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**Information technology — Coded  
representation of immersive media —  
Part 10:  
Carriage of visual volumetric video-  
based coding data**

*Technologies de l'information — Représentation codée de média  
immersifs —*

*Partie 10: Transport de données de codage basé sur la vidéo  
volumétrique*

ISO/IEC 23090-10:2022

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Published in Switzerland

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## 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](http://www.iso.org/directives) or [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs)).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, 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](http://www.iso.org/members.html) and [www.iec.ch/national-committees](http://www.iec.ch/national-committees).

## Introduction

This document addresses the storage of visual volumetric video-based coding data in files based on ISO/IEC 14496-12, reusing existing tools for storage of video-coded components. Another important aspect considered by this document is supporting flexible extraction of component streams at delivery or decoding time, or both.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

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# Information technology — Coded representation of immersive media —

## Part 10: Carriage of visual volumetric video-based coding data

### 1 Scope

This document specifies carriage of coded media representations which comply with visual volumetric video-based coding and video-based point cloud compression (specified in ISO/IEC 23090-5).

### 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.

IEEE 754-2019, *IEEE Standard for Floating-Point Arithmetic*

IETF RFC 6381, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types*

ISO/IEC 14496-12, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 14496-15, *Information technology — Coding of audio-visual objects — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO based media file format*

ISO/IEC 23008-1:2017, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 1: MPEG media transport (MMT)*

ISO/IEC 23009-1:2019, *Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats*

ISO/IEC 23090-5:2021, *Information technology — Coded representation of immersive media — Part 5: Visual Volumetric Video-based Coding (V3C) and Video-based Point Cloud Compression (V-PCC)*

W3C Recommendation, *XML schema part 1: Structures*

W3C Recommendation, *XML schema part 2: Datatypes*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 23090-5 and the following 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

##### **atlas parameter sets**

non-ACL NAL units that have `nal_unit_type` equal to `NAL_ASPTS`, `NAL_AAPTS`, or `NAL_AFPST`.

**3.2**  
**V3C content**

volumetric media that is encoded

Note 1 to entry: For the purposes of this document, the media shall be encoded using ISO/IEC 23090-5.

**3.3**  
**volumetric visual track**

track with a handler type reserved to describe volumetric visual track

**3.4**  
**V3C track**

V3C bitstream track, V3C atlas track or V3C atlas tile track

**3.5**  
**V3C bitstream track**

volumetric visual track containing V3C bitstream in case of single-track container

**3.6**  
**V3C atlas track**

volumetric visual track containing V3C atlas bitstream in case of multi-track container

**3.7**  
**V3C atlas tile track**

volumetric visual track containing portion of V3C atlas bitstream corresponding to one or more tiles in case of multi-track container

**3.8**  
**V3C video component track**

video track which carries 2D video encoded data for any of the occupancy, geometry, or attribute component video bitstreams of the V3C bitstream

**4 Abbreviated terms**

2D	two-dimensional
3D	three-dimensional
CVS	coded V3C sequence
DASH	dynamic adaptive streaming over HTTP
HTTP	Hyper-text transfer protocol
IRAP	intra random access point
ISOBMFF	ISO base media file format
LoD	level of detail
PCC	point cloud compression
SEI	supplemental enhancement information
V3C	visual volumetric video-based coding
VPS	V3C parameter set
V-PCC	video-based Point Cloud Coding

## 5 Overview

### 5.1 General

Visual volumetric video-based coding (V3C) provides mechanism for coding visual volumetric frames. Visual volumetric frames are coded by converting the 3D volumetric information into a collection of 2D images and associated data. The converted 2D images are coded using widely available video and image coding specifications and the associated data, i.e., atlas data, is coded according to ISO/IEC 23090-5. The coded images and the coded atlas data are multiplexed and form a V3C bitstream.

A V3C bitstream consists of one or more CVSs. A CVS starts with a VPS, included in at least one V3C unit or provided through external means, and contains one or more V3C units carrying V3C sub-bitstreams, with each V3C sub-bitstream associated with a V3C component, e.g., atlas, occupancy, geometry, or attribute.

### 5.2 Overall architecture for carriage of V3C data

Figure 1 shows a typical content flow process for V3C media.

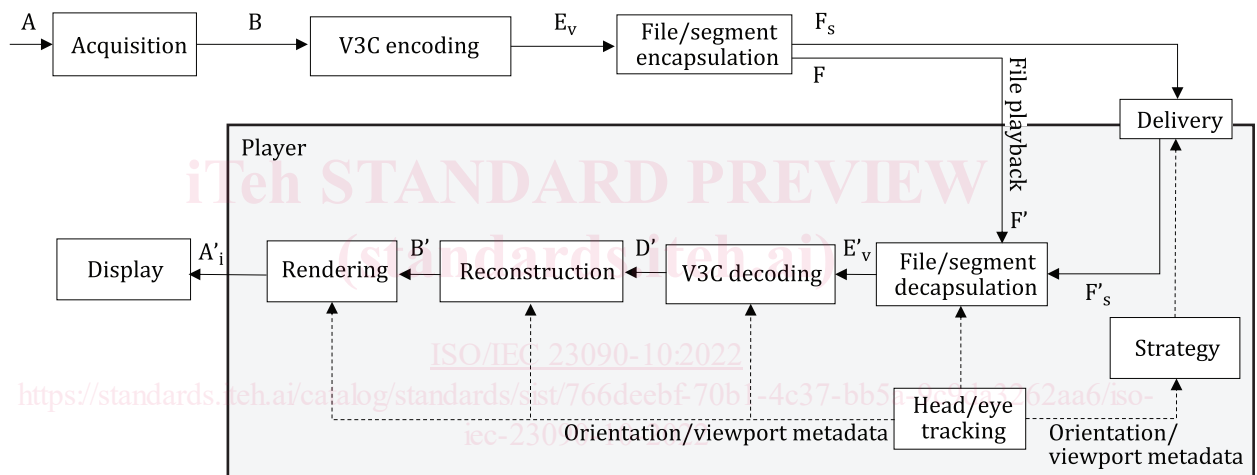


Figure 1 — Content flow process for V3C media

A real-world or synthetic visual scene (A) is captured by a set of cameras, a camera device with multiple lenses and sensors, or by virtual cameras. The acquisition results in source volumetric data (B). One or multiple volumetric frames are encoded as a coded V3C bitstream including an atlas bitstream, at most one occupancy bitstream, a geometry bitstream, and zero or more attribute bitstreams ( $E_v$ ). One or more coded bitstreams are then packaged into a media file for local playback (F) or a sequence of an initialization segment and media segments for streaming ( $F_s$ ), according to a particular media container file format. In this document, the media container file format is the ISO Base Media File Format specified in ISO/IEC 14496-12. The file encapsulator may also include metadata into the file or the segments. The segments  $F_s$  are delivered using a delivery mechanism to a player.

The file that the file encapsulator outputs (F) is identical to the file that the file decapsulator takes as input ( $F'$ ). A file decapsulator processes the file ( $F'$ ) or the received segments ( $F'_s$ ) and extracts the coded bitstreams ( $E'_v$ ) and parses the metadata. The V3C bitstream is then decoded into a decoded signal ( $D'$ ). The decoded volumetric data ( $D'$ ) are reconstructed, rendered, and displayed onto the screen of a head-mounted display or any other display device based on the current viewing orientation or viewport. The current viewing orientation is determined by the head tracking and possibly also eye tracking functionality. In viewport-dependent delivery, the current viewing orientation is also passed to the strategy module, which determines the tracks to be received based on the viewing orientation.

The process described above is applicable to both live and on-demand use cases.

The following interfaces are normatively specified in this document:

- F/F': media file including the specification of the track formats, which may contain constraints on the elementary streams contained within the samples of the tracks; see [Clause 7](#) for timed V3C content and [Clause 8](#) for non-timed V3C data.
- [Clause 11](#) specifies the delivery related interfaces for DASH delivery.
- [Clause 12](#) specifies the delivery related interfaces for MMT delivery.

### 5.3 Summary of referenceable code points

#### 5.3.1 Brands

ISO/IEC 14496-12 defines the concept of brands, which may be indicated in the FileTypeBox. Brands are used in this document to indicate conformance to an encapsulation mode and a specific set of tools, as well as requirements on other specifications (e.g., ISO/IEC 14496-12).

The brands specified in this document are listed in [Table 1](#) and defined in [Annex A](#).

**Table 1 — Brands specified in this document**

Brand	Clause	Informative description
v3st	<a href="#">A.2</a>	Single track encapsulation mode
v3mt	<a href="#">A.3</a>	Multi-track encapsulation mode
v3mp	<a href="#">A.3</a>	Multi-track encapsulation mode with partial access support
v3nt	<a href="#">A.4</a>	Non-timed V3C data

#### 5.3.2 Uniform resource names

The URNs specified in this document are listed in [Table 2](#).

**Table 2 — URNs specified in this document**

URN	Clause	Informative description
urn:mpeg:mpegI:v3c:2020	<a href="#">11.3.1</a>	Namespace for the XML elements and attributes specified in this document
urn:mpeg:mpegI:v3c:2020:component	<a href="#">11.3.2</a>	Scheme identifier for the V3C component DASH MPD descriptor
urn:mpeg:mpegI:v3c:2020:v3c	<a href="#">11.3.3</a>	Scheme identifier for the V3C content DASH MPD descriptor
urn:mpeg:mpegI:v3c:2020:v3sr	<a href="#">11.6.1</a>	Scheme identifier for the V3C static spatial region DASH MPD descriptor

#### 5.3.3 Restricted scheme types

The restricted scheme types specified in this document are listed in [Table 3](#).

**Table 3 — Restricted scheme types specified in this document**

Restricted scheme type	Clause	Informative description
v3vc	<a href="#">7.4.5.1</a>	V3C component video

#### 5.3.4 Sample entry types

The sample entry types specified in this document are listed in [Table 4](#).

Table 4 — Sample entry types specified in this document

Sample entry type	Clause	Informative description
v3e1	<a href="#">7.3.2.2</a>	For use with the single-track mode with all atlas parameter sets and SEI messages carried in decoder configuration record
v3eg	<a href="#">7.3.2.2</a>	For use with the single-track mode with atlas parameter sets and SEI messages carried in decoder configuration record and in track samples
v3c1	<a href="#">7.4.2</a>	For use with the multi-track mode with a single atlas and all atlas parameter sets and SEI messages carried in decoder configuration record
v3cg	<a href="#">7.4.2</a>	For use with the multi-track mode with a single atlas and atlas parameter sets and SEI messages carried in decoder configuration record and in track samples
v3cb	<a href="#">7.4.2</a>	For use with a base track in the multi-track mode with multiple atlases
v3a1	<a href="#">7.4.2</a>	For use with an atlas track in the multi-track mode with multiple atlases and all atlas parameter sets and SEI messages carried in decoder configuration record
v3ag	<a href="#">7.4.2</a>	For use with an atlas track in multi-track mode with multiple atlases and atlas parameter sets and SEI messages carried in decoder configuration record and in track samples
v3t1	<a href="#">7.4.3</a>	For use with an atlas tile track in the multi-track mode
dyvm	<a href="#">9.7.1</a>	For use with a timed metadata track indicating the dynamic spatial regions that are dynamically changing over time
6vpt	<a href="#">10.3.2</a>	For use with a timed metadata track indicating viewport information that are dynamically changing over time

### 5.3.5 Box types

The box types specified in this document are listed in bold in [Table 5](#). Mandatory boxes are marked with an asterisk. Box types without a four-character code are marked with '-' in the structure.

Table 5 — Box types specified in this document

Box types, structure, and cross-reference (Informative)													
moov										*	ISOBMFF	<i>container for all the metadata</i>	
	trak									*	ISOBMFF	<i>container for an individual track or stream</i>	
		trgr									ISOBMFF	<i>track grouping indication</i>	
			<b>potg</b>								<a href="#">7.4.8.2</a>	<i>payout track group box</i>	
			<b>vtcg</b>								<a href="#">9.4</a>	<i>atlas tile components track group box</i>	
		mdia								*	ISOBMFF	<i>container for the media information in a track</i>	
			minf							*	ISOBMFF	<i>media information container</i>	
				stbl						*	ISOBMFF	<i>sample table box, container for the time/space map</i>	
					stsd					*	ISOBMFF	<i>sample descriptions (codec types, initialization etc.)</i>	
						-					ISOBMFF	<i>sample entry or restricted sample entry</i>	
							rinf				ISOBMFF	<i>restricted scheme info box</i>	
								frma			ISOBMFF	<i>original format box</i>	
									schm		ISOBMFF	<i>scheme type box</i>	
											ISOBMFF	<i>scheme information box</i>	
											<b>vunt</b>	<a href="#">7.2.3</a>	<i>V3C unit header box</i>
											<b>mmvi</b>	<a href="#">7.4.5.2</a>	<i>Multimap video box</i>
									<b>dyvm</b>			<a href="#">9.7.2</a>	<i>dynamic volumetric metadata sample entry</i>
											<b>6vpt</b>	<a href="#">10.3.2</a>	<i>viewport information sample entry</i>
											<b>6vpC</b>	<a href="#">10.3.2</a>	<i>viewport information configuration box</i>
											-	ISOBMFF	<i>visual sample entry</i>

**Table 5 (continued)**

Box types, structure, and cross-reference (Informative)											
						-				<a href="#">6.4</a>	<i>volumetric visual sample entry</i>
							v3cC			<a href="#">7.2.2</a>	<i>V3C decoder configuration box</i>
							vunt			<a href="#">7.2.3</a>	<i>V3C unit header box</i>
							v3tC			<a href="#">7.4.3</a>	<i>V3C atlas tile configuration box</i>
							vpbb			<a href="#">9.5</a>	
							v3sc			<a href="#">9.6</a>	<i>Static spatial region collection box</i>
meta										ISOBMFF	<i>Metadata</i>
	grpl									ISOBMFF	<i>group list box</i>
		epl								<a href="#">8.5.5.2</a>	<i>playout entity group box</i>
		swpc								<a href="#">7.2.5</a>	<i>object switch alternatives box</i>
	iprp									ISOBMFF	<i>item properties box</i>
		ipco								ISOBMFF	<i>item property container box</i>
			v3cp							<a href="#">8.5.2</a>	<i>V3C configuration item property</i>
			vutp							<a href="#">8.5.3</a>	<i>V3C unit header item property</i>
			v3tp							<a href="#">8.5.4</a>	<i>V3C atlas tile configuration item property</i>

### 5.3.6 Track reference types

The track reference types specified in this document are listed in [Table 6](#).

**Table 6 — Track reference types specified in this document**

Track reference type	Clause	Informative description
v3cs	<a href="#">7.4.6.1</a>	Referenced track is a V3C atlas track
v3ct	<a href="#">7.4.6.2</a>	Referenced track is a V3C atlas tile track
v3vo	<a href="#">7.4.6.3</a>	Referenced track is a V3C video component track carrying occupancy data
v3vg	<a href="#">7.4.6.3</a>	Referenced track is a V3C video component track carrying geometry data
v3va	<a href="#">7.4.6.3</a>	Referenced track is a V3C video component track carrying attribute data

### 5.3.7 Track grouping types

The track grouping types specified in this document are listed in [Table 7](#).

**Table 7 — Track grouping types specified in this document**

Track grouping type	Clause	Informative description
potg	<a href="#">7.4.8.2</a>	Playout track grouping
vtcg	<a href="#">9.4</a>	V3C tile components track grouping

### 5.3.8 Entity grouping types

The entity grouping types specified in this document are listed in [Table 8](#).

**Table 8 — Entity grouping type specified in this document**

Entity grouping type	Clause	Informative description
epl	<a href="#">8.5.5.2</a>	Playout entity grouping
swpc	<a href="#">7.2.5</a>	Object switch alternatives box

### 5.3.9 Sample grouping types

The sample grouping types specified in this document are listed in [Table 9](#).

**Table 9 — Sample grouping types specified in this document**

Sample grouping type	Clause	Informative description
vaps	<a href="#">7.2.4</a>	V3C atlas parameter set sample grouping

## 6 Volumetric media

### 6.1 General

This clause contains descriptions and definitions, which are intended to be defined in ISO/IEC 14496-12.

### 6.2 Volumetric visual media

A volumetric visual track shall be identified by the volumetric visual media handler type 'volv' in the `HandlerBox` of the `MediaBox`, as defined in ISO/IEC 14496-12, and by a volumetric visual media header as defined in this document.

Multiple volumetric visual tracks may be present in the file.

### 6.3 Volumetric visual media header

#### 6.3.1 Definition

Box Type: 'vvhd'

Container: `MediaInformationBox`

Mandatory: Yes

Quantity: Exactly one

Volumetric visual tracks shall use a `VolumetricVisualMediaHeaderBox` in the `MediaInformationBox` as defined in ISO/IEC 14496-12.

#### 6.3.2 Syntax

```
aligned(8) class VolumetricVisualMediaHeaderBox
    extends FullBox('vvhd', version = 0, 0) {
}
```

#### 6.3.3 Semantics

`version` is an integer that specifies the version of this box

### 6.4 Volumetric visual sample entry

#### 6.4.1 Definition

Volumetric visual tracks shall use a `VolumetricVisualSampleEntry`

#### 6.4.2 Syntax

```
class VolumetricVisualSampleEntry(unsigned int(32) codingname)
    extends SampleEntry(codingname) {
```