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Information technology — MPEG audio technologies —

Part 3: Unified speech and audio coding

AMENDMENT 1: Conformance

Technologies de l'information — Technologies audio MPEG —
Partie 3: Discours unifié et codage audio
AMENDEMENT 1: Conformité

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO/IEC 23003-3:2012 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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Information technology — MPEG audio technologies —

Part 3:
Unified speech and audio coding

AMENDMENT 1: Conformance

In Clause 2, "Normative References", add the following entry:

ISO/IEC 14496-26:2010, *Information technology — Coding of audio-visual objects — Part 26: Audio conformance*

In 4.5.4 replace:

Four different hierarchical levels are defined with increasing number of audio channels and increasing complexity. All four levels include Level 2 of the Baseline USAC profile. The definition of the four levels of the Extended HE AAC profile is given in Table 3. All notes in Table 3 and all restrictions listed in the columns 2, 3, 4, and 5 ("Max. channels/object", "Max. AAC sampling rate, SBR not present [kHz]", "Max. AAC sampling rate, SBR present [kHz]", "Max. SBR sampling rate [kHz] (in/out)") of Table 3 apply only when decoding HE AAC v2 profile compliant bit streams.

Table 3 — Levels for the Extended HE AAC profile

Level (NOTE 1)	Max. channels / object	Max. AAC sampling rate, SBR not present [kHz]	Max. AAC sampling rate, SBR present [kHz]	Max. SBR sampling rate [kHz] (in/out)	Max. PCU	Max. RCU	Max. PCU HQ / LP SBR (NOTE 5)	Max. RCU HQ / LP SBR (NOTE 5)
1	NA	NA	NA	NA	NA	NA	NA	NA
2	2	48	24	24/48	12	11	12	11
3	2	48	24/48 (NOTE 3)	48/48 (NOTE 2)	15	11	15	11
4	5	48	24/48 (NOTE 4)	48/48 (NOTE 2)	25	28	20	23
5	5	96	48	48/96	49	28	39	23

NOTE 1: Level 2, 3, and 4 Extended HE AAC profile decoders implement the baseline version of the parametric stereo tool. A level 5 decoder shall not be limited to the baseline version of the parametric stereo tool.

NOTE 2: For level 3 and level 4 decoders, it is mandatory to operate the SBR tool in downsampled mode if the sampling rate of the AAC core is higher than 24kHz. Hence, if the SBR tool operates on a 48kHz signal, the internal sampling rate of the SBR tool will be 96kHz, however, the output signal will be downsampled by the SBR tool to 48kHz.

NOTE 3: If Parametric Stereo data are present the maximum AAC sampling rate is 24kHz, if Parametric Stereo data are not present the maximum AAC sampling rate is 48kHz.

NOTE 4: For one or two channels the maximum AAC sampling rate, with SBR present, is 48kHz. For more than two channels the maximum AAC sampling rate, with SBR present, is 24kHz.

NOTE 5: The PCU/RCU number are given for a decoder operating the LP SBR tool whenever applicable.

with:

A number of hierarchical levels are defined with increasing number of audio channels and increasing complexity. All levels include Level 2 of the Baseline USAC profile. The definition of the levels of the Extended HE AAC profile is given in Table 3. All notes in Table 3 and all restrictions listed in the columns 2, 3, 4, and 5 ("Max. channels/object", "Max. AAC sampling rate, SBR not present [kHz]", "Max. AAC

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sampling rate, SBR present [kHz]", "Max. SBR sampling rate [kHz] (in/out)") of Table 3 apply only when decoding HE AAC v2 profile compliant bit streams.

Table 3 — Levels for the Extended HE AAC profile

Level (NOTE 1)	Max. channels / object	Max. AAC sampling rate, SBR not present [kHz]	Max. AAC sampling rate, SBR present [kHz]	Max. SBR sampling rate [kHz] (in/out)	Max. PCU	Max. RCU	Max. PCU HQ / LP SBR (NOTE 5)	Max. RCU HQ / LP SBR (NOTE 5)
1	NA	NA	NA	NA	NA	NA	NA	NA
2	2	48	24	24/48	12	11	12	11
3	2	48	24/48 (NOTE 3)	48/48 (NOTE 2)	15	11	15	11
4	5	48	24/48 (NOTE 4)	48/48 (NOTE 2)	25	28	20	23
5	5	96	48	48/96	49	28	39	23
6	7	48	24/48 (NOTE 4)	48/48	34	37	27	30
7	7	96	48	48/96	67	37	53	30

NOTE 1: Level 2, 3, 4, 6 and 7 Extended HE AAC profile decoders implement the baseline version of the parametric stereo tool. A level 5 decoder shall not be limited to the baseline version of the parametric stereo tool.

NOTE 2: For level 3, 4 and 6 decoders, it is mandatory to operate the SBR tool in downsampled mode if the sampling rate of the AAC core is higher than 24kHz. Hence, if the SBR tool operates on a 48kHz signal, the internal sampling rate of the SBR tool will be 96kHz, however, the output signal will be downsampled by the SBR tool to 48kHz.

NOTE 3: If Parametric Stereo data are present the maximum AAC sampling rate is 24kHz, if Parametric Stereo data are not present the maximum AAC sampling rate is 48kHz.

NOTE 4: For one or two channels the maximum AAC sampling rate, with SBR present, is 48kHz. For more than two channels the maximum AAC sampling rate, with SBR present, is 24kHz.

NOTE 5: The PCU/RCU number are given for a decoder operating the LP SBR tool whenever applicable.

NOTE 6: A Level 6 or 7 decoder is not required to decode a Level 5 stream.

In 5.3.2 amend Table 36 as follows:

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Table 36 — Syntax of acelp_coding()

Syntax	No. of bits	Mnemonic
acelp_coding(acelp_core_mode)		
{		
[...]		
switch (acelp_core_mode) {		
case 0		
icb_index[sfr];	**20**	**uimsbf**
break;		
case 1		
icb_index[sfr];	**28**	**uimsbf**
break;		
case 2		
icb_index[sfr];	**36**	**uimsbf**
break;		
case 3		
icb_index[sfr];	**44**	**uimsbf**
break;		
case 4		
icb_index[sfr];	**52**	**uimsbf**
break;		
case 5		
icb_index[sfr];	**64**	**uimsbf**
break;		
case 6		
icb_index[sfr];	**12**	**uimsbf**
break;		
case 7		
icb_index[sfr];	**16**	**uimsbf**
break;		
}		
gains[sfr];	**7**	**uimsbf**
}		

NOTE: coreCoderFrameLength designates the core frame length in samples and is equal to either 1024 or 768. See also 6.1.1.2.

In 7.14.5.2.1, replace:

Depending on the coding mode, the following codebooks are used:

with:

Depending on the coding mode, the following codebooks are used:

— 12-bit codebook with 2 pulses i_0 and i_1. Pulse i_0 can be selected from either track 0 or 2, pulse i_1 can be selected from either track 1 or 3 (5×2+2)

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— 16-bit codebook with 3 pulses on three tracks. One pulse on track 0, one pulse on track 2 and one pulse on either track 1 or 3 (selected track signalled by a 1 bit field), which amounts to (5×3+1) = 16 bits.

Add a new Clause 8, "Conformance testing", as shown below:

8 Conformance testing

8.1 Introduction

The present Clause 8 specifies conformance criteria for both bitstreams and decoders compliant with the USAC standard as defined in this document. This is done to assist implementers and to ensure interoperability.

8.2 Terms and definitions

bitstream
encoded audio data

conformance data
conformance test sequences and conformance tools

conformance tool
tool to check certain conformance criteria

conformance test sequence
generic term for conformance test bitstreams and corresponding reference waveforms

conformance test bitstream
USAC bitstream used for testing the conformance of a USAC decoder

conformance test condition
condition which applies to properties of a conformance test bitstream in order to test a certain functionality of the USAC decoder

conformance test case
combination of one or more conformance test conditions for which a set of conformance test sequences is provided

main audio channel
audio channel conveyed by means of a UsacSingleChannelElement or UsacChannelPairElement

reference waveform
decoded counterpart of a bitstream

USAC bitstream
data encoded according to the USAC standard

UsacCPE
UsacChannelPairElement

UsacEXT
UsacExtElement

UsacLFE
UsacLfeElement

UsacSCE
UsacSingleChannelElement

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8.3 USAC conformance testing

8.3.1 Profiles

Profiles are defined in 4.5. Some conformance criteria apply to USAC in general, while others are specific to certain profiles and their respective levels. Conformance shall be tested for the level of the profile with which a given bitstream or decoder claims to comply.

In addition to the conformance requirements described in this clause, a decoder which claims to comply with the Extended HE AAC Profile shall fulfill conformance for the HE AAC v2 profile according to ISO/IEC 14496-26:2010.

8.3.2 Conformance tools and test procedure

To test USAC compliant audio decoders, ISO/IEC JTC 1/SC 29/WG 11 supplies a number of conformance test sequences. Supplied sequences cover all profiles as defined in 4.5. For a supplied test sequence, testing can be done by comparing the output of a decoder under test with a reference waveform also supplied by ISO/IEC JTC 1/SC 29/WG 11. In cases where the decoder under test is followed by additional operations (e.g. quantizing a signal to a 16 bit output signal) the conformance point is prior to such additional operations, i.e. it is permitted to use the actual decoder output (e.g. with more than 16 bit) for conformance testing.

Measurements are carried out relative to full scale where the output signals of the decoders are normalized to be in the range between –1.0 and +1.0.

In ISO/IEC 14496-26:2010 a set of test methods is defined to test the output of the decoder under test against the reference output. RMS/LSB Measurement, Segmental SNR and PNS conformance criteria are used for the comparison. A particular test method for a certain test sequence is specified in 8.5.

For elements producing output that cannot be tested with the methods described in ISO/IEC 14496-26:2010, specific conformance testing procedures are described in 8.5.

8.3.2.1 Conformance data

All test sequences are provided in the shape of a zip archive as an electronic attachment. Furthermore, an MS Excel worksheet (“Usac_Conformance_Tables.xlsx”) is provided as an electronic attachment that lists all test sequences for each module.

For all conformance test sequences, the file names are composed of several parts which convey information about:

— which module of the decoder is tested

— which channelConfigurationIndex is employed

— which test conditions apply to the test sequence

— which coreSbrFrameLengthIndex applies to the test sequence

— which sampling frequency is signalled in the test sequence

The file naming convention given in Table 149 is used. Values in box brackets are optional.

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Table 149 — File name conventions

Module	File Name (compressed)	File Name (uncompressed)
Frequency domain coding (FD mode), 8.4.4	Fd_<cCI>_c<cSFLI>_<testCase>_<uSFI>.mp4	FD_<cCI>_c<cSFLI>_<testCase>_<uSFI>.wav
Linear predictive domain coding (LPD mode), 8.4.5	Lpd_<cCI>_c<cSFLI>_<testCase>_[<uSFI>].mp4	Lpd_<cCI>_c<cSFLI>_<testCase>_[<uSFI>].wav
Common core coding tools, 8.4.6	Cct_<cCI>_c<cSFLI>_<testCase>_[<uSFI>].mp4	Cct_<cCI>_c<cSFLI>_<testCase>_[<uSFI>].wav
Enhanced spectral band replication (eSBR), 8.4.7	eSbr_<cSFLI>_<testCase>.mp4	eSbr_<cSFLI>_<testCase>.wav
MPEG Surround 2-1-2, 8.4.10	Mps_<bsFR>_Sc<sCI>_<testCase>.mp4	Mps_<bsFR>_Sc<sCI>_<testCase>.wav

<cCI> channelConfigurationIndex as described in Table 68.

<testCase> Setup string. May consist of a concatenation of one or more abbreviations as listed in Table 150. If no setup string is specified the basic test conditions apply

<cSFLI> coreSbrFrameLengthIndex as described in Table 70.

<uSFI> usacSamplingFrequencyIndex as described in Table 67. If the escape value is specified the used sampling frequency is appended, e.g. “xx_1f_42000.mp4” for a sampling frequency of 42 kHz.

<bsFR> bsFreqRes as described in ISO/IEC 23003-1:2007, Table 39

<sCI> stereoConfigIndex as described in Table 72

Table 150 — Test conditions and abbreviations

FD core mode	
Test Condition	**Abbrev.**
FD window switching test condition	Win
Noise filling test condition	Nf
Tns test condition	Tns
Varying max_sfb test condition	Sfb
Handling of extensions condition	Ex
Arithmetic coder test condition	Ac
Non-meaningful FD window switching test condtion	Nmf
M/S stereo test condition	Ms
Complex prediction stereo test condition	Cp

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LPD core mode	
Test Condition	**Abbrev.**
LPC coding test condition	Lpc
ACELP core mode test condition	Ace
TCX and noise filling test condition	Tcx
LPD mode coverage and FAC test condition	Lpd
Bass-post filter test condition	Bpf
AVQ test condition	Avq

Combined core coding	
Test Condition	**Abbrev.**
FD-LPD transition and FAC test condition	Flt
FD/TCX noise filling test condition	Cnf
Bass-post filter test condition	Cbf
synchr. FD-LPD transition and FAC test condition	Flts
asynchr. FD-LPD transition and FAC test condition	Flta
Arithmetic coder test condition	CAc

eSbr	
Test Condition	**Abbrev.**
QMF accuracy test condition	Qma
Envelope adjuster accuracy and SBR pre-processing test condition	Eaa
Header and grid control test condition test condition	Hgt
Inverse filtering test condition	Ift
Additional sine test (missing harmonics) test condition	Ast
Sampling rate test condition	Sr
Channel mode test condition	Cm
interTes test condition	Tes
PVC test condition	Pvc
Harmonic transposition (QMF) test condition	Htq
Harmonic transposition (crossproducts) test condition	Xp
Transposer toggle test condition	Ttt
Envelope shaping toggle (PVC on/off) test condition	Est
Varying crossover frequency test condition	Xo
stereoConfigIndex test condition	Mps

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Mpeg surround 212	
Test Condition	**Abbrev.**
TSD test condition	Tsd
Rate mode test condition	Rm
Phase coding test condition	Pc
Decorrelator configuration. test condition	Dc
DMX gain test condition	Dm
Bands phase test condition	Bp<X>
Pseudo lr test condition	Plr
Residual bands test condition	Rb<X>

8.4 USAC Bitstreams

8.4.1 General

8.4.1.1 Characteristics

Characteristics of bitstreams specify the constraints that are applied by the encoder in generating the bitstreams. These syntactic and semantic constraints may, for example, restrict the range or the values of parameters that are encoded directly or indirectly in the bitstreams. The constraints applied to a given bitstreams may or may not be known a priori.

8.4.1.2 Test procedure

Each USAC bitstream shall meet the syntactic and semantic requirements specified in this document. The present subclause defines the conformance criteria that shall be fulfilled by a compliant bitstream. These criteria are specified for the syntactic elements of the bitstream and for some parameters decoded from the USAC bitstream payload.

For each tool a set of semantic tests to be performed on the bitstreams is described. To verify whether the syntax is correct is straightforward and therefore not defined herein after. In the description of the semantic tests it is assumed that the tested bitstreams contains no errors due to transmission or other causes. For each test the condition or conditions that must be satisfied are given, as well as the prerequisites or conditions in which the test can be applied.

8.4.2 USAC Configuration

8.4.2.1 Characteristics

Encoders may apply restrictions to the following parameters of the bitstream:

a) usacSamplingFrequencyIndex

b) usacSamplingFrequency

c) coreSbrFrameLengthIndex

d) channelConfigurationIndex

e) presence of configuration extensions

f) numOutChannels

g) bsOutputChannelPos

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h) numElements

i) stereoConfigIndex

j) use of time warped MDCT

k) use of noise filling in FD mode

l) use of the eSBR harmonic transposer

m) use of the eSBR inter-TES tool

n) use of the eSBR PVC tool

o) SBR default header, for details see 8.4.7.

p) MPS config, for details see 8.4.10.

8.4.2.2 Test procedure

8.4.2.2.1 UsacConfig()

usacSamplingFrequencyIndex Shall be encoded with a non-reserved value specified in Table 67. For further profile and level dependent restrictions see 8.4.11.

usacSamplingFrequency No restrictions apply. For profile and level dependent restrictions see 8.4.11.

coreSbrFrameLengthIndex no restrictions apply

channelConfigurationIndex Shall be encoded with a non-reserved value specified in Table 68. For further profile and level dependent restrictions see 8.4.11. In the case of channelConfigurationIndex==0 further restrictions apply as described in 8.4.2.2.2.

usacConfigExtensionPresent no restrictions apply

8.4.2.2.2 UsacChannelConfig()

numOutChannels no restrictions apply. For profile and level dependent restrictions see 8.4.11.

bsOutputChannelPos A bsOutputChannelPos of value 3 or 26 (LFE speaker positions) shall be associated with an LFE channel. Any other value shall be associated with a main audio channel.

8.4.2.2.3 UsacDecoderConfig()

numElements the value of this data element shall be such that the accumulated sum of all channels contained in the bitstream complies with the restrictions outlined in 8.4.2.2.1.

usacElementType no restrictions apply. For profile and level dependent restrictions see 8.4.11.

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8.4.2.2.4 UsacSingleChannelElementConfig()

No restrictions are applicable to this bitstream element.

8.4.2.2.5 UsacChannelPairElementConfig()

NOTE The UsacChannelPairElementConfig() element and all included elements may only be present when coding more than one output channel (see restrictions applying to UsacConfig() in 8.4.2.2.1).

stereoConfigIndex no restrictions apply

8.4.2.2.6 UsacLfeElementConfig()

No restrictions are applicable to this bitstream element.

8.4.2.2.7 UsacCoreConfig()

tw_mdct no restrictions apply. For profile and level dependent restrictions see 8.4.11.

noiseFilling no restrictions apply

8.4.2.2.8 SbrConfig()

harmonicSBR no restrictions apply

bs_interTes no restrictions apply

bs_pvc no restrictions apply

8.4.2.2.9 SbrDfltHeader()

dflt_start_freq no restrictions apply

dflt_stop_freq no restrictions apply

dflt_header_extra1 no restrictions apply

dflt_header_extra2 no restrictions apply

dflt_freq_scale no restrictions apply

dflt_alter_scale no restrictions apply

dftl_nose_bands no restrictions apply

dflt_limiter_bands no restrictions apply

dflt_limiter_gains no restrictions apply

dflt_interpol_freq no restrictions apply

dflt_smoothing_mode no restrictions apply

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8.4.2.2.10 Mps212Config()

bsFreqRes	shall not be encoded with a value of 0
bsFixedGainDMX	no restrictions apply
bsTempShapeConfig	no restrictions apply
bsDecorrConfig	shall not be encoded with a value of 3
bsHighRateMode	no restrictions apply
bsPhaseCoding	no restrictions apply
bsOttBandsPhasePresent	no restrictions apply
bsOttBandsPhase	shall not be encoded with a value larger than the value of numBands as given by ISO/IEC 23003-1:2007, 5.2, Table 39 and depends on bsFreqRes.
bsResidualBands	shall not be encoded with a value larger than the value of numBands as given by ISO/IEC 23003-1:2007, 5.2, Table 39 and depends on bsFreqRes.
bsPseudoLr	no restrictions apply
bsEnvQuantMode	shall be 0

8.4.2.2.11 UsacExtElementConfig()

usacExtElementType	no restrictions apply
usacExtElementConfigLength	no restrictions apply
usacExtElementDefaultLengthPresent	no restrictions apply
usacExtElementDefaultLength	no restrictions apply
usacExtElementPayloadFrag	no restrictions apply

8.4.2.2.12 UsacConfigExtension()

numConfigExtensions	no restrictions apply
usacConfigExtType[]	no restrictions apply
usacConfigExtLength[]	no restrictions apply
fill_byte	should be '10100101'

8.4.3 Framework

8.4.3.1 Characteristics

Encoders may apply restrictions to the following parameters of the bitstream:

a) signalling of independently decodable frames

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b) presence of extension elements

c) core_mode

d) presence of TNS

8.4.3.2 Test procedure

8.4.3.2.1 UsacFrame()

usacIndependencyFlag no restrictions apply

8.4.3.2.2 UsacSingleChannelElement

No restrictions are applicable to this bitstream element.

8.4.3.2.3 UsacChannelPairElement

No restrictions are applicable to this bitstream element.

8.4.3.2.4 UsacLfeElement

No restrictions are applicable to this bitstream element.

8.4.3.2.5 UsacExtElement

usacExtElementPresent no restrictions apply

usacExtElementUseDefaultLength no restrictions apply

usacExtElementPayloadLength no restrictions apply

usacExtElementStart no restrictions apply

usacExtElementStop no restrictions apply

usacExtElementSegmentData no restrictions apply

8.4.3.2.6 UsacCoreCoderData

core_mode no restrictions apply.

tns_data_present no restrictions apply

8.4.4 Frequency domain coding (FD mode)

8.4.4.1 Characteristics

Encoders may apply restrictions to the following parameters of the bitstream:

a) use of noise filling

b) window_shape

c) M/S Stereo

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d) use of TNS

e) Complex prediction stereo coding

f) max_sfb

g) use of time warped MDCT

h) use of long blocks

i) use of short blocks

8.4.4.2 Test procedure

8.4.4.2.1 fd_channel_stream

global_gain no restrictions apply.

noise_level no restrictions apply

noise_offset no restrictions apply

fac_data_present shall be 0, if the core_mode of the preceding frame of the same channel was 0 or if mod[3] of the preceding frame of the same channel was > 0.

8.4.4.2.2 ics_info

window_sequence A conformant bitstream shall consist of only meaningful window_sequence transitions. However, decoders are required to handle non-meaningful window_sequence transitions as well. The meaningful window_sequence transitions are shown in Table 133.

window_shape no restrictions apply

max_sfb shall be <= num_swb_long or num_swb_short as appropriate for window_sequence and sampling frequency and core coder frame length.

scale_factor_grouping no restrictions apply

8.4.4.2.3 tw_data

tw_data_present no restrictions apply

tw_ratio no restrictions apply

8.4.4.2.4 scale_factor_data

hcod_sf Shall only be encoded with the values listed in the scalefactor Huffman table. Shall be encoded such that the decoded scalefactors sf[g][sfb] are within the range of zero to 255, both inclusive.

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