International Standard

ISO/IEC 23090-30

First edition
2026-07

Information technology — Coded representation of immersive media —

Part 30: Low latency, low complexity light detection and ranging (LiDAR) coding

Reference number
ISO/IEC 23090-30:2026(en)

© ISO/IEC 2026



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Foreword ... viii

Introduction ... ix

1 Scope ... 1

2 Normative references ... 1

3 Terms and definitions ... 1
3.1 General terms ... 1
3.2 High-level syntax and entropy coding terms ... 4
3.3 Tree structure terms ... 7
3.4 Geometry coding terms ... 7
3.5 Attribute coding terms ... 7

4 Abbreviated terms and symbols ... 8
4.1 Abbreviated terms ... 8
4.2 Symbols ... 8
4.3 Mnemonics ... 9

5 Conventions ... 9
5.1 General ... 9
5.2 Numerical representation ... 9
5.3 Arithmetic operators ... 9
5.4 Logical operators ... 10
5.5 Relational operators ... 10
5.6 Bit-wise operators ... 10
5.7 Assignment operators ... 11
5.8 Range notation ... 11
5.9 Mathematical functions ... 11
5.9.1 General ... 11
5.9.2 IntCos and IntSin ... 12
5.9.3 IntSqrt ... 12
5.9.4 IntRecipSqrt ... 13
5.9.5 Div ... 14
5.9.6 Morton ... 14
5.9.7 FromMorton ... 14
5.10 Order of operation precedence ... 15
5.11 Named expressions ... 15
5.11.1 General ... 15
5.11.2 Scope ... 16
5.11.3 Arguments of named expressions ... 17
5.11.4 Sub-expressions ... 17
5.11.5 Definitions with multiple statements ... 17
5.11.6 Textual definitions ... 17
5.12 Variables, syntax elements and tables ... 17

6 Point cloud format and relationship to coded and output representations ... 18
6.1 General format ... 18
6.2 Attributes ... 18
6.2.1 General ... 18

© ISO/IEC 2026 – All rights reserved

6.2.2 Colour 18
6.2.3 Opacity 19
6.2.4 Reflectance 19
6.2.5 Normal vector 19
6.2.6 Material identifier 19
6.2.7 Frame number/index 19
6.2.8 User defined attributes 20
6.3 Codec-derived attributes 20
6.3.1 General 20
6.3.2 Slice identifier 20
6.3.3 Slice tag 20
6.3.4 Canonical point order 20
6.3.5 Point Morton order 21
6.4 Coded point cloud format 21
6.4.1 Sequence coordinate system 21
6.4.2 Coding coordinate system 22
6.4.3 Coded point cloud sequence 22
6.4.4 Coded point cloud frame 23
6.4.5 Slice of a coded point cloud frame 23
6.4.6 Repetition of slices 24
6.4.7 Relationship between tiles and slices 24
6.4.8 Parameter sets 25
6.5 Output point cloud format 25
6.5.1 General 25
6.5.2 Coordinate system 25
6.5.3 Fixed-point conformance output 25
6.5.4 Attributes 26
6.5.5 Output point cloud sequence 26
6.5.6 Output point cloud frame 26

7 Syntax and semantics 26
7.1 Method of specifying syntax in tabular form 26
7.2 Specification of syntax functions and descriptors 27
7.3 Syntax in tabular form 28
7.3.1 General 28
7.3.2 Parameter sets, ancillary data and byte alignment 28
7.3.3 Geometry data unit 35
7.3.4 Attribute data unit 38
7.3.5 Defaulted attribute data unit syntax 40
7.4 Semantics 41
7.4.1 General 41
7.4.2 Parameter sets, ancillary data and byte alignment 41
7.4.3 Geometry data unit 53
7.4.4 Attribute data unit 55
7.4.5 Defaulted attribute data unit semantics 55

8 Decoding process 56
8.1 General decoding process 56
8.2 Frame decoding processes 56
8.2.1 General 56
8.2.2 Frame counter 56
8.3 Slice decoding processes 56

© ISO/IEC 2026 – All rights reserved

8.3.1 General 56
8.3.2 State variables 56
8.3.3 Geometry decoding process 57
8.3.4 Default attribute values 57
8.3.5 Attribute decoding process 57
8.3.6 At the end of a slice 57

9 Slice geometry 57
9.1 General 57
9.2 Sensed point sequence 58
9.2.1 General 58
9.2.2 State variables and expressions 58
9.2.3 Syntax element semantics 59
9.2.4 Contextualization of decoding elevation_offset 62
9.2.5 Reconstruction of sensed point positions 65
9.2.6 Reconstructed output point positions 74
9.2.7 Reconstructed output low latency attributes values 74
9.2.8 Reconstructed point positions for attributes decoding 74

10 Slice attributes 74
10.1 General 74
10.2 Point coordinates 74
10.2.1 General 74
10.2.2 Conversion to scaled angular coordinates 75
10.3 Syntax element semantics 75
10.4 Raw attribute decoding 76
10.5 Attribute decoding using the region-adaptive hierarchical transform 76
10.5.1 General 76
10.5.2 Transform tree 76
10.5.3 Coefficient order 79
10.5.4 Coefficient scaling 80
10.5.5 Transform domain prediction 82
10.5.6 Inverse transform 86
10.5.7 Reconstructed attribute values 88
10.6 Attribute decoding using levels of detail 88
10.6.1 General 88
10.6.2 Syntax element semantics 89
10.6.3 Reconstruction process 89
10.6.4 State variables 89
10.6.5 Levels of detail 90
10.6.6 Predictor search 96
10.6.7 Reconstruction of attribute values 102
10.6.8 Prediction mode coding 103
10.6.9 Scaling 105
10.6.10 Coefficient prediction 105
10.6.11 Transform coefficient weights 106
10.6.12 Transform 107
10.7 Attribute quantization parameters 108
10.7.1 Syntax element semantics 108
10.7.2 Per-point regional QP offset 109
10.7.3 Attribute coefficient QP 109
10.7.4 Definition of *AttrQstep* 109

© ISO/IEC 2026 – All rights reserved

11 Parsing process **110**
11.1 General **110**
11.2 Data unit buffer **111**
11.2.1 General **111**
11.2.2 State **111**
11.2.3 Initialization at the start of parsing a data unit **112**
11.2.4 Initialization at the start of parsing a geometry data unit footer **112**
11.2.5 Definition of *DuNextBit* **112**
11.3 Chunked bytestream parsing **112**
11.3.1 General **112**
11.3.2 Chunk syntax **113**
11.3.3 Chunk semantics **113**
11.3.4 State **113**
11.3.5 Span of chunked bytestream data within a data unit **113**
11.3.6 The chunk buffer **114**
11.3.7 State update at the start of every CBS **114**
11.3.8 Unpacking a single chunk **114**
11.3.9 Definition of *ChunkNextAeBit* **114**
11.3.10 Definition of *ChunkNextBpBit* **115**
11.3.11 Boundary between spliced chunked bytestreams **115**
11.3.12 Location of chunked bytestream boundaries **116**
11.4 General inverse binarization processes **116**
11.4.1 Parsing unsigned fixed-length codes (FL) **116**
11.4.2 Parsing signed fixed-length codes (FL+S) **116**
11.4.3 Parsing *k*-th order exp-Golomb codes (EGk) **117**
11.4.4 Parsing concatenated truncated unary and *k*-th order exp-Golomb codes (TU+EGk) **117**
11.4.5 Parsing concatenated bounded truncated unary and *k*-th order exp-Golomb codes (BTU+EGk) **117**
11.4.6 Parsing signed concatenated truncated unary and *k*-th order exp-Golomb codes (TU+EGk+S) **118**
11.4.7 Parsing signed concatenated bounded truncated unary and *k*-th order exp-Golomb codes (BTU+EGk+S) **118**
11.4.8 Parsing signed concatenated asymmetrically bounded truncated unary and *k*-th order exp-Golomb codes (ABTU+EGk+S) **119**
11.4.9 Parsing truncated unary codes (TU) **120**
11.4.10 Mapping process for signed codes **120**
11.4.11 Parsing ASN.1 object identifiers **120**
11.5 CABAC parsing processes **121**
11.5.1 Initialization **121**
11.5.2 Definition of *AeReadBin* **121**
11.5.3 Contextual probability models **121**
11.5.4 Arithmetic decoding engine **125**
11.6 Sensor Coding State **127**
11.6.1 State variable **127**
11.6.2 Initialization at the start of a GDU **129**
11.6.3 Initialization with decoded coarse position of first sensed point **130**
11.6.4 Update with azimuth_offset **131**
11.6.5 Update while decoding elevation_offset **132**
11.6.6 Update with sensed point coarse position **132**
11.7 Parsing state memorization and restoration **133**

© ISO/IEC 2026 – All rights reserved

11.7.1 General ... **133**
11.7.2 Geometry data units ... **133**
11.7.3 Attribute data units ... **134**
11.7.4 Defaulted attribute data units ... **134**

12 OBUF parsing process ... **134**
12.1 General ... **134**
12.2 Creation of an OBUF instance ... **134**
12.2.1 Creation and initialization of OBUF trees ... **135**
12.2.2 Creation and initialization of an array of OBUF ACPMs ... **136**
12.3 Call and update of an OBUF instance ... **136**
12.3.1 Decode and update according to OBUF trees ... **136**
12.4 Decode of a bin based on an OBUF ACPM ... **137**

Annex A (normative) Profiles and levels ... **139**

Annex B (normative) Type-length-value encapsulated bytestream format ... **144**

Annex C (informative) Arithmetic encoding engine ... **146**

Annex D (informative) Index of named expressions and variables ... **149**

© ISO/IEC 2026 – All rights reserved

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and https://patents.iec.ch. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

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 and IEC websites.

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 and www.iec.ch/national-committees.

© ISO/IEC 2026 – All rights reserved

Introduction

Advancements in 3D capturing and rendering technologies are enabling new applications and services in the fields of assisted and autonomous driving, cartography, and other industrial processes. Point clouds captured with LiDAR (Light Detection And Ranging) sensors, sometimes coupled with traditional camera sensors, have arisen as one of the main representations for such applications. A point cloud frame consists of a set of 3D points. Every point, in addition to having a 3D position, may also be associated with numerous other attributes such as intensity, colour, timestamp, and classification. Such representations require a large amount of data, which can be costly in terms of storage and transmission and are often used in real-time application which requires fast processing of the point cloud data. This document provides the method for efficiently compressing point cloud representations while ensuring low complexity and low latency constraints can be met.

© ISO/IEC 2026 – All rights reserved

Information technology — Coded representation of immersive media —

Part 30: Low latency, low complexity light detection and ranging (LiDAR) coding

1 Scope

This document specifies low latency, low complexity light detection and ranging (LiDAR) coding.

2 Normative references

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 8825-1 | Rec. ITU-T X.690, *Information technology — ASN.1 encoding rules — Part 1: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 9834-1 | Rec. ITU-T X.660, *Information technology — Procedures for the operation of object identifier registration authorities — Part 1: General procedures and top arcs of the international object identifier tree*

ISO/IEC 9834-8 | Rec. ITU-T X.667, *Information technology — Procedures for the operation of object identifier registration authorities — Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

ISO/IEC 23091-2, *Information technology — Coding-independent code points — Part 2: Video*

Recommendation ITU-T T.35, *Procedure for the allocation of ITU-T defined codes for non-standard facilities*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General terms

3.1.1
point
fundamental element of a *point cloud* (3.1.2) comprising a position specified as *Cartesian coordinates* (3.1.8) and zero or more *attributes* (3.1.19)

© ISO/IEC 2026 – All rights reserved