AACD_INT32 framelengthflag;
      AACD_INT32 iMulti_Channel_Support;
      AACD_INT32 bsacDecLayer;
} AACD_Block_Params;
```

Description of the structure `AACD_Block_Params`

num_pce

Number of program config elements in the header. If there are no program config elements in the header, num_pce should be set to zero.

pce

Pointer to the Program config structure. (Details of Program config structure is given below).

ChannelConfig

Channel Configuration parameter can take values in the range 0-7. Each value specified indicates preset channel-to-speaker mapping defined in the standard. If num_pce is greater than zero, then ChannelConfig will be ignored as pce will be used.

SamplingFreqIndex

This is an index into an array of valid sampling-frequency values. This will be Ignored if num_pce is greater than zero.

BitstreamType

0 = Constant bit rate (CBR)

1 = Variable bit rate (VBR)

BitRate

If BitstreamType = CBR, then it indicates actual bit rate

If BitstreamType = VBR, then it indicates peak bit rate if not equal to zero

If BitstreamType = VBR and BitRate = 0, then peak bit rate is unknown.

BufferFullness

No. of bits remaining in the encoder buffer after encoding the first raw_data_block in the frame. This will be ignored if num_pce is greater than zero.

ProtectionAbsent

If ProtectionAbsent =1, then CrcCheck value will not be present in the stream

If ProtectionAbsent =0, then CrcCheck value will be present in the stream and CrcCheck will be done by the decoder.

<u>CrcCheck</u>

32bit field used to perform CRC check by the decoder.

frame_length

Bytes in one frame which get from ADTS header.

<u>*Flush_LEN_EMPHASIS_Bits*</u>

This is used only for the MPEG4 streams with old format ADTS headers

0 : If byte alignment is already existing at the end of the header

1: If there is no byte alignment at the end of the header.

 If this is 1, decoder flushes 2 bits before decoding every frame.

. Below elements is used for bsac decoding:

<u>scalOutObjectType</u>

This is used for identify bsac type bitstream, for bsac type, the value should be 22.

<u>scalOutNumChannels</u>

This is used for bsac output channels, it should be less or equal than 2.

<u>sampleRate</u>

This is used to indicate current bitstream's sample rate.

<u>Framelengthflag</u>

This is used to indicate the frame size

 0: current frame size is 1024.

 1: current frame size is 960.

<u>iMulti_Channel_Support</u>

This is used to indicate whether the decoder need to decode channel than two. This is for future use, currently, we do not support this feature.

<u>bsacDecLayer</u>

This is used to indicate how many enhanced layer you want to decode.

 -1: decode all layers that in current bitstream.

 0: only decode base layer

 Others: decode specific layers of enhanced layers

```
PCE Structure:
typedef struct
{
    AACD_INT32          profile;
    AACD_INT32          sampling_rate_idx;
    AACD_EleList        front;
    AACD_EleList        side;
    AACD_EleList        back;
    AACD_EleList        lfe;
    AACD_EleList        data;
    AACD_EleList        coupling;
    AACD_MIXdown        mono_mix;
    AACD_MIXdown        stereo_mix;
    AACD_MIXdown        matrix_mix;
    AACD_INT8           comments[1];
    AACD_INT32          buffer_fullness;
    AACD_INT32          tag;
}AACD_ProgConfig;
```

Description of the structure `AACD_ProgConfig`

profile

      This should be set to 1 always (MPEG4 AAC Low Complexity profile)

sampling_rate_idx

      This is an index into an array of valid sampling-frequency values

front

      Structure containing information about front channel elements.

side

      Structure containing information about side channel elements.

back

      Structure containing information about back channel elements.

lfe

      Structure containing information about low frequency enhancement channel elements.

data

      Structure containing information about the associated data elements for this program

coupling

      Structure containing information about the coupling channel elements.

mono_mix

      Structure containing information about the mono_mixdown element

stereo_mix

      Structure containing information about the stereo mixdown element

matrix_mix

      Structure containing information about the matrix mixdown element.

comments

      General information

buffer_fullness

      No. of bits remaining in the encoder buffer after encoding the first raw_data_block in the frame.

tag

      ID of the PCE

```
EleList structure:

typedef struct
{
    AACD_INT32          num_ele;
    AACD_INT32          ele_is_cpe[16];
    AACD_INT32          ele_tag[16];
}  AACD_EleList;
```

Description of the structure `AACD_EleList`

num_ele

      Number of elements in the channel

ele_is_cpe

      Indicates whether the element is channel_pair or not

ele_tag

      Unique id for the channel element.

Mixdown structure:

```
typedef struct
{
    AACD_INT32          present;
    AACD_INT32          ele_tag;
    AACD_INT32          pseudo_enab;
}   AACD_MIXdown;
```

Description of the structure `AACD_MIXdown`

present

> Indicates if the mix_down element is present or not

_ele_tag_

> Indicates the number of the mix_down element

_pseudo_enab_

> This is defined only for matrix mix-down and indicates if pseudo-surround is enabled or not.

Step 6: Memory allocation for input buffer

For each frame decoding process, we do decoding on the application's buffer, do not allocate new buffer for input. For bsac specific, we allocate 2k bytes for arithmetic input buffer, its internal data have a layered structure.

Step 7: Initialization routine

All initializations required for the decoder are done in _aacd_decode_init_. This function must be called before the main decoder function is called.

C prototype:
_AACD_RET_TYPE aacd_decode_init (AACD_Decoder_Config *);_

Arguments:
- Decoder parameter structure pointer.

Return value:
- AACD_OK   - Initialization successful.
- Other codes   - Initialization Error

Example pseudo code for calling the initialization routine of the decoder

```
/* Initialize the AAC decoder. */
retval = aacd_decode_init (dec_config);

if (retval != AACD_OK)
    return 1;
```

Step 8: Memory allocation for output buffer

The application has to allocate memory for the output buffers to hold the decoded stereo PCM samples for a maximum of one frame size. The pointer to this output buffer needs to be passed to the aacd_decode_frame function. The application can allocate memory for output buffer in external memory using alloc_slow. Allocating memory in internal memory using alloc_fast will improve the performance (MHz) of the decoder marginally. It would be desirable to allocate the buffer in the slow memory.

Example pseudo code for allocating memory for output buffer

```
/* Allocate memory for output buffer */
    outbuf = alloc_slow(<number_of_channels>*AACD_FRAME_SIZE);
```

In the example code, the output buffer has been declared as a two dimensional array

```
        AACD_OutputFmtType Outbuf[num_of_channels][AACD_FRAME_SIZE];
```

Note: The current implementation of MPEG4 AAC Decoder supports only LC profile. Hence the maximum number of channels is two. If the output is mono, the output will be generated in outbuf[0][0]. If the output is stereo, the two channels output will be generated in outbuf[1][0] and outbuf[2][0].

Step 9: Call the frame decode routine

The main AAC decoder function is *aacd_decode_frame*. This function decodes the AAC bit stream in the input buffer to generate one frame of decoder output per channel in every call. If the input buffer does not contain enough data for one frame, then only the call back function app_swap_buff will be called to get more input.

The output buffer is first filled with left channel samples and then with the right channel , samples. For mono streams, the decoder fills only the left channel samples and leaves the right channel samples unfilled.

The decoder fills up the structure AACD_Decoder_Info.

```
typedef struct {
    AACD_UINT32 aacd_sampling_frequency;
        /* Sampling frequency of the current frame in KHz  */
    AACD_UINT32 aacd_num_channels;
        /* Number of channels decoded in current frame */
    AACD_UINT32 aacd_frame_size;
        /* Number of stereo samples being output for this frame  */
    AACD_UINT32 aacd_len;                       /*     */
    AACD_UINT32      aacd_bit_rate;             /*     */
    AACD_UINT32      BitsInBlock;
        /* Decoder outputs the number of bits in the raw data block
        decoded. This can be used by the application to keep track of
        the bitstream */
} AACD_Decoder_Info;
```

If the bit stream has errors, the decoder will return the corresponding error (mentioned in the appendix), except for the AACD_END_OF_STREAM.
For bsac specific, it have another info function: BSACD_decode_info, this function will determine the layer that need to decoded. Below is the pseudo code for this logic:

```
 if (bsacDecLayer == -1 )
    p_decparam->sam_DecBr = 0;
 else
    p_decparam->sam_DecBr = bsacDecLayer + 16;
```

C prototype:
```
AACD_RET_TYPE  aacd_decode_frame ( AACD_Decoder_Config *dec_config,
                                   AACD_Decoder_Info *dec_info,
                                   AACD_OutputFmtType *output_buffer
                                   AACD_INT8 * inbuf, AACD_INT32 len);
```

Arguments:
- dec_config   Decoder parameter structure pointer
- dec_info   Decoder output parameter pointer
- output_buffer   Pointer to the output buffer to hold the decoded samples
- inbuf   Pointer to the input buffer containing the raw data block
- len   Length of the input buffer

Return value:
- AACD_OK   indicates decoding was successful.
- **Others**   **indicates error**

When the decoder encounters the end of bit-stream, the application comes out of the loop. In case of error while decoding the current frame, the application can just ignore the frame without processing the output samples by continuing the loop.
In case of mono bit-streams, as mentioned earlier, the decoder fills only the left channel. It is the responsibility of the application to use it accordingly. One example is the case in which the application can copy the left channel samples into right channel. This is illustrated in the example code below.

Example pseudo code for calling the main decode routine of the decoder

```
AACD_Decoder_Info    dec_info;
AACD_INT8 inbuf;
AACD_UINT32 len;

while (TRUE)
{
      /* Decode one frame */
      /* The decoded parameters for this frame are available in the
         structure AACD_Decoder_info */
      /* application determine below length */
      len = input buffer's length;

      /* Get the input raw data block */

      /* Read(inbuf, len); */
```

```
 if (packer_loss)
{
        dec_config->packet_loss = AACD_PACKET_LOSS;
}

retval = aacd_decode_frame (dec_config, &dec_info,
                                outbuf, inbuf, len);


if (retval == AACD_END_OF_STREAM)
{
        /* Reached the end of bit-stream */
        break;
}

if (retval != AACD_OK)
{
        /* Invalid frame encountered, do not output */
      continue;
}

/* If mono, copy the left channel to the right channel. */
if (dec_info.aacd_num_channels == 1)
{
        int i;
        for (i = 0; i < dec_info.aacd_frame_size; i++)
            outbuf [AACD_FRAME_SIZE+i] = outbuf [i];
}

/* The output frame is ready for use. Decoding of the next frame
should start only if the previous output frame has been fully used
by the application. */

/* audio_output_frame () is an application function that outputs
the decoded samples to the output port/device. This function is not
given in this document. */

audio_output_frame(outbuf, 2*AACD_FRAME_SIZE);
}
```

Step 10: Free memory

The application releases the memory that it allocated to AAC Decoder if it no longer needs the
decoder instance.

```
free (outbuf);
free (inbuf);
for (i=0; i<nr; i++)
{
      free (dec_config-> aacd_mem_info.mem_info_sub[i].app_base_ptr);
}
free (dec_config);
```

2.1.1 app_swap_buffers_aac_dec function usage

app_swap_buffers_aac_dec is called by the decoder to get a new input buffer for decoding. This function is called by the AAC decoder within the *aacd_decode_frame* function when it runs out of current bit stream input buffer. The decoder uses this function to return the used buffer and get a new bit stream buffer.

This function should be implemented by the application. The parameter new_buf_ptr is a double pointer. This will hold the recently used buffer by the decoder when this function is called. The application can decide to free this or do any sort of arithmetic to get any new address. The application needs to put the new input buffer pointer in *new_buf_ptr to be used by the decoder.

The interface for this function is described below:

C prototype:
*AACD_INT8 app_swap_buffers_aac_dec (AACD_UINT8 ** new_buf_ ptr,*
*AACD_UINT32 * new_buf_len,*
*void *glbl_struct);*

Arguments:
- *new_buf_ ptr*   - Pointer to the new buffer given by the application.
- *new_buf_len*   - Pointer to length of the new buffer in bytes
- *glbl_struct*   - Pointer to be used in multithreaded environment

Return value:
- 0   - Buffer allocation successful.
- -1   - End of bit-stream

Example pseudo code

```
AACD_INT8 app_swap_buffers_aac_dec (AACD_INT8 ** new_buf_ptr,
                                    AACD_UINT32 * new_buf_len,
                                    void *glbl_struct)
{
        Request for an input buffer from the application

        Wait for the input buffer corresponding to the decoder instance of
        instance_id.

        If the new buffer arrives
        {
                Return the used buffer to the application.

                Set the new_buf_ptr to point to the new buffer and
                set *new_buf_len to the length of the new buffer.
```

```
        Return 0 to the calling function to indicate that new buffer
        has been received.
}

Else if the application indicates end of bit stream
{
        Set new_buf_ptr to NULL and *new_buf_len to 0.

        Return -1 to the calling function to indicate the end of
        input bit stream.
}
```

3 Example calling Routine

Example for aac lc:

```
#include < aacd_dec_interface.h>
#include <aacd_tables.h>

int main (void)
{
        AACD_UINT8 retval;
        AACD_Mem_Alloc_Info_sub *mem;
        AACD_OutputFmtType outbuf[Chans][AACD_FRAME_SIZE];
        AACD_INT8 *input_buf;
        AACD_UINT32 len;
        AACD_Decoder_Config *dec_config;
        AACD_Decoder_info dec_info;
        AACD_INT32 i, nr;
        AACD_Block_Params BlockParams;
        void *aptable[58];        /* tables addresses are copied here
                                   * Total of 58 tables are there */

        /*
        * Initializing the Debug Function Pointers. If the Debug level is
        * enable. The ENABLE_DEBUG_LOG should be define in the test
        * application make file
        */
        #ifdef ENABLE_DEBUG_LOG

        aacd_register_debug_funcptr (DebugLogText, DebugLogData);

        #endif

        /* Allocate memory for the decoder parameter structure */
        dec_config = (AACD_Decoder_Config *)
        alloc_fast (sizeof(AACD_Decoder_Config));

        /* Fill up the Relocated data position. All the tables start
        address is provided in the header file aacd_tables.h. Update
        the table addresses in to the local tables pointer aptable */

        aptable[0] = (Lfract *) AACD_pow_4by3_table_lf;
        aptable[1] = (int *) AACD_pred_max_bands_tbl;
        aptable[2] = (unsigned short *) AACD_neg_mask;
        aptable[3] = (short *) AACD_sgn_mask;
        aptable[4] = (unsigned int *) AACD_hufftab_off;
        aptable[5] = (int (*)[])AACD_tns_max_bands_tbl;
        aptable[6] = (unsigned char **)AACD_huffstart;
        aptable[7] = (Lfract *(*)[])AACD_windowPtr;
        aptable[8] = (unsigned char *) AACD_HuffTable1;
        aptable[9] = (unsigned char *) AACD_HuffTable2;
        aptable[10] = (unsigned char *) AACD_HuffTable3;
        aptable[11] = (unsigned char *) AACD_HuffTable4;
        aptable[12] = (unsigned char *) AACD_HuffTable5;
        aptable[13] = (unsigned char *) AACD_HuffTable6;
        aptable[14] = (unsigned char *) AACD_HuffTable7;
```

```
aptable[15] = (unsigned char *) AACD_HuffTable8;
aptable[16] = (unsigned char *) AACD_HuffTable9;
aptable[17] = (unsigned char *) AACD_HuffTable10;
aptable[18] = (unsigned char *) AACD_HuffTableEsc;
aptable[19] = (unsigned char *) AACD_HuffTableScl;
aptable[20] = (SR_Info *) AACD_samp_rate_info;

aptable[21] = (short *) AACD_sfb_96_1024;
aptable[22] = (short *) AACD_sfb_96_128;
aptable[23] = (short *) AACD_sfb_64_1024;
aptable[24] = (short *) AACD_sfb_64_128;
aptable[25] = (short *) AACD_sfb_48_1024;
aptable[26] = (short *) AACD_sfb_48_128;
aptable[27] = (short *) AACD_sfb_32_1024;
aptable[28] = (short *) AACD_sfb_24_1024;
aptable[29] = (short *) AACD_sfb_24_128;
aptable[30] = (short *) AACD_sfb_16_1024;
aptable[31] = (short *) AACD_sfb_16_128;
aptable[32] = (short *) AACD_sfb_8_1024;
aptable[33] = (short *) AACD_sfb_8_128;

aptable[34] = (unsigned char *) AACD_n_lzeros_8bit;
aptable[35] = (short *) AACD_bitrev_indices_256;
aptable[36] = (short *) AACD_bitrev_indices_2048;

aptable[37] = (short **) AACD_bitrev_indices;
aptable[38] = (short *) AACD_num_bitrev_sets;
aptable[39] = (Lfract *) AACD_fft_radix4_twidfac;
aptable[40] = (Lfract *) AACD_prepost_twidfac;
aptable[41] = (Lfract *) AACD_scale_fac_table_lf;
aptable[42] = (Lfract *) AACD_k_tab_lf;

aptable[43] = (Lfract *) AACD_window_fhg_long;
aptable[44] = (Lfract *) AACD_window_fhg_short;
aptable[45] = (Lfract *) AACD_window_dol_long;
aptable[46] = (Lfract *) AACD_window_dol_short;
aptable[47] = (Lfract(*)[])log2_coef;
aptable[48] = (Lfract (*)[])pow2_coef;
aptable[49] = (Lfract *) pow2_neg_coef;
aptable[50] = (Lfract *)Coeff_CR_512;
aptable[51] = (Lfract *)Coeff_CI_512;
aptable[52] = (Lfract *)Coeff_CR_64;
aptable[53] = (Lfract *)Coeff_CI_64;
aptable[54] = (Lfract *)Coeff_PostTwid_CR_long;
aptable[55] = (Lfract *)Coeff_PostTwid_CI_long;
aptable[56] = (Lfract *)Coeff_PostTwid_CR_short;
aptable[57] = (Lfract *)Coeff_PostTwid_CI_short;

dec_config->aacd_initialized_data_start = (void *) aptable;


/* Assign swap buffer function to swap buffer function
pointer */
dec_config->app_swap_buffer = app_swap_buffers_aac_dec;

/* for 16 bit output */
```

```
dec_config->num_pcm_bits  = AACD_SIXTEEN_BIT;
/* for 24 bit */
/*    dec_config->num_pcm_bits = AACD_TWENTYFOUR_BIT; */

/* Query for memory */
retval = aacd_query_dec_mem (dec_config);

if (retval != AACD_OK)
    return 1;

/* Number of memory chunk requests by the decoder */
nr = dec_config->aacd_mem_info.aacd_num_req;

/* Allocate memory requested by the decoder*/
for(i = 0; i < nr; i++)
{
    mem = &(dec_config-> aacd_mem_info.mem_info_sub[i]);
    if (mem->aacd_type == AACD_FAST_MEMORY)
    {
        mem->app_base_ptr = alloc_fast(mem->aacd_size);
    }
    else
    {
        mem->app_base_ptr = alloc_slow(mem->aacd_size);
    }
}

/* Parse the header and fill the header structure
BlockParams;
    This is done by the application*/

dec_config->params = &BlockParams;

/* Allocate memory for input buffer */
input_buf = alloc_fast(AACD_INPUT_BUFFER_SIZE);

len = AACD_INPUT_BUFFER_SIZE;

/* Initialize the AAC decoder. */
retval = aacd_decode_init (dec_config);

if (retval != AACD_OK)
    return 1;

/* Decoder loop */
while (TRUE)
{
    /* Decode one frame */
    /* The decoded parameters for this frame are available
    in the structure AACD_Decoder_info */
    retval = aacd_decode_frame (dec_config, &dec_info,
                outbuf, input_buf, len);


    if (retval == AACD_END_OF_STREAM)
    {
```

```
                    /* Reached the end of bitstream */
                    break;
            }

            if (retval != AACD_OK)
            {
                    /* Invalid frame encountered, do not output */
                    continue;
            }



            /* The output frame is ready for use. Decoding of the
            next frame should start only if the previous output
            frame has been fully output by the application.
            Note: For mono outputs, the output will be generated in
            outbuf[0]. For stereo outputs, the output will be
            generated in outbuf[1] and outbuf[2] */

            audio_output_frame(outbuf);
    }

    free (outbuf);
    free (input_buf);
    for (i=0; i<nr; i++)
    {
            free (dec_config->
aacd_mem_info.mem_info_sub[i].app_base_ptr);
    }
     free (dec_config);

     return 0;
}
```

Example for aac-bsac:

```
int main(int argc, char *argv[])
{
  AACD_RET_TYPE rc;
  int Length;

  AACD_Decoder_Config *dec_config;
  AACD_Decoder_info dec_info;
  AACD_Mem_Alloc_Info_Sub  *mem;
  int            nr;
  int            rec_no;
  char opath[AACD_PATH_LEN];
  char InFileName[AACD_PATH_LEN];


#ifdef TIME_PROFILE_RVDS
  unsigned int  prev_clk, curr_clk, max_frm, max_clk, min_frm, min_clk, clk,nframe, max_sf;
  unsigned int total_clk=0;
```

```
    unsigned char chname[] = "[PROFILE-INFO]";
    extern int prev_cycles(void);
    extern int curr_cycles(void);
    FILE *fp_mhz;
    int sampling_rate = 0;
    int bit_rate = 0;
    int num_chans = 0;
    int len = 0;
#endif

#ifdef TIME_PROFILE
    struct timeval StartTime, EndTime;
    unsigned long TotalDecTimeUs = 0;
    unsigned long prev_DecTimeUs = 0;
    unsigned long cur_DecTimeUs = 0;
    unsigned long min_DecTimeUs = 0;
    int max_frame = 0 ;
    int min_frame = 0;
    unsigned char chname[] = "[PROFILE-INFO]";
    FILE *fp_mhz;
    int sampling_rate = 0;
    int bit_rate = 0;
    int num_chans = 0;
    int len = 0;
#endif

#ifdef __WINCE        // for taking timing on wince platform
        BOOL Flag;
        LARGE_INTEGER lpFrequency1 ;
        LARGE_INTEGER lpPerformanceCount1;
        LARGE_INTEGER lpPerformanceCount2;
        __int64 TotalDecTime=0;
        __int64 Temp;
#endif

#ifdef MEASURE_STACK_USAGE //TLSbo88602
    int      *ps32SP, *ps32BaseSP;
    int      s32StackCount, s32StackValue;
    int      s32PeakStack = 0;
#endif

#ifdef MEASURE_HEAP_USAGE
    int    s32TotalMallocBytes=0;
#endif


    int ShouldOpen; /* For managing file opening by AACD_writeout */
    int ShouldClose; /* For managing file opening by AACD_writeout */
```

```
    int  n_bytes;
#ifdef OUT_DUMP
#ifdef INTERLEAVE_OUTPUT
        FILE *pfOutput;
#endif /*END - INTERLEAVE_OUTPUT*/
#endif /*END - OUT_DUMP */

  if (argc < 3)
  {
    printf ("Usage: %s <infile> <outfile> <output bits per sample>\n", argv[0]);
    exit (1);
  }

  printf("\nsize of struct = %d\n", sizeof(dec_config-
>aacd_mem_info.mem_info_sub[0].aacd_size));

  dec_config = (AACD_Decoder_Config *) aacd_alloc_fast (sizeof(AACD_Decoder_Config));

  if (dec_config == NULL)
     return 1;
//DSPhl28081 Removed the statement
//dec_config->aacd_initialized_data_start = (void *) aptable;
#ifdef ENABLE_DEBUG_LOG
  aacd_register_debug_funcptr(DebugLogText, DebugLogData);       //DSPhl28187
#endif
  if( aacd_query_dec_mem (dec_config) != AACD_ERROR_NO_ERROR)
  {
    printf("Failed to get the memory configuration for the decoder\n");
    return 1;
  }
//DSPhl28081 Removed the function call
//aacd_init_tables();
  /* Number of memory chunk requests by the decoder */
  nr = dec_config->aacd_mem_info.aacd_num_reqs;

  for(rec_no = 0; rec_no < nr; rec_no++)
  {
    mem = &(dec_config->aacd_mem_info.mem_info_sub[rec_no]);

    if (mem->aacd_type == AACD_FAST_MEMORY)
    {
      mem->app_base_ptr = aacd_alloc_fast (mem->aacd_size);

#ifdef MEASURE_HEAP_USAGE
  s32TotalMallocBytes +=  mem->aacd_size;
#endif


        if (mem->app_base_ptr == NULL)
```

```
        return 1;
    }
    else
    {
        mem->app_base_ptr = aacd_alloc_slow (mem->aacd_size);

#ifdef MEASURE_HEAP_USAGE
        s32TotalMallocBytes +=  mem->aacd_size;
#endif
        if (mem->app_base_ptr == NULL)
            return 1;
    }
                memset(dec_config->aacd_mem_info.mem_info_sub[rec_no].app_base_ptr,
                    0, dec_config->aacd_mem_info.mem_info_sub[rec_no].aacd_size);
//TLSbo74884

    }


#ifdef TIME_PROFILE_RVDS                            //tlsbo85204
    fp_mhz = fopen("bsac_dec.txt","a");
    if (fp_mhz == NULL)
    {
        printf("Couldn't open cycles file\n");
    }
#endif




#ifdef TIME_PROFILE_RVDS                            //tlsbo85204
        max_clk = 0; max_frm = 0;
                        min_clk = 0xffffffff; min_frm = 0;
        nframe=0;
#endif
        ShouldOpen = 1;
        ShouldClose = 0;


        bitstream_buf_index = 0;
        bitstream_count = 0;
        bytes_supplied = 0;
        BitsInHeader=0;
        App_adif_header_present = 0;
        App_adts_header_present = 0;

        dec_config->app_swap_buf = app_swap_buffers_aac_dec;
        dec_config->num_pcm_bits    = AACD_16_BIT_OUTPUT;
            if (argc == 4)
```

```
        {
            if(strcmp(argv[3],"16")==0)
            {
                dec_config->num_pcm_bits    = AACD_16_BIT_OUTPUT;
            }
            else if(strcmp(argv[3],"24")==0)
            {
                dec_config->num_pcm_bits    = AACD_24_BIT_OUTPUT;
            }
            else
            {
                printf ("Usage: %s <infile> <outfile> <output bits per sample>\n", argv[0]);
                printf ("<output bits per sample> is 16 or 24\n");
                exit (1);
            }
        }


    strcpy(InFileName, argv[1]);
    strcpy(opath, argv[2]);


    printf(" Initializing decoder..");
    rc = aacd_decoder_init(dec_config);


    printf("Done\n");

    fin = fopen (InFileName, "rb");
    if (fin == NULL)
    {
        printf ("Couldn't open input file %s\n", InFileName);
        exit (1);
    }

#ifdef OUT_DUMP
#ifdef INTERLEAVE_OUTPUT
            pfOutput = fopen (opath, "wb");
            if (pfOutput == NULL)
            {
            printf ("Couldn't open output file %s\n", opath);
            return 1;
            }
#endif
#endif

    in_buf_done = 0;

    if (strlen(opath) + strlen("_f00.pcm") + 1 > AACD_PATH_LEN)
```

```
        {
            myexit(AAC_ERROR_FILEIO);  //DSPhl28187
        }

        strcpy(dec_info.output_path,opath);
        fseek(fin, 0, SEEK_END);
        /*get the stream to the buffer*/
        bitstream_count = ftell(fin);

        if (bitstream_count > MAX_ENC_BUF_SIZE)
        {
            printf("Application Error: InputFileSize > InputBufferSize\n");
            printf("Application Error: \nInputFileSize=%d \nInputBufferSize=%d\n",
bitstream_count, MAX_ENC_BUF_SIZE);
            exit(1);
        }

        //rewind(fin);
        fseek(fin, 0, SEEK_SET);
        n_bytes = fread(bitstream_buf, 1, bitstream_count, fin);
        if( n_bytes != (int)bitstream_count )          //tlsbo89610
        {
            printf("Bitstream not read correctly\n");
            return 1;
        }


        /***************** Decoding Begins **************************/

#ifdef TIME_PROFILE
#ifdef __SYMBIAN32__
        fp_mhz = fopen("D:\\aac_mhz.txt","a");
#else
        fp_mhz = fopen("aac_mhz.txt","a");
#endif
        if (fp_mhz == NULL)
        {
            printf("Couldn't open cycles file\n");
        }
#endif

        printf(" Decoding %s\n", InFileName);

        Length = prepare_bitstream();
        App_bs_readinit(bitstream_buf+(bitstream_buf_index-Length), Length);

        BitsInHeader = 0;
        App_get_mp4forbsac_header(&BlockParams);
        dec_config->params = &BlockParams;
```

```
    update_bitstream_status(BitsInHeader/8);

        BlockParams.num_pce = 0;
        BlockParams.iMulti_Channel_Support= 0;
        BlockParams.bsacDecLayer= -1;

#ifdef BSAC_DEBUG_DUMP
        App_dump_bsac_init();
        dec_config->dump_bsac_data =  App_dump_bsac_data;
#endif
        /* Get ADTS-Header if present and start decoding */

        //while(1) //tlsbo89610
        for(;;)
        {
           if (bitstream_count <= 0)
           {
              ShouldClose = 1;
              break;

           //DSPhl28187
#ifdef OUT_DUMP
#ifdef INTERLEAVE_OUTPUT
                                     if (AACD_24_BIT_OUTPUT == dec_config-
>num_pcm_bits)
                                     {
                                              if (fwrite(outbuf, 3,
dec_info.aacd_len*dec_info.aacd_num_channels, pfOutput) != \

       dec_info.aacd_len*dec_info.aacd_num_channels)
                                              {
                                                       printf("Application File I/O
Error\n");
                          break;
                                              }
                                     }
                                       else
                                     {
                                              if (fwrite(outbuf, 2,
dec_info.aacd_len*dec_info.aacd_num_channels, pfOutput) != \

       dec_info.aacd_len*dec_info.aacd_num_channels)
                                              {
                                                       printf("Application File I/O
Error\n");
                          break;
                                              }
                                     }
```

```
#else
            if (AACD_writeout(outbuf, dec_config, &ShouldOpen, &ShouldClose, opath)!=0)
            {
              printf("Application File I/O Error\n");
              exit(1);
            }
#endif
#endif
            //printf("End of Input\n");
        }


        Length = prepare_bitstream();


#ifdef ALIGNMENT_CHECK
        __asm
        {
            mrc p15, 0, cp_ctrl_data, c1, c0, 0;  /* Read the CP15 control
register value in
                                    cp_ctrl_data variable */
            orr cp_ctrl_data, cp_ctrl_data, 0x2;   /* enable strict                alignment
check by
                                    resetting A bit
                                    [bit number                2] of control register */
            mcr p15, 0, cp_ctrl_data, c1, c0, 0   /* write back to control register */
              mrc p15, 0, cp_ctrl_data, c1, c0, 0; /* read control register for verification */
        }
#endif

#ifdef TIME_PROFILE
    gettimeofday(&StartTime, NULL);
#endif

#ifdef __WINCE
    Flag=QueryPerformanceFrequency(&lpFrequency1);
        Flag=QueryPerformanceCounter(&lpPerformanceCount1);
#endif

#ifdef MEASURE_STACK_USAGE //TLSbo88602
    PAINT_STACK (ps32BaseSP, ps32SP, s32StackCount);
#endif
#ifdef TIME_PROFILE_RVDS                                //tlsbo85204
        prev_clk = prev_cycles();
#endif

        rc = aacd_decode_frame(dec_config,&dec_info,outbuf,
bitstream_buf+bitstream_buf_index-Length, Length);
#ifdef TIME_PROFILE_RVDS
```

```
            nframe++;
                curr_clk = curr_cycles();

            clk = (curr_clk-prev_clk);             /* clk gives the total core cycles per decode frame call
*/

            if (clk > max_clk)
            {
              max_clk = clk;
              max_frm = nframe;
              max_sf = dec_info.aacd_sampling_frequency;
            }

                if (clk < min_clk)
                {
                  min_clk = clk;
                  min_frm = nframe;

                }
                total_clk = total_clk + clk;

        printf ("Current clock = %d\n", curr_clk);
#endif

//TLSbo88602
#ifdef MEASURE_STACK_USAGE
    GET_STACK_USAGE (ps32BaseSP, ps32SP, s32StackCount, s32StackValue);
#endif

#ifdef MEASURE_STACK_USAGE
    if (s32PeakStack < s32StackValue)
        s32PeakStack = s32StackValue;
#endif
//TLSbo88602
#ifdef __WINCE
        Flag=QueryPerformanceCounter(&lpPerformanceCount2);
        Temp=(((lpPerformanceCount2.QuadPart -
lpPerformanceCount1.QuadPart)*1000000)/(lpFrequency1.QuadPart));
        TotalDecTime += Temp;
#endif


#ifdef TIME_PROFILE
    gettimeofday(&EndTime, NULL);
    cur_DecTimeUs = (EndTime.tv_usec - StartTime.tv_usec) + (EndTime.tv_sec -
StartTime.tv_sec)*1000000L;

    if(cur_DecTimeUs > prev_DecTimeUs)
    {
```

```
        prev_DecTimeUs = cur_DecTimeUs ;
        max_frame = *(dec_config->AACD_bno); //DSPhl28187
    }

    TotalDecTimeUs += cur_DecTimeUs ;

#endif

#ifdef ALIGNMENT_CHECK
        __asm
      {
        mrc p15, 0, cp_ctrl_data, c1, c0, 0;  /* Read the control register value */
        and cp_ctrl_data, cp_ctrl_data, 0xfffffffd;  /* disable alignment chect */
        mcr p15, 0, cp_ctrl_data, c1, c0, 0   /* write back control register data */
            mrc p15, 0, cp_ctrl_data, c1, c0, 0;  /* Read control register data for verification
*/
      }
#endif




        if (rc != AACD_ERROR_NO_ERROR)
        {
        App_display_error_message(rc);
        ShouldClose = 1;
        //DSPhl28187
#ifdef OUT_DUMP
        if (rc == AACD_ERROR_EOF)
        {
#ifdef INTERLEAVE_OUTPUT
            if (AACD_24_BIT_OUTPUT == dec_config->num_pcm_bits)
            {
                if (fwrite(outbuf, 3, dec_info.aacd_len*dec_info.aacd_num_channels,
pfOutput) != \
                    dec_info.aacd_len*dec_info.aacd_num_channels)
                {
                    printf("Application File I/O Error\n");
                    break;
                }
            }
            else
            {
                if (fwrite(outbuf, 2, dec_info.aacd_len*dec_info.aacd_num_channels,
pfOutput) != \
                    dec_info.aacd_len*dec_info.aacd_num_channels)
                {
                    printf("Application File I/O Error\n");
                    break;
```

```
                }
            }
#else
            if (AACD_writeout(outbuf, dec_config, &ShouldOpen, &ShouldClose, opath)!=0)
            {
                printf("Application File I/O Error\n");
                exit(1);
            }
#endif
        }

#endif

        break;
    }

    update_bitstream_status(dec_info.BitsInBlock/8);

#ifndef CT_CONF
    if (*(dec_config->AACD_bno) > 0)      //DSPhl28187
#endif
    {
        //ptr->out_ptr = opath; //TLSbo63933
        //DSPhl28187
#ifdef OUT_DUMP
#ifdef INTERLEAVE_OUTPUT
        if (AACD_24_BIT_OUTPUT == dec_config->num_pcm_bits)
        {
            if (fwrite(outbuf, 3, dec_info.aacd_len*dec_info.aacd_num_channels, pfOutput) != \
                dec_info.aacd_len*dec_info.aacd_num_channels)
            {
                printf("Application File I/O Error\n");
                break;
            }
        }
        else
        {
            if (fwrite(outbuf, 2, dec_info.aacd_len*dec_info.aacd_num_channels, pfOutput) != \
                dec_info.aacd_len*dec_info.aacd_num_channels)
            {
                printf("Application File I/O Error\n");
                break;
            }
        }
#else
        if (AACD_writeout(outbuf, dec_config, &ShouldOpen, &ShouldClose, opath)!=0)
        {
```

```
            printf("Application File I/O Error\n");
            exit(1);
        }
#endif
#endif
    }

    if (rc == AACD_ERROR_EOF)
    {
        App_display_error_message(rc);
        break;
    }
    //DSPhl28187
#ifndef CT_CONF
    if (*(dec_config->AACD_bno) > 2)
#endif
    {
        if (*(dec_config->AACD_bno) == 3)  //DSPhl28187
        {
            // To get the parameters in Log file

#ifdef TIME_PROFILE
            sampling_rate = dec_info.aacd_sampling_frequency;
            bit_rate = dec_info.aacd_bit_rate;
            num_chans = dec_info.aacd_num_channels;
            len = dec_info.aacd_len;
#endif

#ifdef TIME_PROFILE_RVDS
            sampling_rate = dec_info.aacd_sampling_frequency;
            bit_rate = dec_info.aacd_bit_rate;
            num_chans = dec_info.aacd_num_channels;
            len = dec_info.aacd_len;
#endif


#ifdef TIME_PROFILE
            /* fprintf (fp_mhz,"sampling_rate = %d\n", dec_info.aacd_sampling_frequency);
            fprintf (fp_mhz,"bit_rate = %d\n", dec_info.aacd_bit_rate);
            fprintf (fp_mhz,"num_chans = %d\n", dec_info.aacd_num_channels);
            fprintf (fp_mhz,"len = %d\n", dec_info.aacd_len);*/

#endif
        }

#ifndef TIME_PROFILE
    printf ("\r[%3d]\n", (int) *(dec_config->AACD_bno));  //DSPhl28187
#endif
        fflush (stdout);
```

```
        }
        //  printf ("Frame No = [%3d]\n", (int) ptr->AACD_bno);
        fflush (stdout);
        } /*end-while*/

#ifdef TIME_PROFILE_RVDS
            {

                //den = (double)(1024.0 * 1000000.0);
                //curr_mhz = (double)((double)(64.0*max_clk*max_sf)/den);

                int    count=0,n=0,ch=0,tot_char=0;
                char fileName[300]="";
                char file[100]="";

                strcpy(fileName,InFileName);
                tot_char = strlen(fileName);
                count = tot_char - 1;
                while (fileName[count] != '/')
                {
                    count --;

                    if(count==0)
                    {
                      if(fileName[count]!='/')
                      {
                            count--;
                      }
                      break;
                    }
                }

                n=count+1;

                while (n != tot_char)
                {
                    file[ch ++] = fileName [n ++];


                }
#ifdef MEASURE_STACK_USAGE
#ifdef MEASURE_HEAP_USAGE


printf("\n%s\t%s\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d",chname,file,sampling_rate,
bit_rate,\

        num_chans,max_clk,min_clk,nframe,max_frm,min_frm,total_clk,s32PeakStack,s32TotalMa
llocBytes);
```

```
                fprintf(fp_mhz,
"\n%s\t%s\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t",chname,file,sampling_rate,bit_rat
e,\

        num_chans,max_clk,min_clk,nframe,max_frm,min_frm,total_clk,s32PeakStack,s32TotalMa
llocBytes);

#endif
#endif

#ifndef MEASURE_STACK_USAGE
#ifndef MEASURE_HEAP_USAGE


printf("\n%s\t%s\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t",chname,file,sampling_rate,bit_rate,\
                num_chans,max_clk,min_clk,nframe,max_frm,min_frm,total_clk);
            fprintf(fp_mhz,
"\n%s\t%s\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d\t",chname,file,sampling_rate,bit_rate,\
                num_chans,max_clk,min_clk,nframe,max_frm,min_frm,total_clk);

#endif
#endif



            }
#endif

#ifdef TIME_PROFILE

        printf("\n%s\t%s\t%d\t%d\t%d\t%ld\t%ld\t%d\t%d\t%d\t%ld\t",chname,InFileName,sampl
ing_rate,bit_rate,\
            num_chans,prev_DecTimeUs,min_DecTimeUs,(int) *(dec_config-
>AACD_bno),max_frame,min_frame,TotalDecTimeUs);
            fprintf(fp_mhz,
"\n%s\t%s\t%d\t%d\t%d\t%ld\t%ld\t%d\t%d\t%d\t%ld\t",chname,InFileName,sampling_rate,bit_r
ate,
            num_chans,prev_DecTimeUs,min_DecTimeUs,(int) *(dec_config-
>AACD_bno),max_frame,min_frame,TotalDecTimeUs);
            /*fprintf(fp_mhz,"Total Decode Time [microseconds] = %ld\n",
TotalDecTimeUs);
            fprintf (fp_mhz,"Total frames = %3d\n", (int) *(dec_config->AACD_bno));
//DSPhl28187
            fprintf (fp_mhz,"Peak time = %ld\n", prev_DecTimeUs);*/
            fclose(fp_mhz);
#endif
#ifdef __SYMBIAN32__
#ifdef MEASURE_HEAP_USAGE
            printf("\n Stack and Heap are  %d\t%d\t",s32PeakStack,s32TotalMallocBytes);
#endif
```

```
#endif


                fclose(fin);

#ifdef OUT_DUMP
#ifdef INTERLEAVE_OUTPUT
                if (NULL != pfOutput)
                {
                  fclose(pfOutput);
                }
#endif
#endif



#ifdef MHZ_MEASUREMENT
                fclose(fp_mhz);
#endif

                for(rec_no = 0; rec_no < nr; rec_no++)
                {
                  mem = &(dec_config->aacd_mem_info.mem_info_sub[rec_no]);

                  if (mem->app_base_ptr)
                  {
                        aacd_free(mem->app_base_ptr);
                        mem->app_base_ptr = 0;
                  }
                }
                aacd_free(dec_config);

#ifdef __WINCE
                printf("\n Input File =%s lpPerformanceCount in us
=%ld",argv[1],TotalDecTime);
#endif
                return 0;
}
```

Appendix A   Debug Levels

AAC decoder provides 4 different levels of debug information. All the four levels are orthogonal which means more than one debug level can be set simultaneously and information pertaining to all the levels set can be logged.

How to select debug level?

The debug level can be set ON or OFF using variable "*debug_level*" in header file *debug.h*. Four LSBs of "*debug_level*" represents the four different debug levels.
- 0x1 means debug level 0 is active. (Function Entry and Exit notification)
- 0x2 means debug level 1 is active. (Frame data)
- 0x4 means debug level 2 is active. (To Log PCM output)
- 0x8 means debug level 3 is active. (Output at the end of selected modules)
- 0x3 means debug level 0 and 1 both are active.
- 0x7 means debug level 0, 1 and 2 are active.

Debug level 0

This is the basic debug level which provides the information of function entry and exit. This information is provided for all the modules of AAC decoder.

Debug level 1

This level logs the information extracted from the AAC frame data. The information mentioned below is logged by setting "debug_level" to 0x1

This level gives the frame information of the current frame being decoded
1. Sampling frequency
2. Bit rate
3. Number of channels
4. Number of output samples

Debug level 2

This level gives the decoded PCM output samples at the end of decoding every granule. PCM output samples can be available in 16bit or 24 bit format. For details of the PCM output format, refer [3].

Debug level 3

This level logs the intermediate output samples during the course of decoding a granule. The outputs are available at the end of the modules mentioned below.

Huffman Decoding output	*AACD_huffdecode( )*
Stereo Decoding output	*AACD_synt( )*
PNS output	*Pns( )*
Intensity output	*AACD_intensity( )*
TNS decode output	AACD_tns_decode_subblock( )
Imdct output	AACD_freq2time_adapt( )

Logger Functions

The AAC decoder does not have any logger function to the log the text and data information by itself. The logger function must be provided by the application to the library through function interface *aacd_register_debug_funcptr*. The logger functions are passed as arguments to this function. This function must be called before calling any other AAC decoder interface functions. If this function is not called by the application, then the AAC decoder considers the Debug Level as inactive.

The function prototype for *aacd_register_debug_funcptr* is as below.

C prototype:
```
void aacd_register_debug_funcptr ( \
int (*text_debug_ptr)(short int msgid,char *fmt,...), \
int (*data_debug_ptr)(short int msgid,void *ptr,int size));
```

Arguments:
- text_debug_ptr - Text Debug Log function pointer.
- data_debug_ptr - Data Debug Log function pointer.

Return Value:
None

There are two logger functions which are used to log the text and data respectively.
1. *DebugLogText (short int msgid, char *fmt, ...)*
   Where, *msgid* is used to identify the module and the action required.
   fmt is a character string with the format same as "*printf()*" in 'C'.

The types of message types for each of the module used in the current version of the encoder are as shown in Table 1.

Table 1. Message Types in each of the Hierarchies

Message Type	Comments
Message Identity	States the start of message logging for a given

(ENTRY)	function
Message Identity (EXIT)	States the end of message logging for a given function
Output Information (OUTPUT)	Information and values of the output of various processing steps and parameters that a function executes.

2. *DebugLogData (short int msgid, int size, void *ptr)*
   where *size* - size of data in bytes.
        ptr   - pointer of data to be logged.

Appendix B   Header-data extraction and Presentation to the decoder

Channel-to-speaker mapping can be specified as part of the header in two ways
1. Program Configuration elements (PCE's)
2. Channel Configuration parameter

PCE is an elaborate and flexible way of specifying mappings. A header might contain zero or more PCE's. Every PCE also contains data about sampling-frequency used.

Channel Configuration parameter can take values in the range 0-7. Each value specified indicates preset-mapping defined in the standard. (IS 13818-7, Table 3.1)

AACD_Block_Params supports both of the above options in a mutually exclusive manner, i.e. only one of the above options can be used at a given time. The following are the fields in this struct.

```
typedef struct
{
    AACD_INT32        num_pce;
    AACD_ProgConfig   *pce;

    AACD_INT32 ChannelConfig;
    AACD_INT32 SamplingFreqIndex;
    AACD_INT32 BitstreamType;
    AACD_INT32 BitRate;
    AACD_INT32 BufferFullness; /*No. of bits in encoder buffer after
                           encoding first raw_data_block */
    AACD_INT32 ProtectionAbsent;
    AACD_INT32 CrcCheck;
    AACD_INT32 frame_length;

#ifdef OLD_FORMAT_ADTS_HEADER
    AACD_INT32 Flush_LEN_EMPHASIS_Bits;
#endif

} AACD_Block_Params;
```

For every PCE that occurs in the header, there is an associated value called 'buffer_fullness', if (bitstream_type == 0). i.e., a constant-bitrate stream. This pair consisting of a PCE and an associated 'buffer_fullness' value are stored in the ProgConfig struct. If (bitstream_type != 0), then the 'buffer_fullness' field is of no meaning and hence it can have any arbitrary value. Frow now on, PCE and ProgConfig will be used interchangeably.

If the header has no PCE, then num_pce should be set to zero. Otherwise, all the ProgConfig elements in the header must be put in an array and a pointer to the first-item in the array should be assigned to pce and num_pce should indicate how many PCE's are in the array.

To support both types of specifying channel-to-speaker mapping, the following protocol is to be used.

If Channel Configuration is to be used, then num_pce should be set to zero. Except pce all other fields will be used.

If PCE is to be used, then num_pce must be positive. In this case $ChannelConfig$ will be not be used. Also, $BufferFullness$, $SamplingFreqIndex$ will be ignored, as these are available in ProgConfig struct itself. (The PCE contains $SamplingFreqIndex$ value).

If cyclic-redundancy-check (crc check) is not be done, then $protection\_absent$ must be 1.

PsyTEL Encoder

The field $Flush\_LEN\_EMPHASIS\_Bits$, can have two values : 0 or 1. Some encoders, while generating adts outputs, use the old format adts header which has a two bit field named $emphasis$. This field will not be present in compliant-encoders. If the application knows that the input file uses old-format adts headers, then the decoder library should be compiled after defining OLD_FORMAT_ADTS_HEADER. In particular, the PsyTEL encoder (a freely available encoder) used old format adts headers and in addition it does not perform a byte-alignment after header-parsing is over. This is an error and decoding will fail. To avoid this error, two bits have to be flushed everytime the decoder begins decoding a fresh raw_data_block. To summarize, if the encoder used old format adts header and if the stream if of type MPEG4 and if there is no byte-alignment at the end of every header, then set $Flush\_LEN\_EMPHASIS\_Bits$ to 1, otherwise set it to zero. This is true for the PsyTEL encoder.

Note that, compliant encoders do not use old-format adts headers and neither do fail to do byte-alignment.

Struct ProgConfig

```
typedef struct
{
    AACD_INT32          profile;
    AACD_INT32          sampling_rate_idx;
    AACD_EleList        front;
    AACD_EleList        side;
    AACD_EleList        back;
    AACD_EleList        lfe;
    AACD_EleList        data;
    AACD_EleList        coupling;
    AACD_MIXdown        mono_mix;
    AACD_MIXdown        stereo_mix;
    AACD_MIXdown        matrix_mix;
    /* Ignore the comment field to minimize memory usage */
    AACD_INT8           comments[1];
    AACD_INT32          buffer_fullness;
    AACD_INT32          tag;
}   AACD_ProgConfig;
```

$profile$ - This should be set to 1 always (MPEG4 AAC Low Complexity profile)
          (IS 13818-7, Table 2.1, Profiles)
$sampling\_rate\_idx$ - This is an index into an array of valid sampling-frequency values
               (IS 13818-7, Section 3.1.1, sampling_frequency_index)

$buffer_fullness$ - No. of bits remaining in the encoder buffer after encoding the first
               raw_data_block in the frame.
tag - id of a PCE

Struct EleList

```
typedef struct
{
    AACD_INT32                num_ele;
    AACD_INT32                ele_is_cpe[(1 << LEN_TAG)];
    AACD_INT32                ele_tag[(1 << LEN_TAG)];
}   AACD_EleList;
```

A channel can map to any of front, side, back, lfe (low sampling frequency enhancements)
speakers. For e.g, for the front-channel, num_ele indicates the number of front-channel elements,
ele_is_cpe indicates if a front-channel element is a channel-pair or not and ele_tag defines a
unique id for a front-channel element.

Struct MIXdown

```
typedef struct
{
    AACD_INT32              present;
    AACD_INT32              ele_tag;
    AACD_INT32              pseudo_enab;
}   AACD_MIXdown;
```

Consider stereo mix down.
$present$ - indicates if a strereo-mix down element is present
ele_tag - indicates the number of a specified channel pair element that is the stereo
          mixdown element
$pseudo_enab$ - this is defined only for matrix mix-down and indicates if
                pseudo-surround is enabled or not.

More details can be found in the standards (IS 13818-7, ISO/IEC 14496-3)