

ISO/IEC 23008-3:2026-02 (E)

Information technology - High efficiency coding and media delivery in heterogeneous environments - Part 3: 3D audio

Contents		Page
Foreword.....		xii
Introduction.....		xii
1	Scope	1
2	Normative references	1
3	Terms, definitions, symbols, abbreviated terms and conventions.....	1
3.1	Terms and definitions.....	1
3.2	Symbols, abbreviated terms and conventions	2
3.2.1	Symbols and abbreviated terms.....	2
3.2.2	Conventions	2
4	Technical overview	2
4.1	Decoder block diagram	2
4.2	Overview over the codec building blocks	3
4.3	Efficient combination of decoder processing blocks in the time domain and QMF domain.....	6
4.4	Rule set for determining processing domains	9
4.4.1	Audio core codec processing domain	9
4.4.2	Mixing	10
4.4.3	DRC-1 Operation domains (DRC in rendering context).....	10
4.4.4	Audio core codec interface domain to rendering	10
4.4.5	Rendering context.....	10
4.4.6	Post-processing context.....	11
4.4.7	End-of-chain context.....	11
4.5	Sample rate converter	11
4.6	Decoder delay	11
4.7	Contribution mode of MPEG-H 3D audio.....	12
4.8	MPEG-H 3D audio profiles and levels	12
4.8.1	General	12
4.8.2	Profiles	13
5	MPEG-H 3D audio core decoder.....	27
5.1	Definitions.....	27
5.1.1	Joint stereo.....	27
5.1.2	MPEG surround based stereo (MPS 212)	28
5.2	Syntax.....	28
5.2.1	General	28
5.2.2	Decoder configuration	28
5.2.3	MPEG-H 3D audio core bitstream payloads	51
5.3	Data structure	72
5.3.1	General	72
5.3.2	General configuration data elements.....	72
5.3.3	Loudspeaker configuration data elements	75
5.3.4	Core decoder configuration data elements	77
5.3.5	Downmix matrix data elements	81
5.3.6	HOA rendering matrix data elements	84
5.3.7	Signal group information elements	87
5.3.8	Low frequency enhancement (LFE) channel element, mpegh3daLfeElement().....	87

5.3.9	Compatible profile and levels sets.....	88
5.4	Configuration element descriptions	88
5.4.1	General	88
5.4.2	Downmix configuration.....	88
5.4.3	HOA rendering matrix configuration	94
5.5	Tool descriptions	98
5.5.1	General.....	98
5.5.2	Quad channel element.....	98
5.5.3	Transform splitting.....	100
5.5.4	MPEG surround for mono to stereo upmixing.....	107
5.5.5	Enhanced noise filling	110
5.5.6	Audio pre-roll.....	134
5.5.7	Fullband LPD	137
5.5.8	Time-domain bandwidth extension.....	148
5.5.9	LPD stereo coding	161
5.5.10	Multichannel coding tool.....	169
5.5.11	Filterbank and block switching	179
5.5.12	Frequency domain prediction.....	180
5.5.13	Long-term postfilter.....	183
5.5.14	Tonal component coding.....	188
5.5.15	Internal channel on MPS212 for low complexity format conversion	198
5.5.16	High resolution envelope processing (HREP) tool.....	210
5.6	Buffer requirements	216
5.6.1	Minimum decoder input buffer	216
5.6.2	Bit reservoir.....	216
5.6.3	Maximum bit rate.....	217
5.7	Stream access point requirements and inter-frame dependency.....	217
6	Dynamic range control and loudness processing	218
6.1	General.....	218
6.2	Description.....	218
6.3	Syntax.....	219
6.3.1	Loudness metadata	219
6.3.2	Dynamic range control metadata.....	219
6.3.3	Data elements.....	220
6.4	Decoding process	222
6.4.1	General.....	222
6.4.2	Dynamic range control.....	224
6.4.3	Usage of downmixId in MPEG-H	224
6.4.4	DRC set selection process	225
6.4.5	DRC-1 for SAOC 3D Content	227
6.4.6	DRC-1 for HOA content.....	228
6.4.7	Loudness normalization.....	229
6.4.8	Peak limiter.....	229
6.4.9	Time-synchronization of DRC gains	230
6.4.10	Default parameters	230
7	Object metadata decoding	230
7.1	General.....	230
7.2	Description.....	230
7.3	Syntax.....	231
7.3.1	Object metadata configuration	231
7.3.2	Top level object metadata syntax	232
7.3.3	Subsidiary payloads for efficient object metadata decoding.....	233
7.3.4	Subsidiary payloads for object metadata decoding with low delay	238
7.3.5	Enhanced object metadata configuration	244
7.4	Data structure	247
7.4.1	Definition of ObjectMetadataConfig() payloads	247
7.4.2	Efficient object metadata decoding	247
7.4.3	Object metadata decoding with low delay	255

7.4.4	Enhanced object metadata	260
8	Object rendering	263
8.1	Description.....	263
8.2	Terms and definitions.....	263
8.3	Input data	264
8.4	Processing	265
8.4.1	General remark	265
8.4.2	Imaginary loudspeakers	265
8.4.3	Dividing the loudspeaker setup into a triangle mesh	266
8.4.4	Rendering algorithm	268
9	SAOC 3D.....	272
9.1	Description.....	272
9.2	Definitions.....	272
9.3	Delay and synchronization.....	274
9.4	Syntax.....	274
9.4.1	Payloads for SAOC 3D	274
9.4.2	Definition of SAOC 3D payloads.....	278
9.5	SAOC 3D processing	280
9.5.1	Compressed data stream decoding and dequantization of SAOC 3D data	280
9.5.2	Time/frequency transforms	280
9.5.3	Signals and parameters.....	281
9.5.4	SAOC 3D decoding.....	283
9.5.5	Dual mode	288
10	Generic loudspeaker rendering/format conversion	288
10.1	Description.....	288
10.2	Definitions.....	290
10.2.1	General remarks	290
10.2.2	Variable definitions	290
10.3	Processing	290
10.3.1	Application of transmitted downmix matrices.....	290
10.3.2	Application of transmitted equalizer settings	295
10.3.3	Downmix processing involving multiple channel groups.....	295
10.3.4	Initialization of the format converter	296
10.3.5	Audio signal processing.....	312
11	Immersive loudspeaker rendering/format conversion	318
11.1	Description.....	318
11.2	Syntax.....	320
11.3	Definitions.....	320
11.3.1	General remarks	320
11.3.2	Variable definitions	321
11.4	Processing	322
11.4.1	Initialization of the format converter	322
11.4.2	Audio signal processing.....	364
12	Higher order ambisonics (HOA).....	372
12.1	Technical overview	372
12.1.1	Block diagram	372
12.1.2	Overview of the decoder tools	373
12.2	Syntax.....	374
12.2.1	Configuration of HOA elements	374
12.2.2	Payloads of HOA elements.....	378
12.3	Data structure	391
12.3.1	Definitions of HOA Config	391

12.3.2	Syntax of getSubbandBandwidths()	395
12.3.3	Definitions of HOA payload	396
12.4	HOA tool description	403
12.4.1	HOA frame converter	403
12.4.2	Spatial HOA decoding	419
12.4.3	HOA renderer	448
12.4.4	Layered coding for HOA	457
13	Binaural renderer	460
13.1	General	460
13.2	Frequency-domain binaural renderer	460
13.2.1	General	460
13.2.2	Definitions	462
13.2.3	Parameterization of binaural room impulse responses	466
13.2.4	Frequency-domain binaural processing	478
13.3	Time-domain binaural renderer	485
13.3.1	General	485
13.3.2	Definitions	486
13.3.3	Parameterization of binaural room impulse responses	488
13.3.4	Time-domain binaural processing	492
14	MPEG-H 3D audio stream (MHAS)	493
14.1	Overview	493
14.2	Syntax	494
14.2.1	Main MHAS syntax elements	494
14.2.2	Subsidiary MHAS syntax elements	496
14.3	Semantics	496
14.3.1	mpeghAudioStreamPacket()	496
14.3.2	MHASPacketPayload()	497
14.3.3	Subsidiary MHAS packets	499
14.4	Description of MHASPacketTypes	499
14.4.1	PACTYP_FILLDATA	499
14.4.2	PACTYP_MPEGH3DACFG	499
14.4.3	PACTYP_MPEGH3DAFRAME	499
14.4.4	PACTYP_SYNC	500
14.4.5	PACTYP_SYNCGAP	500
14.4.6	PACTYP_MARKER	500
14.4.7	PACTYP_CRC16 and PACTYP_CRC32	501
14.4.8	PACTYP_DESCRIPTOR	501
14.4.9	PACTYP_USERINTERACTION	501
14.4.10	PACTYP_LOUDNESS_DRC	501
14.4.11	PACTYP_BUFFERINFO	502
14.4.12	PACTYP_GLOBAL_CRC16 and PACTYP_GLOBAL_CRC32	502
14.4.13	PACTYP_AUDIOTRUNCATION	502
14.4.14	PACTYP_AUDIOSCENEINFO	503
14.4.15	PACTYP_EARCON	503
14.4.16	PACTYP_PCMCONFIG	504
14.4.17	PACTYP_PCMDATA	504
14.4.18	PACTYP_LOUDNESS	504
14.4.19	MHASPacketType specific requirements for MHASPacketLabel	504
14.5	Application examples	505
14.5.1	Light-weighted broadcast	505
14.5.2	MPEG-2 transport stream	506
14.5.3	CRC error detection	506
14.5.4	Audio sample truncation	507
14.6	Multi-stream delivery and interface	507

14.7	Carriage of generic data	510
14.7.1	Syntax.....	510
14.7.2	Semantics.....	511
14.7.3	Processing at the MPEG-H 3D audio decoder	512
15	Metadata audio elements (MAE).....	512
15.1	General	512
15.2	Syntax.....	513
15.3	Semantics.....	522
15.4	Definition of mae_metaDataElementIDs	534
15.5	Loudness compensation after gain interactivity.....	535
16	Loudspeaker distance compensation.....	537
17	Interfaces to the MPEG-H 3D audio decoder.....	538
17.1	General	538
17.2	Interface for local setup information	538
17.2.1	General	538
17.2.2	WIRE output	538
17.2.3	Syntax for local setup information	539
17.2.4	Semantics for local setup information	539
17.3	Interface for local loudspeaker setup and rendering.....	540
17.3.1	General	540
17.3.2	Syntax for local loudspeaker signalling.....	540
17.3.3	Semantics for local loudspeaker signalling.....	541
17.4	Interface for binaural room impulse responses (BRIRs).....	542
17.4.1	General	542
17.4.2	Syntax of binaural renderer interface	542
17.4.3	Semantics.....	547
17.5	Interface for local screen size information	551
17.5.1	General	551
17.5.2	Syntax.....	551
17.5.3	Semantics.....	551
17.6	Interface for signaling of local zoom area.....	552
17.6.1	General	552
17.6.2	Syntax.....	552
17.6.3	Semantics.....	552
17.7	Interface for user interaction.....	553
17.7.1	General	553
17.7.2	Definition of user interaction categories.....	553
17.7.3	Definition of an interface for user interaction.....	554
17.7.4	Syntax of interaction interface	555
17.7.5	Semantics of interaction interface	556
17.8	Interface for loudness normalization and dynamic range control (DRC).....	558
17.9	Interface for scene displacement data.....	558
17.9.1	General	558
17.9.2	Definition of an interface for scene-displacement data	559
17.9.3	Syntax of the scene displacement interface.....	560
17.9.4	Semantics of the scene displacement interface.....	560
17.10	Interfaces for channel-based, object-based, and HOA metadata and audio data.....	561
17.10.1	General	561
17.10.2	Expectations on external renderers	561
17.10.3	Object-based metadata and audio data (object output interface)	561
17.10.4	Channel-based metadata and audio data	569
17.10.5	HOA metadata and audio data	573
17.10.6	Audio PCM data	577

17.11	Interface for positional scene displacement data	577
17.11.1	General	577
17.11.2	Syntax of the positional scene displacement interface.....	578
17.11.3	Semantics of the positional scene displacement interface	578
17.11.4	Processing.....	578
18	Application and processing of local setup information and interaction data and scene displacement data	579
18.1	Element metadata preprocessing	579
18.1.1	General information	579
18.1.2	Initialization	580
18.1.3	Processing loop.....	581
18.1.4	Element routing.....	585
18.2	Interactivity limitations and restrictions	585
18.2.1	General information	585
18.2.2	WIRE interactivity	585
18.2.3	Position interactivity.....	586
18.2.4	Screen-related element remapping and object remapping for zooming	586
18.2.5	Closest loudspeaker payout.....	587
18.3	Screen-related element remapping	587
18.4	Screen-related adaptation and zooming for higher order ambisonics (HOA).....	590
18.5	Object remapping for zooming	592
18.6	Determination of the closest loudspeaker	594
18.7	Determination of a list of loudspeakers for conditioned closest loudspeaker playback	594
18.8	Processing of scene displacement angles for channels and objects (CO).....	596
18.9	Processing of scene displacement angles for scene-based content (HOA)	598
18.10	Determination of a reduced reproduction layout based on excluded sectors	600
18.11	Diffuseness rendering.....	601
19	MPEG-H 3D audio profile definition.....	603
20	Carriage of MPEG-H 3D audio in ISO base media file format	603
20.1	General.....	603
20.2	Random access and stream access	603
20.3	Overview of new box structures.....	603
20.4	MHA decoder configuration record.....	604
20.4.1	Definition	604
20.4.2	Syntax.....	604
20.4.3	Semantics.....	604
20.5	MPEG-H audio sample entry	604
20.5.1	Definition	604
20.5.2	Syntax.....	605
20.5.3	Semantics.....	605
20.6	MPEG-H audio MHAS sample entry	606
20.6.1	Definition	606
20.6.2	Syntax.....	607
20.7	MHA dynamic range control and loudness	607
20.7.1	Definition	607
20.7.2	Syntax.....	607
20.7.3	Semantics.....	609
20.8	MHA multi-stream signalling.....	610
20.8.1	Definition	610
20.8.2	Syntax.....	610
20.8.3	Semantics.....	610
20.9	Audio scene information	611

20.9.1	MHA group definition.....	611
20.9.2	MHA switch group definition.....	613
20.9.3	MHA group preset definition.....	614
20.9.4	MHA group description text label.....	615
20.9.5	MHA scene information.....	617
20.10	Track references.....	618
20.11	MPEG-H Audio profile and level compatibility sets.....	618
20.11.1	Definition.....	618
20.11.2	Syntax.....	618
20.11.3	Semantics.....	618
21	Sub-parameters for the MIME type 'Codecs' parameter.....	619
21.1	General.....	619
21.2	'Codecs' parameter for MPEG-H 3D audio.....	619
22	Timing considerations and decoder behaviour.....	619
23	Multi-stream handling.....	619
23.1	Restrictions on extension payloads.....	619
24	Low complexity generic loudspeaker rendering/format conversion.....	621
24.1	Description.....	621
24.2	Definitions.....	622
24.2.1	General remarks.....	622
24.2.2	Variable definitions.....	623
24.3	Processing.....	623
24.3.1	Application of transmitted downmix matrices.....	623
24.3.2	Application of transmitted equalizer settings.....	628
24.3.3	Downmix processing involving multiple channel groups.....	628
24.3.4	Initialization of the format converter.....	629
24.3.5	Audio signal processing.....	646
25	Low complexity immersive loudspeaker rendering/format conversion.....	648
25.1	Description.....	648
25.2	Syntax.....	649
25.3	Definitions.....	650
25.3.1	General remarks.....	650
25.3.2	Variable definitions.....	650
25.4	Processing.....	651
25.4.1	Initialization of the format converter.....	651
25.4.2	Audio signal processing.....	695
26	MPEG surround.....	698
26.1	Technical overview.....	698
26.2	Syntax and data structure.....	699
26.3	Tool description.....	699
27	Production metadata decoding.....	699
27.1	General.....	699
27.1.1	Object distance coding.....	699
27.1.2	Direct headphone signalling.....	699
27.1.3	Reference distance coding.....	700
27.2	Syntax.....	701
27.2.1	Production metadata configuration.....	701
27.2.2	Production metadata frame.....	702
27.3	Semantics.....	703
27.3.1	Production metadata configuration.....	703
27.4	Decoding process.....	705

28	Earcon metadata	705
28.1	General.....	705
28.2	Syntax.....	705
28.3	Semantics.....	707
28.4	Decoding process	711
Annex A (normative)	Tables for arithmetic decoding of IGF information	713
Annex B (normative)	SAOC 3D Decorrelator pre-mixing matrices.....	717
Annex C (informative)	Encoder tools.....	724
Annex D (normative)	Peak limiter for unguided clipping prevention	772
Annex E (normative)	Compact template downmix matrices	773
Annex F (normative)	HOA tables.....	774
Annex G (informative)	Low complexity HOA rendering.....	816
Annex H (informative)	Information on delay and complexity of time-domain binauralization	830
Annex I (informative)	Determination of a rotation matrix for processing of scene displacement data	835
Annex J (informative)	Decorrelation filtering for 'diffuseness' processing.....	837
Annex K (informative)	Distance and depth spread rendering	838
Annex L (informative)	HREP encoder description.....	840
Annex M (informative)	Screen-related adaptation of HOA content in complexity constrained implementations	844
Annex N (normative)	Retaining original file length with MPEG-H 3D audio.....	845
Annex O (normative)	Codebook tables used to de-quantize high band time domain bandwidth extension parameters.....	847
Annex P (informative)	Implementation and usage guidelines for signalling of profile and level compatibility sets	856
Bibliography		856