

ISO/IEC 23090-4:2025-11 (E)

Information technology - Coded representation of immersive media - Part 4: MPEG-I immersive audio

Contents	Page
Foreword.....	vi
Introduction.....	vii
1 Scope.....	1
2 Normative references.....	1
3 Terms, definitions and abbreviated terms.....	1
3.1 Terms and definitions.....	1
3.2 Mnemonics.....	5
3.3 Abbreviated terms.....	6
4 Overview.....	7
5 MPEG-I immersive audio transport.....	10
5.1 Overview.....	10
5.2 Definitions.....	11
5.3 MHAS syntax.....	11
5.3.1 Audio stream.....	11
5.3.2 Audio stream packet.....	12
5.4 Semantics.....	21
6 MPEG-I Immersive audio renderer.....	31
6.1 Definitions.....	31
6.2 Syntax.....	31
6.2.1 General.....	31
6.2.2 Generic codebook.....	31
6.2.3 Directivity payloads syntax.....	33
6.2.4 Diffraction payload syntax.....	36
6.2.5 Voxel payload syntax.....	42
6.2.6 Early reflection payload syntax.....	47
6.2.7 Portal payload syntax.....	50
6.2.8 Reverberation payload syntax.....	52
6.2.9 Audio plus payload syntax.....	54
6.2.10 Dispersion payload syntax.....	54
6.2.11 Scene plus payload syntax.....	54
6.2.12 Airflow payload syntax.....	71
6.2.13 Granular payload syntax.....	72
6.2.14 RasterMap payload syntax.....	75
6.2.15 Support elements.....	76
6.3 Data structure.....	82
6.3.1 General.....	82
6.3.2 Renderer payloads data structure.....	82
6.3.3 Generic codebook.....	134
6.4 Renderer framework.....	134
6.4.1 Control workflow.....	134
6.4.2 Rendering workflow.....	146
6.5 Geometry data decompression.....	159
6.5.1 General.....	159
6.5.2 Metadata extraction.....	159

6.5.3	Geometry	160
6.5.4	Materials	163
6.6	Renderer stages.....	164
6.6.1	Effect activator.....	164
6.6.2	Acoustic environment assignment.....	165
6.6.3	Granular synthesis.....	167
6.6.4	Reverberation	181
6.6.5	Portals	242
6.6.6	Early reflections.....	256
6.6.7	Airflow simulation	270
6.6.8	DiscoverSESS.....	277
6.6.9	Occlusion	279
6.6.10	Diffraction.....	284
6.6.11	Voxel-based occlusion and diffraction	301
6.6.12	Multi-Path voxel-based diffraction with RasterMaps	326
6.6.13	Voxel-based early reflections	332
6.6.14	Metadata culling	340
6.6.15	Heterogeneous extent	345
6.6.16	Directivity	374
6.6.17	Distance	380
6.6.18	Directional focus	390
6.6.19	Consolidation of render items	391
6.6.20	Equalizer (EQ)	398
6.6.21	Low-complexity early reflections (LC-ERs)	399
6.6.22	Fade.....	408
6.6.23	Single point higher order ambisonics (SP-HOA).....	411
6.6.24	Homogeneous extent	416
6.6.25	Panner	421
6.6.26	Multi-point higher order ambisonics (MP-HOA)	428
6.6.27	Low-complexity MP-HOA.....	468
6.7	Spatializer	475
6.7.1	Binaural spatializer.....	475
6.7.2	Adaptive loudspeaker rendering	494
6.8	Limiter.....	528
6.8.1	General.....	528
6.8.2	Data elements and variables.....	528
6.8.3	Description	528
6.9	Interface for audio utilization information	530
6.9.1	General.....	530
6.9.2	Syntax and semantics of an interface for renderer audio utilization	530
Annex A	(normative) Tables and additional algorithm details.....	531
A.1	Panner default output positions	531
A.2	Adaptive loudspeaker rendering calibration guide	531
A.3	RIR analysis: loudspeaker source directivity factor.....	535
A.4	Default acoustic environment presets.....	535
A.5	VR filter design initialization vector	541
A.6	Octave band neural network parameters	542
A.7	Third-octave band neural network parameters	545
A.8	Third-octave GEQ design filter bandwidths.....	574
A.9	Constants for feedback matrix calculation	574
A.10	Dispersion filter coefficient template.....	575
A.11	freqVec(b) - STFT band centre frequencies.....	580
A.12	Closest centre frequency bin for each one-third octave band frequency	581

A.13	EQbin	581
A.14	Fast convolution	582
A.14.1	Uniformly partitioned overlap-save convolution	582
A.14.2	Fast stereo convolution	583
A.15	Support element lookup tables	583
A.16	Airflow default frequency profiles	593
A.17	Reverberation extent mesh definitions	605
A.18	Headphone equalization preset responses	607
A.19	Listener voice default directivity pattern	607
A.20	Portal LoS data decoder tables	608
A.21	Reverberator output directions	609
A.22	Variable delay line anti-aliasing IIR lowpass filters	612
Annex B (informative) Encoder, interfaces and feature guidance		613
B.1	Encoder overview	613
B.2	Encoder modules	614
B.2.1	Scene configuration parameters	614
B.2.2	Audio plus metadata creation	614
B.2.3	Reverberation parametrization	614
B.2.4	Default acoustic environment (Default AE)	614
B.2.5	Low complexity early reflection parametrization	615
B.2.6	Portal creation in implicit portal mode	617
B.2.6.1	Creation of the geometry of the portal	617
B.2.6.2	Identification of the connection state between two portals	617
B.2.6.3	Creation of the portal struct containing all its metadata to be encoded	618
B.2.7	Line-of-sight data creation in explicit portal mode	619
B.2.8	Source/geometry staticity analysis	619
B.2.9	Diffraction edges and paths analysis	620
B.2.10	Early reflection surfaces and sequences analysis	620
B.2.11	Module data collection	620
B.2.12	Module data serialization	620
B.3	Listener space description format (LSI)	620
B.4	Encoder input format (EIF)	620
B.5	Accessibility user interface	620
B.6	Guidance on own voice usage – influence of system delay	621
Bibliography		624