Candidate Standard:
The Advanced Television Systems Committee, Inc., is an international, non-profit organization developing voluntary standards for digital television. The ATSC member organizations represent the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

Specifically, ATSC is working to coordinate television standards among different communications media focusing on digital television, interactive systems, and broadband multimedia communications. ATSC is also developing digital television implementation strategies and presenting educational seminars on the ATSC standards.

ATSC was formed in 1982 by the member organizations of the Joint Committee on InterSociety Coordination (JCIC): the Electronic Industries Association (EIA), the Institute of Electrical and Electronic Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Telecommunications Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE). Currently, there are approximately 140 members representing the broadcast, broadcast equipment, motion picture, consumer electronics, computer, cable, satellite, and semiconductor industries.

ATSC Digital TV Standards include digital high definition television (HDTV), standard definition television (SDTV), data broadcasting, multichannel surround-sound audio, and satellite direct-to-home broadcasting.

Note: The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. One or more patent holders have, however, filed a statement regarding the terms on which such patent holder(s) may be willing to grant a license under these rights to individuals or entities desiring to obtain such a license. Details may be obtained from the ATSC Secretary and the patent holder.

This document reflects the modifications to the Candidate Standard that have been approved by the Specialist Group on ATSC-M/H (TSG/S4). This document contains both substantive and editorial revisions to S4-137r6, originally approved by TSG on 25 November 2008. All ATSC members and non-members are encouraged to review and implement this document and return comments to cs-editor@atsc.org. ATSC Members can also send comments directly to the TSG/S4 Specialist Group. This document is being considered as a Proposed Standard by TSG as of 5 June 2009.
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Candidate Standard:

1. SCOPE
This Part describes a set of constraints on ISO/IEC 14496-3 [1] (“Audio”) HE AAC v2 when used in the ATSC Mobile DTV (mobile/handheld, or simply M/H) system. It also defines the RTP packetization for audio elementary streams.

1.1 Organization
This document is organized as follows:
- Section 1 – Outlines the scope of this Part and provides a general introduction.
- Section 2 – Lists references and applicable documents.
- Section 3 – Provides a definition of terms, acronyms, and abbreviations for this Part.
- Section 4 – System overview
- Section 5 – System specifications
- Annex A – Sample SDP File (Informative)

2. REFERENCES
At the time of publication, the editions indicated below were valid. All standards are subject to revision, and parties to agreement based on this Part are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

2.1 Normative References
The following documents contain provisions which, through reference in this text, constitute provisions of this Part.

2.2 Informative References
3. DEFINITION OF TERMS

With respect to definition of terms, abbreviations, and units, the practice of the Institute of Electrical and Electronics Engineers (IEEE) as outlined in the Institute’s published standards [2] shall be used. Where an abbreviation is not covered by IEEE practice or industry practice differs from IEEE practice, the abbreviation in question is described in Section 3.3 of this document.

3.1 Compliance Notation

As used in this document, “shall” denotes a mandatory provision of the standard. “Should” denotes a provision that is recommended but not mandatory. “May” denotes a feature whose presence does not preclude compliance, which may or may not be present at the option of the implementer.

3.2 Treatment of Syntactic Elements

This document contains symbolic references to syntactic elements used in the audio, video, and transport coding subsystems. These references are typographically distinguished by the use of a different font (e.g., restricted), may contain the underscore character (e.g., sequence_end_code) and may consist of character strings that are not English words (e.g., dynrng).

3.2.1 Reserved Fields

reserved — Fields in this document marked “reserved” are not to be assigned by the user, but are available for future use. Receiving devices are expected to disregard reserved fields for which no definition exists that is known to that unit. Each bit in the fields marked “reserved” is to be set to ‘1’ until such time as it is defined and supported.

3.3 Acronyms and Abbreviation

The following acronyms and abbreviations are used within this Part.

AAC – Advanced Audio Coding
ATSC – Advanced Television Systems Committee
HE AAC – High Efficiency Advanced Audio Coding
HE AAC v2 – High Efficiency Advanced Audio Coding version 2
SBR – Spectral Band Replication
PS – Parametric Stereo

3.4 Terms

The following terms are used within this Part.

MPEG – Refers to standards developed by the ISO/IEC JTC1/SC29 WG11, Moving Picture Experts Group. MPEG may also refer to the Group.
4. SYSTEM OVERVIEW

Please see ATSC A/153 Part 1 [7] for an overall description of the M/H system. The ATSC Mobile/Handheld service (M/H) shares the same RF channel as a standard ATSC broadcast service described in ATSC A/53 [6]. M/H is enabled by using a portion of the total available ~19.4 Mbps bandwidth and utilizing delivery over IP transport. The overall ATSC broadcast system including standard (TS Main) and M/H systems is illustrated in Figure 4.1.

![Figure 4.1 ATSC broadcast system with TS main and M/H services.](image)

This Part relates to the Audio Source Coding and Compression block and specifies audio coding using MPEG-4 HE AAC v2 as described in ISO/IEC 14496 Part 3 [1] and [3], with the constraints indicated herein. HE AAC v2 is used to code mono or stereo audio. HE AAC v2 is the combination of three audio coding tools, MPEG-4 AAC, Spectral Band Replication (SBR) and Parametric Stereo (PS). This furthermore means that HE AAC v2 includes both HE AAC and AAC as illustrated in Figure 4.2.
5. SYSTEM SPECIFICATIONS

5.1 Audio Elementary Stream Configuration

The audio elementary streams shall conform to ISO/IEC 14496-3 [1] and [3] “High Efficiency AAC v2” Profile, Level 2. The definitions of Profiles and Levels for High Efficiency AAC v2 are listed in ISO/IEC 14496-3 [3] Table 1.11A.

The output sampling rate shall be constrained to 32, 44.1 or 48 kHz if no SBR is present, as well as 16 kHz, 22.05 kHz and 24 kHz if SBR is present.

The maximum bitrate shall meet the AAC bit buffer requirements as specified in ISO/IEC 14496-3 [1] by the equation in paragraph 4.5.3.3.

Note: The maximum bit rate is dependent on the sampling frequency of the AAC core codec. According to the restriction on sampling frequencies made by this document for High Efficiency AAC v2 Profile – Level 2, valid AAC core codec sampling frequencies are noted above, and their resulting maximum bitrates are shown in Table 5.1. The maximum bitrates are not influenced by the usage of the HE AAC v2 profile.

Table 5.1 Valid Audio Sampling Frequencies and Maximum Bitrates

<table>
<thead>
<tr>
<th>AAC Sampling Frequency</th>
<th>SBR Present</th>
<th>Maximum Bitrate / AAC Core Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 kHz</td>
<td>N</td>
<td>288 kBit/s</td>
</tr>
<tr>
<td>44.1 kHz</td>
<td>N</td>
<td>264.6 kBit/s</td>
</tr>
<tr>
<td>32 kHz</td>
<td>N</td>
<td>192 kBit/s</td>
</tr>
<tr>
<td>24 kHz</td>
<td>Y</td>
<td>144 kBit/s</td>
</tr>
<tr>
<td>22.05 kHz</td>
<td>Y</td>
<td>132.3 kBit/s</td>
</tr>
<tr>
<td>16 kHz</td>
<td>Y</td>
<td>96 kBit/s</td>
</tr>
</tbody>
</table>

The presence of SBR and PS in the audio stream shall be indicated by the usage of explicit hierarchical signaling. Therefore the audio stream signaling shall be indicated as follows:

- If SBR data is not present, the audioObjectType indicated by the AudioSpecificConfig, shall be set to the value 2 (indicating AAC LC as given by Table 1.1 of ISO/IEC 14496-3 [3]).
- If SBR data is present, the first audioObjectType indicated by the AudioSpecificConfig, shall be set to the value 5 (indicating HE AAC as given by Table 1.1 of ISO/IEC 14496-3 [3]).
• If SBR data and PS data are present, the first audioObjectType indicated by the AudioSpecificConfig, shall be set to the value 29 (indicating HE AAC v2 as given by Table 1.1 of Amendment 2 of ISO/IEC 14496-3 [3]).

5.2 RTP Packetization

HE AAC v2 audio elementary streams shall be packetized in RTP packets according to IETF RFC 3640 [4].

The packetization mode shall be “AAC-hbr” as defined in RFC 3640 [4]. Access units shall be transmitted in sequence. Access unit duration shall be constant.

The signaling of the audio codec configuration and the RTP framing is defined in A/153 Part 3 [8]
Annex A: Sample SDP File (Informative)

The following shows an excerpt of an example SDP file for signaling a HE AAC v2 bitstream in ATSC M/H.

1. c = IN IP4 192.0.2.1 / 127
2. m=audio 5000 RTP/AVP 96
3. a=rtpmap:96 mpeg4-generic/48000/2
4. a=fmtp:96 streamType=5; profile-level-id=48; mode=AAC-hbr; config=EB098800
   sizeLength=13; indexLength=3; indexDeltaLength=3; constantDuration=2048

Within the SDP file,
1) Lines 2 – 4 describe the session information for the HE AAC v2 layer.
2) Lines 2 and 3 describe the use of the audio/mpeg4-generic RTP payload format, as specified in [4]. The RTP time stamp clock rate in this example is 48 kHz, and the number of audio channels is two.
3) Line 4 describes the required media format packetization parameters from [4] and is in line with the requirements specified in Section 5.2 above.
4) Line 4 also describes the media format parameters for the HE AAC v2 bitstream. The bitstream is coded in HE AAC v2 Profile at Level 2 (profile-level-id=48) and the config string contains the hexadecimal representation of the HE AAC v2 AudioSpecificConfig [audioObjectType=2 (AAC LC); extensionAudioObjectType=5 (SBR); psPresentFlag = 1; samplingFrequencyIndex=0x6 (24kHz); extensionSamplingFrequencyIndex=0x3 (48kHz); channelConfiguration=1 (1.0 channels for the AAC LC part)].

Typical values for the config string are listed in Table A.1.

<table>
<thead>
<tr>
<th>Sampling Frequency</th>
<th>AAC LC mono</th>
<th>AAC LC stereo</th>
<th>HE AAC mono</th>
<th>HE AAC stereo</th>
<th>HE AAC v2 stereo</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 kHz</td>
<td>1288</td>
<td>1290</td>
<td>2C0A8800</td>
<td>2C128800</td>
<td>EC0A8800</td>
</tr>
<tr>
<td>44.1 kHz</td>
<td>1208</td>
<td>1210</td>
<td>2B8A0800</td>
<td>2B920800</td>
<td>EB8A0800</td>
</tr>
<tr>
<td>48 kHz</td>
<td>1188</td>
<td>1190</td>
<td>2B098800</td>
<td>2B118800</td>
<td>EB098800</td>
</tr>
</tbody>
</table>

Note: Encoders may append additional data to the AudioSpecificConfig. Hence, the values in Table A.1 are not definite values but represent the shortest possible AudioSpecificConfig.

The config string of the SDP is transmitted as an octet string in the first decoder configuration record of the M/H Component Data for HE AAC v2 (Type 37), as specified in A/153 Part 3 [8]. Additional media-type parameters for backwards-compatible codec extensions (e.g., for multi-channel surround sound) are transmitted as an additional decoder configuration record.