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**Information technology — Coding of  
audio-visual objects —**

**Part 3:  
Audio**

**AMENDMENT 5: BSAC extensions and  
transport of MPEG Surround**

*Technologies de l'information — Codage des objets audiovisuels —  
Partie 3: Codage audio*

*AMENDEMENT 5: Extensions BSAC et transport d'ambiance MPEG*

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Published in Switzerland

## Foreword

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Amendment 5 to ISO/IEC 14496-3:2005 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This Amendment specifies the normative syntax of the integration of ER BSAC and the SBR tool and the corresponding decoding process. An informative encoder description is given in the Annex. Furthermore, this Amendment specifies the transport and embedding of MPEG Surround (ISO/IEC 23003-1) side information in MPEG-4 AAC bitstreams and MPEG-4 Audio environments.

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# Information technology — Coding of audio-visual objects —

## Part 3: Audio

### AMENDMENT 5: BSAC extensions and transport of MPEG Surround

*In the following, changes to existing text and Tables are highlighted by gray background.*

*In the fourth paragraph of subclause 0.3.2.2 General audio coding tools, replace:*

It operates at up to 48 kHz sampling rate and uses a frame length of 512 or 480 samples, compared to the 1024 or 960 samples used in standard MPEG-2/4 AAC to enable coding of general audio signals with an algorithmic delay not exceeding 20 ms.

*with:*

To enable coding of general audio signals with an algorithmic delay not exceeding 20 ms at 48 kHz, it uses a frame length of 512 or 480 samples (compared to the 1024 or 960 samples used in standard MPEG-2/4 AAC).

*In Part 3: Audio, Subpart 1, in subclause 1.2 Normative references, add:*

ISO/IEC 14496-23, *Information technology — Coding of audio-visual objects — Part 23: Symbolic Music Representation*

ISO/IEC 23003-1, *Information technology — MPEG audio technologies — Part 1: MPEG Surround*

*In Part 3: Audio, Subpart 1, in subclause 1.3 Terms and definitions, add:*

**PS:** Parametric Stereo

**SMR:** Symbolic Music Representation

*and increase the index-number of subsequent entries.*

In Part 3: Audio, Subpart 1, in subclause 1.5.1.1 Audio object type definition, amend Table 1.1 with the updates in the table below:

| Tools/<br>Modules    | Remark | Object Type ID |
|----------------------|--------|----------------|
| Audio Object<br>Type |        |                |
| ...                  |        |                |
| MPEG Surround        |        | 30             |
| ...                  |        |                |
| (escape)             | X      | 31             |
| ...                  |        |                |
| (reserved)           |        | 39             |
| SMR Simple           |        | 40             |
| SMR Main             |        | 41             |
| ...                  |        |                |

In Part 3: Audio, Subpart 1, after subclause 1.5.1.2.32 add the following subclauses:

#### 1.5.1.2.33 PS object type

The PS object type contains the PS tool and can be combined with the SBR tool.

#### 1.5.1.2.34 MPEG Surround object type

The MPEG Surround object type conveys MPEG Surround side information (see ISO/IEC 23003-1) in the MPEG-4 Audio framework.

#### 1.5.1.2.35 SMR Simple object type

The SMR simple object type it is used to transport musical scores to be rendered both audibly and visually. The encoded data contains information on the main score, the parts (i.e. instrument specific scores), the possible multilingual lyrics associated with the parts, the visual formatting rules to be used for visual rendering, fonts to be used for custom musical symbols and synchronization information. The fonts and the synchronization information are represented as binary data, all the other as XML data. The SMR simple object type can convey the XML data as plain XML text or as gzip-ped XML (see ISO/IEC 14496-23).

#### 1.5.1.2.36 SMR Main object type

The SMR main object type can transport the musical scores exactly in the same way as the SMR Simple object type but in this case the XML data can be encoded also using the MPEG-B tools defined in ISO/IEC 23001-1 (see ISO/IEC 14496-23).

In Part 3: Audio, Subpart 1, in subclause 1.5.1.2.6 SBR object type, replace Table 1.2 with the table below:

**Table 1.2 — Audio object types that can be combined with SBR**

| Audio Object Type | Object Type ID |
|-------------------|----------------|
| AAC main          | 1              |
| AAC LC            | 2              |
| AAC SSR           | 3              |
| AAC LTP           | 4              |
| AAC Scalable      | 6              |
| ER AAC LC         | 17             |
| ER AAC LTP        | 19             |
| ER AAC scalable   | 20             |
| ER BSAC           | 22             |

In subclause 1.5.2.1, replace Table 1.3 Audio Profiles definition with the table below:

| Object Type ID | Audio Object Type                  | Main Audio Profile | Scalable Audio Profile | Speech Audio Profile | Synthetic Audio Profile | High Quality Audio Profile | Low Delay Audio Profile | Natural Audio Profile | Mobile Audio Internet-working Profile | AAC Profile | High Efficiency AAC Profile | High Efficiency AAC v2 Profile |
|----------------|------------------------------------|--------------------|------------------------|----------------------|-------------------------|----------------------------|-------------------------|-----------------------|---------------------------------------|-------------|-----------------------------|--------------------------------|
| 0              | Null                               |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 1              | AAC main                           | X                  |                        |                      |                         |                            |                         | X                     |                                       |             |                             |                                |
| 2              | AAC LC                             | X                  | X                      |                      |                         | X                          |                         | X                     |                                       | X           | X                           | X                              |
| 3              | AAC SSR                            | X                  |                        |                      |                         |                            |                         | X                     |                                       |             |                             |                                |
| 4              | AAC LTP                            | X                  | X                      |                      |                         | X                          |                         | X                     |                                       |             |                             |                                |
| 5              | SBR                                |                    |                        |                      |                         |                            |                         |                       |                                       |             | X                           | X                              |
| 6              | AAC Scalable                       | X                  | X                      |                      |                         | X                          |                         | X                     |                                       |             |                             |                                |
| 7              | TwinVQ                             | X                  | X                      |                      |                         |                            |                         | X                     |                                       |             |                             |                                |
| 8              | CELP                               | X                  | X                      | X                    |                         | X                          | X                       | X                     |                                       |             |                             |                                |
| 9              | HVXC                               | X                  | X                      | X                    |                         |                            | X                       | X                     |                                       |             |                             |                                |
| 10             | (reserved)                         |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 11             | (reserved)                         |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 12             | TTSI                               | X                  | X                      | X                    | X                       |                            | X                       | X                     |                                       |             |                             |                                |
| 13             | Main synthetic                     | X                  |                        |                      | X                       |                            |                         |                       |                                       |             |                             |                                |
| 14             | Wavetable synthesis                | X*                 |                        |                      | X*                      |                            |                         |                       |                                       |             |                             |                                |
| 15             | General MIDI                       | X*                 |                        |                      | X*                      |                            |                         |                       |                                       |             |                             |                                |
| 16             | Algorithmic Synthesis and Audio FX | X*                 |                        |                      | X*                      |                            |                         |                       |                                       |             |                             |                                |
| 17             | ER AAC LC                          |                    |                        |                      |                         | X                          |                         | X                     | X                                     |             |                             |                                |
| 18             | (reserved)                         |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 19             | ER AAC LTP                         |                    |                        |                      |                         | X                          |                         | X                     |                                       |             |                             |                                |
| 20             | ER AAC Scalable                    |                    |                        |                      |                         | X                          |                         | X                     | X                                     |             |                             |                                |
| 21             | ER TwinVQ                          |                    |                        |                      |                         |                            |                         | X                     | X                                     |             |                             |                                |
| 22             | ER BSAC                            |                    |                        |                      |                         |                            |                         | X                     | X                                     |             |                             |                                |
| 23             | ER AAC LD                          |                    |                        |                      |                         |                            | X                       | X                     | X                                     |             |                             |                                |
| 24             | ER CELP                            |                    |                        |                      |                         | X                          | X                       | X                     |                                       |             |                             |                                |
| 25             | ER HVXC                            |                    |                        |                      |                         |                            | X                       | X                     |                                       |             |                             |                                |
| 26             | ER HILN                            |                    |                        |                      |                         |                            |                         | X                     |                                       |             |                             |                                |
| 27             | ER Parametric                      |                    |                        |                      |                         |                            |                         | X                     |                                       |             |                             |                                |
| 28             | SSC                                |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 29             | PS                                 |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             | X                              |
| 30             | MPEG Surround                      |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 31             | (escape)                           |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 32             | Layer-1                            |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 33             | Layer-2                            |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 34             | Layer-3                            |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |
| 35             | DST                                |                    |                        |                      |                         |                            |                         |                       |                                       |             |                             |                                |

|    |              |  |  |  |  |  |  |  |  |  |  |  |
|----|--------------|--|--|--|--|--|--|--|--|--|--|--|
| 36 | ALS          |  |  |  |  |  |  |  |  |  |  |  |
| 37 | SLS          |  |  |  |  |  |  |  |  |  |  |  |
| 38 | SLS non-core |  |  |  |  |  |  |  |  |  |  |  |
| 39 | (reserved)   |  |  |  |  |  |  |  |  |  |  |  |
| 40 | SMR Simple   |  |  |  |  |  |  |  |  |  |  |  |
| 41 | SMR Main     |  |  |  |  |  |  |  |  |  |  |  |

\*) Subset of Main Synthetic

In subclause 1.6.2.1, extend Table 1.13 — AudioSpecificConfig() as follows:

Table 1.13 — Syntax of AudioSpecificConfig()

| Syntax                                      | No. of bits | Mnemonic      |
|---------------------------------------------|-------------|---------------|
| AudioSpecificConfig ()                      |             |               |
| {                                           |             |               |
| audioObjectType = GetAudioObjectType();     |             |               |
| <b>samplingFrequencyIndex;</b>              | <b>4</b>    | <b>uimsbf</b> |
| if ( samplingFrequencyIndex==0xf )          |             |               |
| <b>samplingFrequency;</b>                   | <b>24</b>   | <b>uimsbf</b> |
| <b>channelConfiguration;</b>                | <b>4</b>    | <b>uimsbf</b> |
| sbrPresentFlag = -1;                        |             |               |
| psPresentFlag = -1;                         |             |               |
| if ( audioObjectType == 5                   |             |               |
| audioObjectType == 29 ) {                   |             |               |
| extensionAudioObjectType = audioObjectType; |             |               |
| sbrPresentFlag = 1;                         |             |               |
| if ( audioObjectType == 29 ) {              |             |               |
| psPresentFlag = 1;                          |             |               |
| }                                           |             |               |
| <b>extensionSamplingFrequencyIndex;</b>     | <b>4</b>    | <b>uimsbf</b> |
| if ( extensionSamplingFrequencyIndex==0xf ) |             |               |
| <b>extensionSamplingFrequency;</b>          | <b>24</b>   | <b>uimsbf</b> |
| audioObjectType = GetAudioObjectType();     |             |               |
| if ( audioObjectType == 22 )                |             |               |
| <b>extensionChannelConfiguration;</b>       | <b>4</b>    | <b>uimsbf</b> |
| }                                           |             |               |
| else {                                      |             |               |
| extensionAudioObjectType = 0;               |             |               |
| }                                           |             |               |
| switch (audioObjectType) {                  |             |               |
| ...                                         |             |               |
| case 28:                                    |             |               |
| SSCSpecificConfig();                        |             |               |
| break;                                      |             |               |
| case 30:                                    |             |               |
| <b>sacPayloadEmbedding;</b>                 | <b>1</b>    | <b>uimsbf</b> |
| SpatialSpecificConfig();                    |             |               |
| break;                                      |             |               |
| case 32:                                    |             |               |
| case 33:                                    |             |               |
| case 34:                                    |             |               |
| ...                                         |             |               |

```

case 40:
case 41:
    SymbolicMusicSpecificConfig()
    break;
default:
    /* reserved */
}

...

if ( extensionAudioObjectType != 5 &&
    bits_to_decode() >= 16 ) {
    syncExtensionType;                                11      bslbf
    if (syncExtensionType == 0x2b7) {
        extensionAudioObjectType = GetAudioObjectType();
        if ( extensionAudioObjectType == 5 ) {
            sbrPresentFlag;                                1      uimsbf
            if (sbrPresentFlag == 1) {
                extensionSamplingFrequencyIndex;          4      uimsbf
                if ( extensionSamplingFrequencyIndex == 0xf ) {
                    extensionSamplingFrequency;          24     uimsbf
                }
                if ( bits_to_decode() >= 12 ) {
                    syncExtensionType;                    11      bslbf
                    if (syncExtensionType == 0x548) {
                        psPresentFlag;                    1      uimsbf
                    }
                }
            }
        }
    }
}

if ( extensionAudioObjectType == 22 ) {
    sbrPresentFlag;                                1      uimsbf
    if (sbrPresentFlag == 1) {
        extensionSamplingFrequencyIndex;          4      uimsbf
        if ( extensionSamplingFrequencyIndex == 0xf )
            extensionSamplingFrequency;          24     uimsbf
        extensionChannelConfiguration;              4      uimsbf
    }
}
}
}

```

After subclause 1.6.2.1.13, add the following new subclauses:

#### 1.6.2.1.14 SpatialSpecificConfig

Defined in ISO/IEC 23003-1:2007, 5.1.

#### 1.6.2.1.15 SymbolicMusicSpecificConfig

Defined in ISO/IEC 14496-23:—<sup>1)</sup>, 7.2.1.

1) To be published.

In subclause 1.6.2.2.1, extend Table 1.15 — Audio Object Types as follows:

**Table 1.15 — Audio Object Types**

| Object Type ID | Audio Object Type | definition of elementary stream payloads and detailed syntax | Mapping of audio payloads to access units and elementary streams |
|----------------|-------------------|--------------------------------------------------------------|------------------------------------------------------------------|
| 0              | NULL              |                                                              |                                                                  |
| ...            |                   |                                                              |                                                                  |
| 29             | PS                | ISO/IEC 14496-3 subpart 8                                    |                                                                  |
| 30             | MPEG Surround     | ISO/IEC 23003-1                                              |                                                                  |
| 31             | (escape)          |                                                              |                                                                  |
| ...            |                   |                                                              |                                                                  |
| 39             | (reserved)        |                                                              |                                                                  |
| 40             | SMR Simple        | ISO/IEC 14496-23                                             |                                                                  |
| 41             | SMR Main          | ISO/IEC 14496-23                                             |                                                                  |

After subclause 1.6.3.15 *fillBits*, add the following new subclauses:

#### 1.6.3.16 **extensionChannelConfiguration**

A four bit field indicating the channel configuration of the BSAC extensions. This configuration data is available in case of explicit signalling for the BSAC extensions. The number of audio output channels is determined according to Table 1.17 — Channel Configuration.

#### 1.6.3.17 **sacPayloadEmbedding**

The audio Object Type ID 30 MPEG Surround is used to convey spatial audio coding side information for MPEG Surround decoding as defined in ISO/IEC 23003-1. Depending on this flag, the MPEG surround data payload, i.e. *SpatialFrame()*, is available by different means:

**Table 1.19A — sacPayloadEmbedding**

| <b>sacPayloadEmbedding</b> | <b>Meaning</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                          | One <i>SpatialFrame()</i> is mapped into one access unit. Subsequent access units form one elementary stream. That elementary stream will always depend on another elementary stream that contains the underlying (downmixed) audio data.                                                                                                                                                                                             |
| 1                          | The top level payload is multiplexed into the underlying (downmixed) audio data. The actual multiplexing details depend on the presentation of the audio data (i.e., usually on the AOT). Note that this leads to an elementary stream with no real payload. That elementary stream will always depend on another elementary stream that contains both, the underlying (downmixed) audio data and the multiplexed spatial audio data. |

*In Part 3: Audio, Subpart 1, after 1.6.6 Signaling of Parametric Stereo (PS), add the following new subclause:*

### **1.6.7 Signalling of BSAC Extension payloads**

The implicit signalling method for BSAC extension payloads is similar to that of SBR tool. The BSAC decoder that can decode the BSAC extension payloads checks if there is an extension type for the SBR tool such as 'EXT\_BSAC\_SBR\_DATA' in the `bsac_raw_data_block()`. The sampling frequency should be updated, when the extension type is detected and the SBR tool is operated in dual-rate mode.

The BSAC extension decoder checks if there is the extension type for the BSAC channel extension such as 'EXT\_BSAC\_CHANNEL' in the `bsac_raw_data_block()`. In case where the extension type for multichannel, the number of channel from the `AudioSpecificConfig()` for BSAC Audio Object Type is updated depending on the 'channel\_configuration\_index' of each extended\_bsac\_base\_element().

When explicit signalling is used, implicit signalling shall not occur. Two different types of explicit signalling are available:

1. Explicit Signalling Method 1: hierarchical signalling

If the first `audioObjectType` (AOT) signalled is the SBR AOT, a second audio object type is signalled which indicates the ER BSAC AOT. The `extensionChannelConfiguration` indicates the total number of channels in the `bsac_raw_data_block()`.

2. Explicit Signalling Method 2 : backward compatible signalling

The `extensionAudioObjectType` is signalled at the end of the `AudioSpecificConfig()`. If the `extensionAudioObjectType` is the ER BSAC AOT, the `extensionChannelConfiguration` indicates the total number of channels in the `bsac_raw_data_block()`. This method shall only be used in systems that convey the length of the `AudioSpecificConfig()`. Hence, it shall not be used for LATM with `audioMuxVersion==0`.

Table 1.22B explains the decoder behaviour with SBR and BSAC channel extension signalling.

Table 1.22B – SBR and BSAC channel extension signalling and Corresponding Decoder Behaviour

| Bitstream characteristics          |                |                                  |                | Decoder behaviour |                                             |
|------------------------------------|----------------|----------------------------------|----------------|-------------------|---------------------------------------------|
| Extension AudioObjectType          | sbrPresentFlag | extensionChannelConfiguration    | raw_data_block | BSAC decoder      | BSAC Extensions decoder                     |
| != ER_BSAC ( Implicit Signalling ) | -1 (Note 1)    | Not available                    | BSAC           | Play BSAC         | Play BSAC                                   |
|                                    |                |                                  | BSAC+SBR       | Play BSAC         | Play at least BSAC, should play BSAC+SBR    |
|                                    |                |                                  | BSAC+MC        | Play BSAC         | Play at least BSAC, should play BSAC+MC     |
|                                    |                |                                  | BSAC+SBR+MC    | Play BSAC         | Play at least BSAC, should play BSAC+SBR+MC |
| == ER_BSAC ( Explicit Signalling ) | 0 (Note 2)     | == channelConfiguration (Note 4) | BSAC           | Play BSAC         | Play BSAC                                   |
|                                    |                | != channelConfiguration          | BSAC + MC      | Play BSAC         | Play BSAC+MC                                |
|                                    | 1 (Note 3)     | == channelConfiguration (Note 4) | BSAC+SBR       | Play BSAC         | Play BSAC+SBR                               |
|                                    |                | != channelConfiguration          | BSAC+SBR+MC    | Play BSAC         | Play BSAC+SBR+MC                            |

Note 1: Implicit signalling, check payload in order to determine output sampling frequency, or assume the presence of SBR data in the payload, giving an output sampling frequency of twice the sampling frequency indicated by samplingFrequency in the AudioSpecificConfig() (unless the down sampled SBR Tool is operated, or twice the sampling frequency indicated by samplingFrequency exceeds the maximum allowed output sampling frequency of the current level, in which case the output sampling frequency is the same as indicated by samplingFrequency).

Note 2: Explicitly signals that there is no SBR data, hence no implicit signalling is present, and the output sampling frequency is given by samplingFrequency in the AudioSpecificConfig().

Note 3: Output sampling frequency is the extensionSamplingFrequency in AudioSpecificConfig().

Note 4: Explicitly signals that there is no BSAC channel extension data, and the number of output channel is given by channelConfiguration in the AudioSpecificConfig().

Replace the definition of *bsac\_raw\_data\_block()* in Part 3: Audio, Subpart 4, subclause 4.4.2.6 Payloads for the audio object type ER BSAC, Table 4.33:

Table 4.33 — Syntax of *bsac\_raw\_data\_block()*

| Syntax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | No. of bits                                      | Mnemonic                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <pre> bsac_raw_data_block() {     bsac_base_element();     layer=layer_size;     while(data_available() &amp;&amp; layer&lt;(top_layer+slayer_size)) {         bsac_layer_element(layer);         layer++;     }     byte_alignment();     if (data_available()) {         <b>zero_code</b>         <b>sync_word</b>         while( bits_to_decode() &gt; 4 ) {             <b>extension_type</b>             switch(extension_type) {                 case EXT_BSAC_CHANNEL :                     extended_bsac_raw_data_block();                     break;                 case EXT_BSAC_SBR_DATA :                     extended_bsac_sbr_data(nch, 0);                     break;                 case EXT_BSAC_SBR_DATA_CRC :                     extended_bsac_sbr_data(nch, 1);                     break;                 case EXT_BSAC_CHANNEL_SBR :                     extended_bsac_raw_data_block();                     extended_bsac_sbr_data(nch, 0);                     break;                 case EXT_BSAC_CHANNEL_SBR_CRC :                     extended_bsac_raw_data_block();                     extended_bsac_sbr_data(nch, 1);                     break;                 case EXT_BSAC_SAC_DATA :                     extended_bsac_sac_data();                     break;                 default :                     extended_bsac_data();                     break;             }         }         byte_alignment();     } } </pre> | <p><b>32</b></p> <p><b>4</b></p> <p><b>4</b></p> | <p><b>bslbf</b></p> <p><b>bslbf</b></p> <p><b>bslbf</b></p> <p>Note 1</p> <p>Note 1</p> <p>Note 1</p> |
| <p>Note 1: The <i>byte_alignment()</i> functions in <i>extended_bsac_raw_data_block()</i> are relative to the start of <i>extended_bsac_raw_data_block()</i>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                  |                                                                                                       |

Renumber Table 4.35 – Syntax of `extended_bsac_raw_data_block()` and Table 4.36 – Syntax of `extended_bsac_base_element()` which were introduced in ISO/IEC 14496-3:2005/Amd.2 as Table 4.43A – Syntax of `extended_bsac_raw_data_block()` and Table 4.43B – Syntax of `extended_bsac_base_element()`, respectively.

Add the following tables after Table 4.43B – Syntax of `extended_bsac_base_element()` in Part 3: Audio, Subpart 4, at the end of subclause 4.4.2.6:

Table 4.43C — Syntax of `extended_bsac_sbr_data()`

| Syntax                                                       | No. of bits                 | Mnemonic      |
|--------------------------------------------------------------|-----------------------------|---------------|
| <code>extended_bsac_sbr_data(nch, crc_flag)</code>           |                             |               |
| {                                                            |                             |               |
| <code>num_sbr_bits = 0;</code>                               |                             |               |
| <code>cnt = count;</code>                                    | 4                           | <b>uimsbf</b> |
| <code>num_sbr_bits += 4;</code>                              |                             |               |
| if (cnt == 15) {                                             |                             |               |
| <code>cnt += esc_count - 1;</code>                           | 8                           | <b>uimsbf</b> |
| <code>num_sbr_bits += 8;</code>                              |                             |               |
| }                                                            |                             |               |
| if (crc_flag) {                                              |                             |               |
| <code>bs_sbr_crc_bits;</code>                                | 10                          | <b>uimsbf</b> |
| <code>num_sbr_bits += 10;</code>                             |                             |               |
| }                                                            |                             |               |
| <code>num_sbr_bits += 1;</code>                              |                             |               |
| if ( <b>bs_header_flag</b> )                                 | 1                           | <b>uimsbf</b> |
| <code>num_sbr_bits += sbr_header();</code>                   |                             |               |
| <code>num_sbr_bits += bsac_sbr_data(nch, bs_amp_res);</code> |                             |               |
| <code>num_align_bits = (8*cnt - num_sbr_bits);</code>        |                             |               |
| <b>bs_fill_bits;</b>                                         | <code>num_align_bits</code> | <b>uimsbf</b> |
| }                                                            |                             |               |

Table 4.43D — Syntax of `bsac_sbr_data()`

| Syntax                                              | No. of bits | Mnemonic |
|-----------------------------------------------------|-------------|----------|
| <code>bsac_sbr_data(nch, bs_amp_res)</code>         |             |          |
| {                                                   |             |          |
| switch (nch) {                                      |             |          |
| case 1 :                                            |             |          |
| <code>sbr_single_channel_element(bs_amp_res)</code> |             |          |
| break;                                              |             |          |
| case 2 :                                            |             |          |
| <code>sbr_channel_pair_element(bs_amp_res)</code>   |             |          |
| break;                                              |             |          |
| }                                                   |             |          |
| }                                                   |             |          |

### Table 4.43F — Syntax of extended\_bsac\_sac\_data()

| Syntax                    | No. of bits | Mnemonic |
|---------------------------|-------------|----------|
| extended_bsac_sac_data()  |             |          |
| {                         |             |          |
| cnt = count;              | 8           | uimbsf   |
| if (cnt == 255) {         |             |          |
| cnt += esc_count - 1;     | 8           | uimbsf   |
| }                         |             |          |
| ancType;                  | 2           | uimbsf   |
| ancStart;                 | 1           | uimbsf   |
| ancStop;                  | 1           | uimbsf   |
| bs_crc_flag               | 1           | uimbsf   |
| bs_fill_bits              | 3           | uimbsf   |
| if (bs_crc_flag) {        |             |          |
| ancCrcWord;               | 8           | uimbsf   |
| cnt = cnt - 1;            |             |          |
| }                         |             |          |
| for (i=0; i<cnt-2; i++) { |             |          |
| ancDataSegmentByte[i];    | 8           | bslbf    |
| }                         |             |          |
| }                         |             |          |

### Table 4.51 — Syntax of extension\_payload()

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In subclause 4.4.2.7 after Table 4.54 add a new Table 4.54A — Syntax of `sac_extension_data()` as given below:

Table 4.54A — Syntax of `sac_extension_data()`

| Syntax                               | No. of bits | Mnemonic      |
|--------------------------------------|-------------|---------------|
| <code>sac_extension_data(cnt)</code> |             |               |
| {                                    |             |               |
| <b>ancType</b> ;                     | 2           | <b>uimsbf</b> |
| <b>ancStart</b> ;                    | 1           | <b>uimsbf</b> |
| <b>ancStop</b> ;                     | 1           | <b>uimsbf</b> |
| for (i=0; i<cnt-1; i++) {            |             |               |
| <b>ancDataSegmentByte</b> [i];       | 8           | <b>bslbf</b>  |
| }                                    |             |               |
| return (cnt);                        |             |               |
| }                                    |             |               |

In subclause 4.5.1 Decoding of the GA specific configuration, replace:

If a certain sampling frequency dependent table stated in the right column of Table 4.68 is not defined, the nearest defined table shall be used.

with:

If in a certain sampling frequency dependent table a sampling frequency stated in the right column of Table 4.68 is not defined, the nearest defined table shall be used.

In Part 3: Audio, Subpart 4, in subclause 4.5.2.6.2.1.1 Data elements, after `bsac_raw_data_block()`, remove the text related to semantics of `zero_code`, `syncword`, and `extension_type` and add the following after `bsac_spectral_data()`:

|                         |                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>zero_code</b>        | 32-bit zero values in order to terminate the arithmetic decoding for the stereo part.                             |
| <b>sync_word</b>        | a four bit code that identifies the start of the extended part. The bit string '1111'.                            |
| <b>bits_to_decode()</b> | A helper function; returns the number of bits not yet decoded in the current <code>bsac_raw_data_block()</code> . |
| <b>extension_type</b>   | a four bit code that identifies the extension type according to Table 4.84A.                                      |

Table 4.84A — BSAC extension\_type

| Symbol                   | Value of extension_type | Purpose                             |
|--------------------------|-------------------------|-------------------------------------|
| EXT_BSAC_CHANNEL         | '1111'                  | BSAC channel extension              |
| EXT_BSAC_SBR_DATA        | '0000'                  | BSAC SBR enhancement                |
| EXT_BSAC_SBR_DATA_CRC    | '0001'                  | SBR enhancement with CRC            |
| EXT_BSAC_SAC_DATA        | '0010'                  | MPEG Surround enhancement           |
| EXT_BSAC_CHANNEL_SBR     | '1110'                  | BSAC channel extension with SBR     |
| EXT_BSAC_CHANNEL_SBR_CRC | '1101'                  | BSAC channel extension with SBR_CRC |
| RESERVED                 | '0011' ~ '1100'         | reserved                            |

In Part 3: Audio, Subpart 4, under Bitstream elements in subclause 4.5.2.6.2.1 Definitions, after reserved\_bit, add the following:

|                                     |                                                                                                                                                                                                                                                                                                      |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>extended_bsac_sbr_data ()</b>    | Syntactic element that contains the SBR extension data for ER BSAC                                                                                                                                                                                                                                   |
| <b>count</b>                        | Initial length of extended_bsac_sbr_data() or extended_bsac_data()                                                                                                                                                                                                                                   |
| <b>esc_count</b>                    | Incremental length of extended_bsac_sbr_data() or extended_bsac_data()                                                                                                                                                                                                                               |
| <b>bs_sbr_crc_bits</b>              | Cyclic redundancy checksum for the SBR extension data. The CRC code is defined by the generator polynomial $G_{10}(x) = x^{10} + x^9 + x^5 + x^4 + x + 1$ and the initial value for the CRC calculation is zero                                                                                      |
| <b>bs_header_flag</b>               | Indicates if an SBR header is present                                                                                                                                                                                                                                                                |
| <b>sbr_header ()</b>                | Syntactic element that contains the SBR header. See Table 4.56 — Syntax of sbr_header()                                                                                                                                                                                                              |
| <b>bsac_sbr_data()</b>              | Syntactic element that contains the SBR data for ER BSAC                                                                                                                                                                                                                                             |
| <b>bs_fill_bits</b>                 | Byte alignment bits                                                                                                                                                                                                                                                                                  |
| <b>sbr_single_channel_element()</b> | Syntactic element that contains data for an SBR single channel element. See Table 4.58-Syntax of sbr_single_channel_element()                                                                                                                                                                        |
| <b>sbr_channel_pair_element()</b>   | Syntactic element that contains data for an SBR channel pair element. See Table 4.59-Syntax of sbr_channel_pair_element()                                                                                                                                                                            |
| <b>extended_bsac_data()</b>         | Syntactic element that contains the payload to be discarded by decoder. This is for the further extensions.                                                                                                                                                                                          |
| <b>byte_payload</b>                 | Byte to be discarded by the decoder                                                                                                                                                                                                                                                                  |
| <b>extended_bsac_sac_data()</b>     | The syntax element extended_bsac_sac_data() contains spatial audio coding side information for MPEG Surround decoding as defined in ISO/IEC 23003-1. The semantics of the syntax elements ancType, ancStart, ancStop, ancCrcWord, and ancDataSegmentByte are defined in ISO/IEC 23003-1:2007, 7.2.4. |
| <b>bs_crc_flag</b>                  | Indicates if CRC word is present                                                                                                                                                                                                                                                                     |

In Part 3: Audio, Subpart 4, replace subclause 4.5.2.6.2.2.14 with:

#### 4.5.2.6.2.2.14 Decoding the extended part

The structure of the extended part of BSAC is a simple replica of mono or stereo BSAC bitstream. The functions `extended_bsac_raw_data_block` and `extended_bsac_base_element` are defined in subclauses 4.5.2.11.2.1 and 4.5.2.11.2.2.

In Part 3: Audio, Subpart 4, remove subclauses 4.5.2.6.2.2.14.1 and 4.5.2.6.2.2.14.2.

In subclause 4.5.2.9.3 extend Table 4.105 — Values of the `extension_type` field as follows:

**Table 4.105 — Values of the `extension_type` field**

| Symbol            | Value of <code>extension_type</code> | Purpose                                                                                       |
|-------------------|--------------------------------------|-----------------------------------------------------------------------------------------------|
| EXT_FILL          | '0000'                               | bitstream payload filler                                                                      |
| EXT_FILL_DATA     | '0001'                               | bitstream payload data as filler                                                              |
| EXT_DATA_ELEMENT  | '0010'                               | data element                                                                                  |
| EXT_DYNAMIC_RANGE | '1011'                               | dynamic range control                                                                         |
| EXT_SAC_DATA      | '1100'                               | MPEG Surround                                                                                 |
| EXT_SBR_DATA      | '1101'                               | SBR enhancement                                                                               |
| EXT_SBR_DATA_CRC  | '1110'                               | SBR enhancement with CRC                                                                      |
| -                 | all other values                     | Reserved: These values can be used for a further extension of the syntax in a compatible way. |

Note: Extension payloads of the type EXT\_FILL or EXT\_FILL\_DATA have to be added to the bitstream payload if the total bits for all audio data together with all additional data are lower than the minimum allowed number of bits in this frame necessary to reach the target bitrate. Those extension payloads are avoided under normal conditions and free bits are used to fill up the bit reservoir. Those extension payloads are written only if the bit reservoir is full.

After subclause 4.5.2.9 add the following new subclauses:

#### 4.5.2.10 MPEG Surround (Spatial Audio Coding)

The syntax element `sac_extension_data()` is used to embed spatial audio coding side information for MPEG Surround decoding as defined in ISO/IEC 23003-1. The semantics of the syntax elements `ancType`, `ancStart`, `ancStop`, and `ancDataSegmentByte` is defined in ISO/IEC 23003-1:2007, 7.2.4.

#### 4.5.2.11 Payloads for the audio object type ER BSAC Extensions

##### 4.5.2.11.1 Introduction

ER BSAC is extended to enhance the performance with extension payloads such as multichannel, SBR and MPEG Surround payloads. This extension is designed to maintain the functionality of FGS when a bitstream is transmitted over MPEG-4 system. ER-BSAC can provide several operating modes for various application scenarios, as shown in Table 4.106A.

Table 4.106A — Operating modes of BSAC Extensions

| Operating Mode             | Extension payload                                        |
|----------------------------|----------------------------------------------------------|
| BSAC mono/stereo           | Not available                                            |
| BSAC multichannel          | BSAC multichannel extension payload                      |
| BSAC mono/stereo with SBR  | BSAC SBR payload                                         |
| BSAC multichannel with SBR | BSAC multichannel extension payload and BSAC SBR payload |
| BSAC with MPEG Surround    | MPEG Surround payload                                    |

The integration of ER-BSAC and SBR is to provide fine grain scalable reproduction with bandwidth extension for stereo and multi-channel. In the preferred modes of operating the integration of ER-BSAC and SBR, the high frequency sound components can be either an ER-BSAC enhancement layer signal or synthesized SBR signal.

#### 4.5.2.11.2 Decoding process

##### 4.5.2.11.2.1 zero\_code and sync\_word

Syntax elements `zero_code` and `sync_word` are parsed while data is available after decoding a BSAC mono or stereo part. Syntax element `zero_code` is used for the arithmetic termination of the BSAC mono or stereo part, and `sync_word` is used to indicate the beginning of an extended part.

##### 4.5.2.11.2.2 extended\_bsac\_raw\_data\_block

An `extended_bsac_raw_data_block` contains multichannel information and has the layered structure as `bsac_raw_data_block`.

##### 4.5.2.11.2.3 extended\_bsac\_base\_element

An extended `bsac_base_element` consists of **`element_length`**, **`channel_configuration_index`**, **`reserved_bit`**, `bsac_header`, `general_header` and `bsac_layer_element`. For the stereo part, the value of *nch* is obtained from **`channelConfiguration`** in Table 1.13 (Syntax of `AudioSpecificConfig`) and it is limited to either 1 or 2 (left and right front speakers). For the extended part, the parameter, *nch*, is concerned with the rest of speakers, and the exact value is determined by **`channel_configuration_index`** specified in Table 4.84B. Each index indicates the number of channels given the channel to speaker mapping.

##### 4.5.2.11.2.4 extended\_bsac\_sbr\_data

SBR elements are inserted into the `bsac_raw_data_block()` after layer element data. By combining a BSAC core coder and the SBR bandwidth extension tool, the functionality of fine grain scalability is supported with full bandwidth for all layers. The start frequency for the SBR frequency range is the `base_band` frequency of the BSAC base layer. The SBR part covers high frequency regions beyond the base layer frequency range. If enhancement layers of the BSAC core are transmitted, the overlapped region of the SBR data is replaced with core data.

## 4.5.2.11.2.5 extended\_bsac\_sac\_data

MPEG Surround payload is embedded into the `bsac_raw_data_block()` after layer element data. For the MPEG Surround payload, the extension type 'EXT\_BSAC\_SAC\_DATA' is defined. The syntax `extended_bsac_sac_data()` is shown in Table 4.43F. The semantics of the syntax elements *ancType*, *ancStart*, *ancStop*, *ancCrcWord*, and *ancDataSegmentByte* are defined in ISO/IEC 23003-1:2007, 7.2.4. In case that CRC error checking is necessary for the MPEG Surround payload, the *bs\_crc\_flag* is set to 1 and the *ancCrcWord* is transmitted. As specified in ISO/IEC 23003-1:2007, 7.2.3, the interface between ER BSAC and the MPEG Surround decoder can be either the time-domain or the QMF domain. In case of ER BSAC combined with SBR tool, the QMF representation is available as an input of the MPEG Surround decoder.

## 4.5.2.11.3 Technical overview of the integration of ER-BSAC and SBR tool

The basic structure of the integration of ER-BSAC and SBR tool is shown in Figure 4.21A. This subclause describes the decoding process of SBR tool integrated with ER BSAC in a scalable manner. The scalable SBR tool is made possible by adding a module referred to as the HF-Overlap. The decoding process of the scalable SBR tool is identical to that of SBR tool except the HF-Overlap module. The scalable SBR decoding block diagram is shown in the following Figure 4.21A. It displays how the HF-Overlap module is interconnected into the SBR decoder.

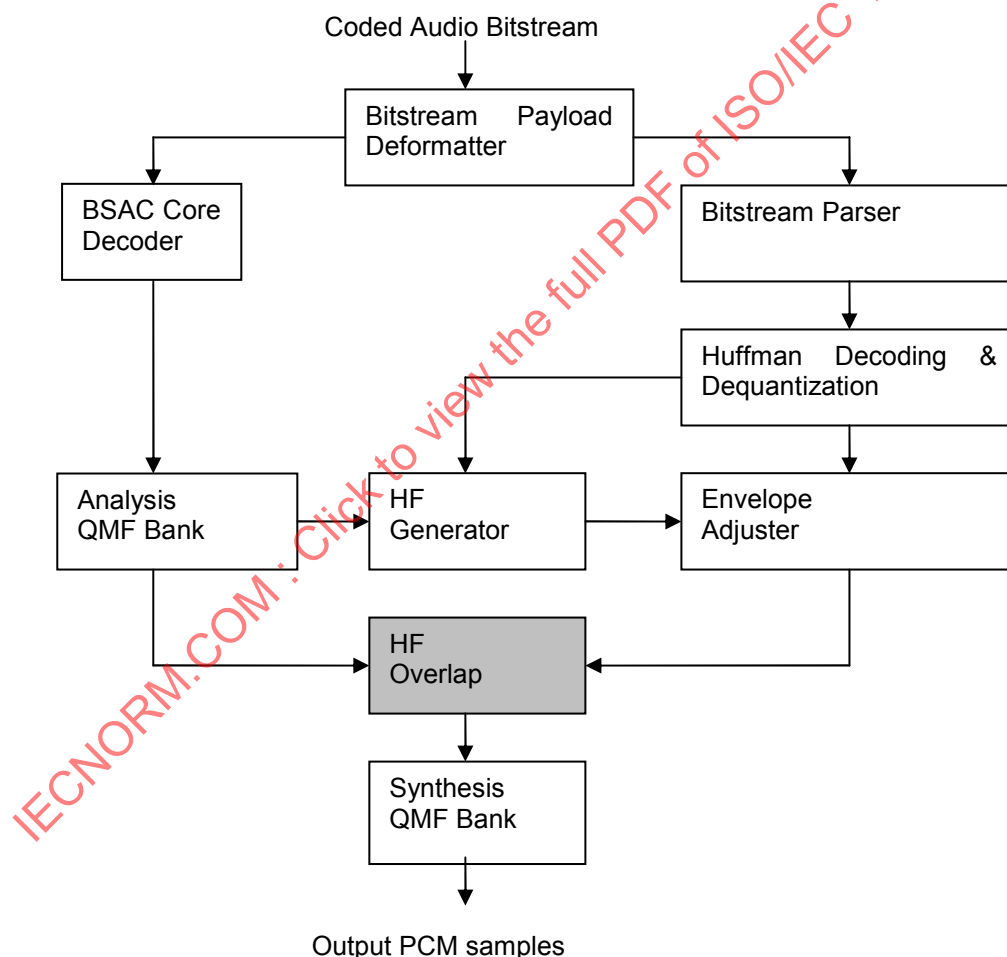


Figure 4.21A — Overview of the integration of ER-BSAC and SBR decoder