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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

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Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/IEC DIS 23090-35

Information technology — Coded representation of immersive media —

Part 35: Conformance and reference software for Low latency, low complexity LiDAR coding

ICS: 35.040.40

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

A list of all parts in the ISO/IEC 23090 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes the reference software and the conformance testing for ISO/IEC 23090-30 low latency, low complexity LiDAR coding.

The reference software includes both encoder and decoder functionality.

The conformance testing specifies how tests can be designed to verify whether bitstreams and decoders meet the requirements as specified in ISO/IEC 23090-30.

Purpose

The purpose of this International Standard is to provide the following:

- Reference decoder software capable of decoding bitstreams that conform to ISO/IEC 23090-30 in a manner that conforms to the decoding process specified in ISO/IEC 23090-30.
- Reference encoder software capable of producing bitstreams that conform to ISO/IEC 23090-30.
- Description of procedures to test conformance of bitstreams and decoders to ISO/IEC 23090-30.
- A set of reference bitstreams conforming to ISO/IEC 23090-30.

Examples of use

Some examples of uses that may be appropriate for the reference decoder software are as follows:

- As an illustration of how to perform the decoding process specified in ISO/IEC 23090-30.
- As the starting basis for the implementation of a decoder that conforms to ISO/IEC 23090-30.
- For testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-30.
- For testing the conformance of a bitstream to the constraints specified for bitstream conformance in ISO/IEC 23090-30, as the software can detect and report many bitstream conformance violations.

NOTE However, the lack of the detection of any conformance violation by the reference decoder software should not be considered as definitive proof that the bitstream conforms to all constraints specified for bitstream conformance in ISO/IEC 23090-30.

Some examples of uses that may be appropriate for the reference encoder software are as follows:

- As an illustration of how to perform an encoding process that produces bitstreams that conform to the constraints specified for bitstream conformance in ISO/IEC 23090-30.
- As the starting basis for the implementation of an encoder that conforms to ISO/IEC 23090-30.
- As a means of generating bitstreams for testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-30.
- As a means of evaluating and demonstrating examples of the quality that can be achieved by an encoding process that conforms to ISO/IEC 23090-30.

NOTE However, no guarantee of the quality that will be achieved by an encoder is provided by its conformance to ISO/IEC 23090-30, as the conformance of an encoder to ISO/IEC 23090-30 is defined only in terms of format constraints imposed on the bitstream syntax. Thus, while the reference encoder software may suffice to provide some illustrative examples of what quality can be achieved in conformance to ISO/IEC 23090-30, it provides neither an assurance of minimum guaranteed encoding quality nor maximum achievable encoding quality.

Information technology — Coded representation of immersive media —

Part 35:

Conformance and reference software for Low latency, low complexity LiDAR coding

1 Scope

This International Standard provides accompanying reference software for ISO/IEC 23090-30. The software is an integral part of this International Standard.

The use of this reference software is not required to make an implementation of an encoder or decoder in conformance to ISO/IEC 23090-30. Requirements established in ISO/IEC 23090-30 take precedence over the behaviour of the reference software.

This International Standard also specifies a set of tests and procedures designed to indicate whether encoders or decoders meet the normative requirements specified in ISO/IEC 23090-30.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23090-30, *Information technology — Coded representation of immersive media — Part 30: Low latency, low complexity LiDAR coding*.

3 Terms and definitions

For the purposes of this International Standard, the terms, definitions, abbreviations and symbols specified in ISO/IEC 23090-30 (particularly in [clause 3](#)) apply. The following terms are further clarified for purposes herein as follows.

3.1

bitstream

ISO/IEC 23090-30 bitstream.

3.2

decoder

ISO/IEC 23090-30 decoder, i.e., embodiment of the decoding process specified by ISO/IEC 23090-30. Decoder does not include the point cloud rendering process, which is outside the scope of this International Standard.

3.3

encoder

Embodiment of a process, not specified in this International Standard (except in regard to identification of the reference software encoder), that produces a bitstream.

3.4

reference software decoder

Software decoder provided in [clause 6](#).

3.5

reference software encoder

Software encoder provided in [clause 6](#).

3.6

L3C2

Low latency, low complexity LiDAR coding.

4 Abbreviations and acronyms

For the purposes of this document, relevant abbreviations and acronyms are specified in clause 4 of ISO/IEC 23090-30.

5 Conventions

For the purposes of this document, relevant conventions are specified in clause 5 of ISO/IEC 23090-30.

6 Reference software for ISO/IEC 23090-30

Reference software is useful in aiding users of a compression standard to establish and test conformance and interoperability, and to educate users and demonstrate the capabilities of the standard. The reference software for ISO/IEC 23090-30 is available at: <https://standards.iso.org/iso-iec/23090/-35/ed-1/en/>.

The software package contains one part:

- mpeg-pcc-tml software: Support for Simple and Main profiles.

The reference software manual is mpeg-pcc-tml-sw-manual.pdf. This manual can be used to install and use the reference software.

7 Conformance testing for ISO/IEC 23090-30

7.1 General

The following clauses specify normative tests for verifying conformance of bitstreams as well as decoders. Those normative tests make use of test data (bitstream test suites) provided as an electronic annex to this International Standard and the reference software decoder specified in [clause 6](#).

7.2 Bitstream conformance

Bitstream conformance follows the specification text in ISO/IEC 23090-30.

7.3 Decoder conformance

Decoder conformance for ISO/IEC 23090-30, such as conformance point, etc., is specified by clause 6.5.1 of ISO/IEC 23090-30.

7.4 Procedure to test bitstreams

A bitstream that claims conformance with ISO/IEC 23090-30 shall pass the following normative test.

The bitstream shall be decoded by processing it with the reference software decoder. When processed by the reference software decoder, the bitstream shall not cause any error or non-conformance messages to be reported by the reference software decoder. This test should not be applied to bitstreams that are known to contain errors introduced by transmission, as such errors are highly likely to result in bitstreams that lack conformance to ISO/IEC 23090-30.

Successfully passing the reference software decoder test provides only a strong presumption that the bitstream under test does indeed meet all the requirements specified in ISO/IEC 23090-30 that are tested by the reference software decoder.

ISO/IEC 23090-30 contains several informative recommendations that are not an integral part of International Standard. When testing a bitstream for conformance, it may also be useful to test whether or not the bitstream follows those recommendations.

To check correctness of a bitstream, it is necessary to parse the entire bitstream and to extract all the syntax elements and other values derived from those syntactic elements and used by the decoding process specified in ISO/IEC 23090-30.

A verifier may not necessarily perform all stages of the decoding process specified in ISO/IEC 23090-30 in order to verify bitstream correctness. Many tests can be performed on syntax elements in a state prior to their use in some processing stages.

7.5 Procedure to test decoder conformance

7.5.1 Conformance bitstreams

A bitstream has values of `main_profile_compatibility_flag` and `level_idc` corresponding to a set of specified constraints on a bitstream for which a decoder conforming to a specified profile, and level is required in Annex A of ISO/IEC 23090-30 to properly perform the decoding process.

7.5.2 Contents of the bitstream file

The conformance bitstreams are included in this International Standard and are available at: <https://standards.iso.org/iso-iec/23090/-35/ed-1/en/>. The following information is included in a single zipped file for each such bitstream.

- *.bit – bitstream as described in [subclause 7.6.2](#)
- readme.md – description
- *.cfg – config file used to generate bitstream with TML encoder SW (not applicable if TML encoder release version not used)
- *.md5 – MD5sum of the bitstream file
- *_dec.ply – unordered decoded point cloud frames
- *_dec.ply.md5 – MD5 checksum for decoded point cloud frame

7.5.3 Requirements on output of the decoding process

The output of the decoding process is specified in clause 8 of ISO/IEC 23090-30.

The rendering process, which may follow the output of the decoding process, is outside the scope of this document.

7.5.4 Recommendations (informative)

In addition to the requirements, it is desirable that conforming decoders implement various informative recommendations specified in ISO/IEC 23090-30 that are not an integral part of that International Standard. This clause discusses some of these recommendations.

It is recommended that a conforming decoder be able to resume the decoding process as soon as possible after the loss or corruption of part of a bitstream.

7.6 Specification of the test bitstreams

7.6.1 General

The test bitstreams are part of the mechanism to verify decoder conformance according to the ISO/IEC 23090-30 specification. The bitstreams used for the decoder conformance testing specified in this document shall be those listed in [Table 1](#). They are available at: <https://standards.iso.org/iso-iec/23090/-35/ed-1/en/>.

Table 1 — List of reference bitstreams.

Categories	Feature Name	Features tested
Common functionality	EBS	Entropy bypass stream
	EC	Entropy continuation
	ST	Slice/Tile
	GPS	GPS (Geometry Parameter Set)
	APS	APS (Attribute Parameter Set)
	ACO	Axis coding order
Geometry coding	GS	Geometry scaling
	OGC	Onechain geometry coding
	PLCS	Preserve laser coding state
	DPOC	Duplicate points in onechain geometry coding
	UNEOC	Use NSensing estimation in onechain coding
	UCN	Use Coarse neighbours
	UVP	Use Vertical prediction
	LLA	Low latency attributes coding
	UPOC	Unordered points in onechain coding
	SCS	Sensing coverage signalling
Attribute coding	GATT	Generic attribute
	QuantATT	Quantization
	LodRAHT	LoD and RAHT
	SLOD	Single LoD
	NumLOD	Number of LoDs
	DecLOD	LoD method: Decimation
	DisLOD	LoD method: Distance
	CentLOD	LoD method: Block-based
	SL	Scalable Lifting
	PSInterLOD	Predictor search: inter LoD
	PSIntraLOD	Predictor search: intra LoD
	NumPRED	Number of predictors
	DirectPRED	Direct predictors (Pred)
	NB	Neighbour bias
	LCP	Last component pred
	ICP	Predicting Transform: Inter component pred
	RahtPRED	RAHT prediction
	SDC	Spherical domain coding
	ANBF	Attribute neighbour blending filtering

7.6.2 Test bitstreams

7.6.2.1 Entropy bypass stream (EBS)

7.6.2.1.1 Test bitstream EBS_A_Xiaomi

Specification: The bitstream exercises the entropy bypass stream Off functionality.

- `bypass_stream_enabled` flag equal to 0.
- `lowLatencyAttributesCoding` equal to 1 (low latency attribute).
- `attr_coding_type` is equal to 4 (onechain).

Functional stage: Entropy bypass stream disabled and low latency attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream disabled.

7.6.2.1.2 Test bitstream EBS_B_Xiaomi

Specification: The bitstream exercises the entropy bypass stream On functionality.

- `bypass_stream_enabled` flag equal to 1
- `lowLatencyAttributesCoding` equal to 1 (low latency attribute)
- `attr_coding_type` is equal to 4 (onechain)

Functional stage: Entropy bypass stream enabled and low latency attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream enabled.

7.6.2.1.3 Test bitstream EBS_C_Xiaomi

Specification: The bitstream exercises the entropy bypass stream On functionality.

- `bypass_stream_enabled` flag equal to 1
- `lowLatencyAttributesCoding` equal to 0
- `attr_coding_type` is equal to 0 (RAHT)

Functional stage: Entropy bypass stream enabled and RAHT attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream enabled.

7.6.2.1.4 Test bitstream EBS_D_Xiaomi

Specification: The bitstream exercises the entropy bypass stream On functionality.

- `bypass_stream_enabled` flag equal to 1
- `lowLatencyAttributesCoding` equal to 0
- `attr_coding_type` is equal to 1 (Predicting)

Functional stage: Entropy bypass stream enabled and Predicting attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream enabled.

7.6.2.1.5 Test bitstream EBS_E_Xiaomi

Specification: The bitstream exercises the entropy bypass stream On functionality.

- bypass_stream_enabled flag equal to 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type is equal to 2 (Lifting)

Functional stage: Entropy bypass stream enabled and Lifting attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream enabled.

7.6.2.1.6 Test bitstream EBS_F_Xiaomi

Specification: The bitstream exercises the entropy bypass stream On functionality.

- bypass_stream_enabled flag equal to 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type is equal to 3 (raw)

Functional stage: Entropy bypass stream enabled and raw attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream enabled.

7.6.2.1.7 Test bitstream EBS_G_Xiaomi

Specification: The bitstream exercises the entropy bypass stream Off functionality.

- bypass_stream_enabled flag equal to 0
- lowLatencyAttributesCoding equal to 0
- attr_coding_type is equal to 0 (RAHT)

Functional stage: Entropy bypass stream disabled and RAHT attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream disabled.

7.6.2.1.8 Test bitstream EBS_H_Xiaomi

Specification: The bitstream exercises the entropy bypass stream Off functionality.

- bypass_stream_enabled flag equal to 0
- lowLatencyAttributesCoding equal to 0
- attr_coding_type is equal to 1 (Predicting)

Functional stage: Entropy bypass stream disabled and Predicting attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream disabled.

7.6.2.1.9 Test bitstream EBS_I_Xiaomi

Specification: The bitstream exercises the entropy bypass stream Off functionality.

- bypass_stream_enabled flag equal to 0
- lowLatencyAttributesCoding equal to 0

- attr_coding_type is equal to 2 (Lifting)

Functional stage: Entropy bypass stream disabled and Lifting attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream disabled.

7.6.2.1.10 Test bitstream EBS_J_Xiaomi

Specification: The bitstream exercises the entropy bypass stream Off functionality.

- bypass_stream_enabled flag equal to 0
- lowLatencyAttributesCoding equal to 0
- attr_coding_type is equal to 3 (raw)

Functional stage: Entropy bypass stream disabled and raw attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy stream disabled.

7.6.2.2 Entropy continuation (EC)

7.6.2.2.1 Test bitstream EC_A_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled.

- gbh_entropy_continuation_flag: 1
- lowLatencyAttributesCoding equal to 1 (low latency attribute)
- attr_coding_type: 4 (onechain)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and low latency attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled.

7.6.2.2.2 Test bitstream EC_B_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled.

- gbh_entropy_continuation_flag: 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type: 1 (predicting)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and predicting attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled.

7.6.2.2.3 Test bitstream EC_C_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled.

- gbh_entropy_continuation_flag: 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type: 0 (RAHT)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and RAHT attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled.

7.6.2.2.4 Test bitstream EC_D_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled.

- gbh_entropy_continuation_flag: 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type: 2 (lifting)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and lifting attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled.

7.6.2.2.5 Test bitstream EC_E_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled.

- gbh_entropy_continuation_flag: 1
- lowLatencyAttributesCoding equal to 0
- attr_coding_type: 3 (raw)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and raw attribute coding on Simple and Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled.

7.6.2.2.6 Test bitstream EC_F_Xiaomi

Specification: The bitstream exercises the entropy continuation functionality enabled/disabled on different slices.

- gbh_entropy_continuation_flag: 0, 1, 0, 1
- lowLatencyAttributesCoding equal to 1 (low latency attribute)
- attr_coding_type: 4 (onechain)
- sliceMaxPoints: 25000
- sliceMinPoints: 5000

Functional stage: Entropy continuation on Onechain Geometry Coding and low latency attribute coding on Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which entropy continuation function is enabled/disabled on different slices.

7.6.2.3 Slice/Tile (ST)**7.6.2.3.1 Test bitstream ST_A_Xiaomi**

Specification: The bitstream consists of zero tile and one slice.

- tileSize: 0
- partitionMethod: 0

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Simple profile.

7.6.2.3.2 Test bitstream ST_B_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize: 0
- partitionMethod: 0

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Main profile.

7.6.2.3.3 Test bitstream ST_C_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize: 0
- partitionMethod: 4

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Simple profile.

7.6.2.3.4 Test bitstream ST_D_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize:0
- partitionMethod: 4

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Main profile.

7.6.2.3.5 Test bitstream ST_E_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize:400000
- partitionMethod: 0

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Simple profile.

7.6.2.3.6 Test bitstream ST_F_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize:400000
- partitionMethod: 0

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Main profile.

7.6.2.3.7 Test bitstream ST_G_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize:400000
- partitionMethod: 4

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Simple profile.

7.6.2.3.8 Test bitstream ST_H_Xiaomi

Specification: The bitstream consists of zero tile and one slice.

- tileSize:400000
- partitionMethod: 4

Functional stage: Main profile.

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which zero tile and one slice are present in Main profile.

7.6.2.3.9 Test bitstream ST_I_Xiaomi

Specification: The bitstream consists of three tiles and three slices.

- tileSize:200000
- partitionMethod: 4

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which three tiles and three slices are present in Simple profile.

7.6.2.3.10 Test bitstream ST_J_Xiaomi

Specification: The bitstream consists of three tiles and three slices.

- tileSize:200000
- partitionMethod: 4

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which three tiles and three slices are present in Main profile.

7.6.2.4 GPS (GPS)

7.6.2.4.1 Test bitstream GPS_A_Xiaomi

Specification: The bitstream includes one geometry parameter sets (GPS), which is sharing among 3 frames.

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which one GPS is sharing among multiple frames.

7.6.2.4.2 Test bitstream GPS_B_Xiaomi

Specification: The bitstream includes one GPS, which is repeating for each frame.

Functional stage: Common functionality in Main profile.

Purpose: Check that the decoder can properly decode bitstreams in which one GPS repeats for each frame.

7.6.2.4.3 Test bitstream GPS_C_Xiaomi

Specification: The bitstream includes one GPS, which is repeating for each frame.

Functional stage: Common functionality in Simple profile.

Purpose: Check that the decoder can properly decode bitstreams in which one GPS repeats for each frame.

7.6.2.5 APS (APS)

7.6.2.5.1 Test bitstream APS_A_Xiaomi

Specification: The bitstream includes one APS, which is sharing among 3 frames.