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**Abstract**

This document contains Committee Draft 2 for the ISO/IEC 23090-32 Carriage of Haptics Data. It is based on text and decisions made at MPEG-143 (July 2023, Geneva) regarding the following input contributions:

* m63725, Summary of Voting on ISO/IEC CD 23090-32;
* m64176, Haptics support in DASH;
* m64338, Improvements to Carriage of Haptics in ISOBMFF.

The changes in this document are with respect to output document w22610 from MPEG-142 (April 2023, Antalya).

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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 carriage of haptic media in an ISO base media file. A separate document, ISO/IEC 23090-31, specifies the MIHS stream format for haptic media. This document specifies the process for incorporating MIHS formatted bitstreams into an ISO base media file.

Information technology — Coded representation of immersive media —

Part 32:  
Carriage of haptics dataINTERNATIONAL STANDARD© ISO/IEC 2015 – All rights reservedISO/IEC 15444-12:2015(E) 63Part 12: ISO base media file formatInformation technology — JPEG 2000 image coding systemTechnologies de l'information — Codage des objets audiovisuels — Partie 12: Format ISO de base pour les fichiers médiasInformation technology — JPEG 2000 image coding system — Part 12: ISO base media file formatE2015-02-20(60) PublicationISO/IECISO/IEC J   International Standard 2015ISO/IEC 15444‑ISO/IEC 15444‑12ISO/IEC 15444-12  Coding of audio, picture, multimedia and hypermedia informationInformation technology 291 2見出し 2見出し 1    02 STD Version 2.1c260   4C:\Users\shinji\_w\AppData\Roaming\Microsoft\Templates\STD\w15177\_14496\_5th.-restyle-R1.doc

# Scope

This document specifies carriage of haptic media in ISO base media files.

# 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 14496-12:2020, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 23009-1:2022, *Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats*

ISO/IEC 23090-31:xxxx, *Information technology — Coded representation of immersive media — Part 31: Haptics Coding*

# Terms, definitions and abbreviated terms

## 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/>
  + 1. band

haptic band described in ISO/IEC 23090-31 for containing a haptic signal

* + 1. channel

haptic channel described in ISO/IEC 23090-31 for containing bands to be combined, with the resulting haptics rendered at a specific body location

* + 1. experience

haptic experience described in ISO/IEC 23090-31 containing perceptions and global information

* + 1. ISOBMFF track

track defined in ISO/IEC 14496-12

* + 1. MIHS band track

ISOBMFF track having the 'hapt' handler type and an MIHSBandSampleEntry

* + 1. MIHS sample

sample belonging to an MIHS track

* + 1. MIHS stream

MIHS formatted bitstream described in ISO/IEC 23090-31

* + 1. MIHS track

ISOBMFF track having the 'hapt' handler type and an MIHSSampleEntry

* + 1. metadata

information about a haptic experience, perception, channel, or band described in ISO/IEC 23090-31

Note 1 to entry ISO/IEC 14496-12 also uses the term “metadata” but with a different meaning from ISO/IEC 23090-31, hence this clarification.

* + 1. perception

haptic perception described in ISO/IEC 23090-31 for containing channels of a specific modality such as vibration, force, pressure, etc.

* + 1. sample

sample defined in ISO/IEC 14496-12

## Abbreviated terms

|  |  |
| --- | --- |
| IEC | International Electrotechnical Commission |
| ISO | International Organization for Standardization |
| ISOBMFF | ISO base media file format (specified in ISO/IEC 14496-12) |
| MIHS | MPEG-I haptic stream |
| MPEG | Moving Pictures Expert Group |
| MPEG-I | MPEG immersive media |

# Overview

## Organization of this document

Subclause 4.2 provides the overall architecture for storage of MIHS streams in ISOBMFF.

Subclause 4.3 provides information for synchronizing MIHS streams with other media.

Subclause 4.4 provides a summary of the referenceable code points, in tabular format.

Clause 5 specifies extensions to the ISOBMFF for storage of MIHS streams.

## Haptic media

### Structure of haptic media

ISO/IEC 23090-31 describes haptic experiences composed of perceptions containing channels, which in turn contain bands.



Figure 1 – Structure of haptic media

Experiences, perceptions, channels, and bands also contain metadata, which do not depend on time.

A perception may additionally contain an effect library comprising haptic effect definitions. Bands may reference haptic effects in their containing perception’s effect library.

Bands additionally contain haptic effect definitions or references to effects in the containing perception’s effect library to be presented at specific times, possibly following external events.

### MIHS streams

ISO/IEC 23090-31 describes an MIHS format for streaming haptic media. An MIHS stream is composed of MIHS units. Each MIHS unit is composed of MIHS packets.

There are several types of MIHS units: *initialization*, *temporal*, *spatial*, and *silent*; and several types of MIHS packets: *timing*, *experience metadata*, *perception metadata*, *channel metadata*, *band metadata*, *effect library*, and *data*.

Figure 2 shows the structure of the different types of MIHS units. Boxes with dashed lines denote optional packets.



Figure 2 – MIHS stream units and packets

An MIHS stream begins with an initialization unit. The initialization unit contains a timing packet providing a timestamp and a timescale. The initialization unit may also contain packets with metadata for the haptic experience, perceptions, channels and bands, and an effect library packet.

One or more temporal or spatial units follow the initialization unit. Each temporal or spatial unit contains one or more data packets. The data packets contain haptic effect data.

Temporal units contain a *sync* flag indicating whether the temporal unit is a sync unit. The data packets in sync units do not depend on data in previous data packets.

Silent units may appear at any time in the MIHS stream to establish periods of haptic silence.

Initialization units may appear from time to time in the MIHS stream to update timing information or provide additional metadata or effect library information.

The metadata and effect library packets in the first initialization unit of an MIHS stream, before any temporal unit, are used as decoder configuration information for the MIHS track.

The initialization, spatial and silent units are sync units by definition.

### Temporal units and MIHS samples

The haptic data for the bands of a channel are stored in one or more temporal units. The data packets in each temporal unit form an MIHS sample.



Figure 3 – Temporal units and MIHS samples

MIHS samples created from temporal units that are sync units are sync samples. An MIHS sample may also include one or more spatial units.

A silent unit results in an MIHS sample containing a single data packet with a payload size of zero.

## Synchronization with other media

An MIHS track may use a 'sync' track reference to indicate that the MIHS track contains haptic data that are synchronized and should be presented with the media in the referenced tracks. When an MIHS track uses a 'sync' track reference, the MIHS samples in the MIHS track may be grouped by the 'mhpg' sample grouping type as specified in subclause 5.2.17 to indicate the MIHS samples that should be presented with the referenced tracks. If there is no SampleGroupDescriptionBox with grouping\_type 'mhpg', all samples in the MIHS track shall be deemed to be dependent on the referenced tracks.

## Summary of referenceable code points

### 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.

Table 1 – Brands specified in this document

|  |  |  |
| --- | --- | --- |
| Brand | Clause | Informative description |
| mih1 | A.2 | Encapsulation of an MIHS bitstream using one or more MIHS tracks only (no MIHS band tracks) |
| mhb1 | A.3 | Encapsulation of an MIHS bitstream using one or more MIHS tracks referencing MIHS band tracks |

### Sample entry types

The sample entry types specified in this document are listed in Table 2.

Table 2 – Sample entry types specified in this document

|  |  |  |
| --- | --- | --- |
| Sample entry type | Clause | Informative description |
| mih1 | 5.2.4 | Sample entry for an MIHS track carrying haptics data or referencing one or more MIHS band tracks |
| mhb1 | 5.2.5 | Sample entry for an MIHS band track carrying haptics data |

### Box types

In the table, the box types specified in ISO/IEC 23090-32 are in bold text with links to the corresponding clauses in the specification. Related container boxes specified in ISOBMFF are not bolded. Non-related ISOBMFF boxes are not included in the table. Mandatory boxes are, as in ISOBMFF, marked with an asterisk. Box types without a four-character code are marked with ‘‑‘ in the structure.

The box types specified in this document are listed in Table 3

Table 3 – Box types specified in this document

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Box types, structure and cross-reference (Informative) | | | | | | | | | | | | | |
| moov |  |  |  |  |  |  |  |  |  |  | \* | ISOBMFF | *container for all the metadata* |
|  | trak |  |  |  |  |  |  |  |  |  | \* | ISOBMFF | *container for an individual track or stream* |
|  |  | mdia |  |  |  |  |  |  |  |  | \* | ISOBMFF | *container for the media information in a track* |
|  |  |  | minf |  |  |  |  |  |  |  | \* | ISOBMFF | *sample information container* |
|  |  |  |  | stbl |  |  |  |  |  |  | \* | ISOBMFF | *sample table box, container for the time/space map* |
|  |  |  |  |  | stsd |  |  |  |  |  | \* | ISOBMFF | *sample descriptions (codec types, initialization, etc.)* |
|  |  |  |  |  |  | **-** |  |  |  |  |  | **5.2.4** | *haptic sample entry* |
|  |  |  |  |  |  |  | **mh1C** |  |  |  |  | **5.2.6** | *MIHS configuration box* |
|  |  |  |  |  |  |  | **hexd** |  |  |  |  | **5.2.7** | *haptic experience description box* |
|  |  |  |  |  |  |  |  | **hexh** |  |  |  | **5.2.7** | *haptic experience header box* |
|  |  |  |  |  |  |  |  | **havd** |  |  |  | **5.2.9** | *haptic avatar description box* |
|  |  |  |  |  |  |  |  | **hprd** |  |  |  | **5.2.10** | *haptic perception description box* |
|  |  |  |  |  |  |  |  |  | **hprh** |  |  | **5.2.10** | *haptic perception header box* |
|  |  |  |  |  |  |  |  |  | **hrdd** |  |  | **5.2.12** | *Haptic reference device description box* |
|  |  |  |  |  |  |  |  |  | **hchd** |  |  | **5.2.13** | *haptic channel description box* |
|  |  |  |  |  |  |  |  |  |  | **hchh** |  | **5.2.13** | *haptic channel header box* |
|  |  |  |  |  |  |  |  |  |  | **hbnd** |  | **5.2.15** | *haptic band description box* |

### Track reference types

The track reference types specified in this document are listed in Table 4

Table 4 – Track reference types specified in this document

|  |  |  |
| --- | --- | --- |
| Sample entry type | Clause | Informative description |
| mhbd | 5.2.1 | Referenced track is an MIHS band track referenced by an MIHS track |

### Track grouping types

The track grouping types specified in this document are listed in Table 5.

Table 5 – Track grouping types specified in this document

|  |  |  |
| --- | --- | --- |
| Sample entry type | Clause | Informative description |
| mhbd | 5.2.2 | MIHS band track grouping for the same channel and perception |

### Sample grouping types

The sample grouping types specified in this document are listed in Table 6.

Table 6 – Sample grouping types specified in this document

|  |  |  |
| --- | --- | --- |
| Sample entry type | Clause | Informative description |
| mhpg | 5.2.17 | Haptics presentation dependency sample group |

# Carriage of haptic coding data

## General

This clause defines the storage of haptic media utilizing the existing capabilities of the ISOBMFF and defining extensions, when necessary.

## MIHS streams and tracks

This subclause defines the boxes and data formats for incorporating all of the data from an MIHS stream into an MIHS track. From the data in an MIHS track, it shall be possible to construct a complete MIHS stream and vice-versa.

An ISO base media file may contain more than one MIHS track. Each MIHS track may be completely self-contained, meaning it contains all the MIHS samples for an experience; or, it may reference one or more MIHS band tracks which contain the MIHS samples for the experience. In the latter case, the MIHS track shall not contain any MIHS samples—the MIHS samples shall be contained by the referenced MIHS band tracks.

### Referencing MIHS band tracks

To link an MIHS track with associated MIHS band tracks, the track reference tool of ISO/IEC 14496-12 shall be used. A TrackReferenceTypeBox with the reference type 'mhbd' shall be added to a TrackReferenceBox within the TrackBox of the MIHS track. The TrackReferenceTypeBox shall contain an array of track\_IDs identifying the referenced MIHS band tracks.

### Grouping MIHS band tracks

When multiple MIHS band tracks are used to carry the band data of the various channels of an experience's perceptions, track grouping according to ISO/IEC 14496-12 shall be used to identify which MIHS band tracks are associated with each channel and perception. This is done using an MIHSBandGroupTypeBox for each group of MIHS band tracks belonging to the same channel and perception.

### MIHS band track group type box

* + - 1. Definition

Track Group Type: 'mhbd'  
Container: Track group box('trgr')  
Mandatory: No  
Quantity: Zero or more

When MIHS band tracks are used, MIHSBandGroupTypeBoxes shall be used to group together MIHS band tracks associated with the same channel and perception.

* + - 1. Syntax

aligned(8) class MIHSBandGroupTypeBox()  
 extends TrackGroupTypeBox('mhbd') {  
 unsigned int(8) perception\_id;  
 unsigned int(8) channel\_id;  
}

* + - 1. Semantics

perception\_id indicates the ID of the associated perception.

channel\_id indicates the ID of the associated channel.

### MIHS sample entry

* + - 1. Definition

Sample Entry Type: 'mih1'  
Container: Sample description box('stsd')  
Mandatory: Yes  
Quantity: One

An MIHSSampleEntry shall contain an MIHSConfigurationBox and an a HapticExperienceDescriptionBox for an MIHS track.

* + - 1. Syntax

aligned(8) class MIHSSampleEntry() extends HapticSampleEntry('mih1') {  
 MIHSConfigurationBox configuration;  
 HapticExperienceDescriptionBox experience;  
}

### MIHS band sample entry

* + - 1. Definition

Sample Entry Type: 'mhb1'  
Container: Sample description box('stsd')  
Mandatory: Yes  
Quantity: Zero or more

An MIHSBandSampleEntry may contain a HapticBandDescriptionBox for an MIHS band track. The MIHS band track shall contain the samples belonging to the band.

* + - 1. Syntax

aligned(8) class MIHSBandSampleEntry() extends HapticSampleEntry('mi1b') {  
 HapticBandDescriptionBox band; // optional  
}

### MIHS configuration box

* + - 1. Definition

Box Type: 'mh1C'  
Container: MIHS sample entry ('mih1')  
Mandatory: Yes  
Quantity: One

An MIHSConfigurationBox contains the metadata and effect library MIHS packets necessary to decode the MIHS samples that are in the MIHS track. As such, an MIHSConfigurationBox reflects the contents of one or more initialization units in the MIHS stream and can be used to initialize the decoder. The timing MIHS packets may be omitted as their contents are reflected in standard ISOBMFF boxes such as the MediaHeaderBox (for timescale). If present, the contents of timing MIHS packets shall agree with timing information in the standard ISOBMFF boxes.

The packet type shall have one of the values documented in Table 7.

Table 7 – Configuration packet types

|  |  |
| --- | --- |
| Value | Type |
| 0 | Timing |
| 1 | Experience |
| 2 | Perception |
| 3 | Channel |
| 4 | Band |
| 6 | Effect library |

* + - 1. Syntax

aligned(8) class MIHSConfigurationBox()  
 extends FullBox('mh1C', version = 0, flags= 0) {  
 unsigned int(32) configuration\_packet\_count;  
 for (int i=0; i<configuration\_packet\_count; i++) {  
 unsigned int(6) configuration\_packet\_type;  
 unsigned int(4) configuration\_packet\_layer;  
 unsigned int(5) reserved = 0;  
 unsigned int(17) configuration\_packet\_payload\_size;  
 bit(configuration\_packet\_payload\_size\*8)  
 configuration\_packet\_payload;  
 }  
}

* + - 1. Semantics

configuration\_packet\_count indicates the number of packets included in the MIHSConfigurationRecord.

configuration\_packet\_type indicates the packet type as documented in Table 7.

configuration\_packet\_layer indicates the scalability layer of the packet. This value shall be same as the MIHSLayer in the MIHS packet. Zero means the packet shall not be skipped. Larger values than zero mean the packet may be skipped. Note that this field is unused at the container level but is there to maintain the same syntax for the packet header defined in ISO/IEC 23090-31 and can be passed through for decoder initialization.

configuration\_packet\_payload\_size indicates the length in bytes of the packet payload that follows.

configuration\_packet\_payload contains the packet payload formatted according to ISO/IEC 23090-31 for the packet type.

### Haptic experience description box

* + - 1. Definition

Box Type: 'hexd'  
Container: MIHS sample entry ('mih1')  
Mandatory: Yes  
Quantity: One

A HapticExperienceDescriptionBox shall contain a HapticExperienceDescriptionHeaderBox and may contain HapticAvatarDescriptionBoxes and HapticPerceptionDescriptionBoxes describing the haptic avatars and perceptions, respectively, that are part of the haptic experience. If present, the contents of the HapticExperienceDescriptionBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

* + - 1. Syntax

aligned(8) class HapticExperienceDescriptionBox()  
 extends Box('hexd')  
 HapticExperienceDescriptionHeaderBox header;  
 HapticAvatarDescriptionBox avatars[];  
 HapticPerceptionDescriptionBox perceptions[];  
}

### Haptic experience description header box

* + - 1. Definition

Box Type: 'hexh'  
Container: Haptic experience description box ('hexd')  
Mandatory: Yes  
Quantity: One

A HapticExperienceDescriptionHeaderBox contains descriptive information about the haptic experience associated with the MIHS track. The contents of the HapticExperienceDescriptionHeaderBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

* + - 1. Syntax

aligned(8) class HapticExperienceDescriptionHeaderBox()  
 extends FullBox('hexh', version = 0, flags= 0) {  
 utf8string edition;  
 utf8string profile;  
 unsiged int(8) level;  
 utf8string date;  
 utf8string description;  
}

* + - 1. Semantics

edition indicates the year of the edition and amendment of ISO/IEC 23090-31 that this haptic experience conforms to, in the following format: XXXX or XXXX-Y, where XXXX is the year of publication and Y is the amendment number, if any.

profile indicates the name of the profile used to generate the encoded stream according to the profile and level definition in ISO/IEC 23090-31.

level indicates the number of the level used to generate the encoded stream according to the profile and level definition in ISO/IEC 23090-31.

date indicates the human-readable creation date of the haptic experience. The date format shall follow the ISO 8601 standard.

description contains a brief description of the haptic experience.

### Haptic avatar description box

* + - 1. Definition

Box Type: 'havd'  
Container: Haptic experience description box ('hexd')  
Mandatory: No  
Quantity: Zero or more

A HapticAvatarDescriptionBox contains descriptive information about a haptic avatar that is part of the haptic experience. If present, the contents of each HapticAvatarDescriptionBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

The avatar type shall have one of the values documented in Table 8.

Table 8 – Avatar types

|  |  |
| --- | --- |
| Value | Type |
| 0 | Custom |
| 1 | Vibration |
| 2 | Pressure |
| 3 | Temperature |
| 4–255 | *Reserved* |

* + - 1. Syntax

aligned(8) class HapticAvatarDescriptionBox()  
 extends FullBox('havd', version = 0, flags= 0) {  
 unsigned int(8) avatar\_id;  
 unsigned int(8) level\_of\_detail;  
 unsigned int(8) avatar\_type;  
 if (type == 0) {  
 utf8string mesh\_uri;  
 }  
}

* + - 1. Semantics

avatar\_id indicates the unique ID of the avatar within the haptic experience.

level\_of\_detail indicates which level of detail should be used for the avatar if the avatar uses a mesh with several levels of detail.

avatar\_type indicates the type of haptic perception represented by the avatar as documented in Table 8.

mesh\_uri indicates the URI to access the associated 3D mesh file. The URI must follow the syntax defined in RFC3986.

### Haptic perception description box

* + - 1. Definition

Box Type: 'hprd'  
Container: Haptic experience description box ('hexd')  
Mandatory: No  
Quantity: Zero or more

A HapticPerceptionDescriptionBox shall contain a HapticPerceptionDescriptionHeaderBox and may contain HapticReferenceDeviceDescriptionBoxes and HapticChannelDescriptionBoxes describing the reference devices and haptic channels, respectively, that are part of the haptic perception. If present, the contents of each HapticPerceptionDescriptionBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

* + - 1. Syntax

aligned(8) class HapticPerceptionDescriptionBox()  
 extends Box('hprd')  
 HapticPerceptionDescriptionHeaderBox header;  
 HapticReferenceDeviceDescriptionBox reference\_devices[];  
 HapticChannelDescriptionBox channels[];  
}

### Haptic perception description header box

* + - 1. Definition

Box Type: 'hprh'  
Container: Haptic perception description box ('hprd')  
Mandatory: Yes  
Quantity: One

A HapticPerceptionDescriptionHeaderBox contains descriptive information about a haptic perception that is part of the haptic experience. The contents of the HapticPerceptionDescriptionHeaderBox box shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

The haptic modality type shall have one of the values documented in .

Table 9 – Haptic modalities

|  |  |
| --- | --- |
| Value | Modality |
| 0 | Other |
| 1 | Pressure |
| 2 | Acceleration |
| 3 | Velocity |
| 4 | Position |
| 5 | Temperature |
| 6 | Vibrotactile |
| 7 | Water |
| 8 | Wind |
| 9 | Force |
| 10 | Vibrotactile texture |
| 11 | Electrotactile |
| 12 | Stiffness |
| 13 | Friction |
| 14 | Humidity |
| 15 | User-define temporal |
| 16 | User-defined spatial |
| 17–255 | *Reserved* |

* + - 1. Syntax

aligned(8) class HapticPerceptionDescriptionHeaderBox()  
 extends FullBox('hprh', version = 0, flags= 0) {  
 unsigned int(8) perception\_id;  
 utf8string description;  
 unsigned int(8) perception\_modality;  
 unsigned int(8) avatar\_id;  
 unsigned int(16) library\_effect\_count;  
 unsigned int(8) unit\_exponent;  
 unsigned int(8) perception\_unit\_exponent;  
}

* + - 1. Semantics

perception\_id indicates the unique ID of the haptic perception.

description contains a brief description of the haptic perception.

perception\_modality indicates the type of perception as documented in .

avatar\_id indicates the unique identifier of the associated avatar body model.

libreary\_effect\_count indicates the number of effects in the haptic perception's effect library.

unit\_exponent refers to the power of 10 exponent for the SI unit of the independent variable.

perception\_unit\_exponent refers to the power of 10 exponent for the SI unit of the dependent variable.

### Haptic reference device description box

* + - 1. Definition

Box Type: 'hrdd'  
Container: Haptic perception description box ('hprd')  
Mandatory: No  
Quantity: Zero or more

A HapticReferenceDeviceDescriptionsBox contains descriptive information about a reference device that is part of the haptic perception. If present, the contents of each HapticReferenceDeviceDescriptionsBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

The haptic actuator type shall have one of the values documented in Table 11.

Table 10 – Haptic actuator types

|  |  |
| --- | --- |
| Value | Actuator type |
| 0 | Unknown |
| 1 | Linear Resonant Actuator (LRA) |
| 2 | Voice Coil Actuator (VCA) |
| 3 | Eccentric Rotating Mass (ERM) |
| 4 | Piezoelectric actuator |
| 5–15 | *Reserved* |

* + - 1. Syntax

aligned(8) class HapticReferenceDeviceDescriptionBox()  
 extends FullBox('hrdd', version = 0, flags= 0) {  
 unsigned int(8) device\_id;  
 utf8string name;  
 unsigned int(32) body\_part\_mask;  
 unsigned int(16) optional\_field\_mask;  
 if (optional\_field\_mask & 0x0001) {  
 unsigned int(32) maximum\_frequency;  
 }  
 if (optional\_field\_mask & 0x0002) {  
 unsigned int(32) minimum\_frequency;  
 }  
 if (optional\_field\_mask & 0x0004) {  
 unsigned int(32) resonance\_frequency;  
 }  
 if (optional\_field\_mask & 0x0008) {  
 unsigned int(32) maximum\_amplitude;  
 }  
 if (optional\_field\_mask & 0x0010) {  
 unsigned int(32) impedance;  
 }  
 if (optional\_field\_mask & 0x0020) {  
 unsigned int(32) maximum\_voltage;  
 }  
 if (optional\_field\_mask & 0x0040) {  
 unsigned int(32) maximum\_current;  
 }  
 if (optional\_field\_mask & 0x0080) {  
 unsigned int(32) maximum\_displacement;  
 }  
 if (optional\_field\_mask & 0x0100) {  
 unsigned int(32) weight;  
 }  
 if (optional\_field\_mask & 0x0200) {  
 unsigned int(32) size;  
 }  
 if (optional\_field\_mask & 0x0400) {  
 unsigned int(32) custom;  
 }  
 if (optional\_field\_mask & 0x0800) {  
 unsigned int(32) type;  
 }  
}

* + - 1. Semantics

device\_id indicates the unique ID of the device within the haptic perception.

name contains the user defined name of the device.

body\_part\_mask is a binary mask specifying the location of the device or actuator on the body as defined in ISO/IEC 23090-31.

optional\_field\_mask is a binary mask defining which of the device properties are stored.

maximum\_frequency indicates the maximum frequency of the actuator in Hertz, mapping the full unsigned int(32) range to [0,10000].

minimum\_frequency indicates the minimum frequency of the actuator in Hertz, mapping the full unsigned int(32) range to [0,10000].

resonance\_frequency indicates the resonance frequency of the actuator in Hertz, mapping the full unsigned int(32) range to [0,10000].

maximum\_amplitude indicates the maximum amplitude value of the targeted device according to the perception modality, mapping the full unsigned int(32) range to [0,10000].

impedance indicates the impedance of the actuator in Ohms, mapping the full unsigned int(32) range to [0,10000].

maximum\_voltage indicates the maximum voltage of the actuator in Volts, mapping the full unsigned int(32) range to [0,10000].

maximum\_current indicates the maximum current of the actuator in Amperes, mapping the full unsigned int(32) range to [0,10000].

maximum\_displacement indicates the maximum displacement of the actuator in millimetres, mapping the full unsigned int(32) range to [0,10000].

weight indicates the weight of the device in kilograms, mapping the full unsigned int(32) range to [0,10000].

size indicates the size of the device in millimetres, mapping the full unsigned int(32) range to [0,10000].

custom contains user defined data.

type indicates the type of actuator as documented in Table 11.

### Haptic channel description box

* + - 1. Definition

Box Type: 'hchd'  
Container: Haptic perception description box ('hprd')  
Mandatory: No  
Quantity: Zero or more

A HapticChannelDescriptionBox shall contain a HapticChannelDescriptionHeaderBox and may contain HapticBandDescriptionBoxes describing haptic bands that are part of the haptic channel. If present, the contents of each HapticChannelDescriptionBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

If the MIHS track references MIHS band tracks, the HapticChannelDescriptionBox shall not contain any HapticBandDescriptionBoxes. In that case, the HapticBandDescriptionBoxes may be contained by MIHSBandSampleEntry boxes.

* + - 1. Syntax

aligned(8) class HapticChannelDescriptionBox()  
 extends Box('hchd')  
 HapticChannelDescriptionHeaderBox header;  
 HapticBandDescriptionBox bands[]; // optional  
}

### Haptic channel description header box

* + - 1. Definition

Box Type: 'hchh'  
Container: Haptic channel description box ('hchd')  
Mandatory: Yes  
Quantity: One

A HapticChannelDescriptionHeaderBox contains descriptive information about a haptic channel that is part of the haptic perception. The contents of the HapticChannelDescriptionHeaderBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox

* + - 1. Syntax

aligned(8) class HapticChannelDescriptionHeaderBox()  
 extends FullBox('hchh', version = 0, flags= 0) {  
 unsigned int(8) channel\_id;  
 utf8string description;  
 unsigned int(8) device\_id;  
 unsigned int(32) gain;  
 unsigned int(32) mixing\_weight;  
 unsigned int(8) optional\_metadata\_mask;  
 if (optional\_metadata\_mask & 0x01) {  
 unsigned int(32) body\_part\_mask;  
 }  
 if (optional\_metadata\_mask & 0x02) {  
 signed int(8) track\_resolution\_x;  
 signed int(8) track\_resolution\_y;  
 signed int(8) track\_resolution\_z;  
 unsigned int(8) num\_body\_part\_targets;  
 for (int i=0; i<num\_body\_part\_targets; i++) {  
 unsigned int(8) body\_part\_target[i];  
 }  
 unsigned(8) num\_actuator\_targets;  
 for (i=0; i<num\_actuator\_targets; i++) {  
 actuator\_target\_x[i];  
 actuator\_target\_y[i];  
 actuator\_target\_z[i];  
 }  
 } unsigned int(32) sampling\_frequency;  
 if (sampling\_frequency > 0) {  
 unsigned int(32) sample\_count;  
 }  
 if (optional\_metadata\_mask & 0x04) {  
 unsigned int(8) direction\_x;  
 unsigned int(8) direction\_y;  
 unsigned int(8) direction\_z;  
 }  
 unsigned int(16) vertex\_count;  
 for (int i=0; i<vertex\_count; i++) {  
 unsigned int(32) vertex[i];  
 }  
}

* + - 1. Semantics

channel\_id indicates the unique ID of the haptic channel within the haptic perception.

description contains a brief description of the haptic channel.

device\_id indicates the unique ID of the associated reference device.

gain indicates the gain associated with the channel, mapping the full unsigned int(32) range to [−10000,10000].

mixing\_weight indicates the weight of the channel when mixing different channels together, mapping the full unsigned int(32) range to [0,10000].

optional\_metadata\_mask is a binary mask defining which of the channel's optional properties are stored.

body\_part\_mask is a binary mask specifying the location of the channel's effects on the user's body according to ISO/IEC 23090-31.

track\_resolution contains the reference actuator resolution used to design the haptic experience for each spatial coordinate X, Y and Z.

body\_part\_target identifies a body part or group of body parts on the human body according to ISO/IEC 23090-31.

actuator\_target identifies the actuators targeted by the channel according to their X, Y and Z coordinates.

sampling\_frequency indicates the sampling frequency of the original encoded signal in Hertz, mapping the full unsigned int(32) range to [0,10000].

sample\_count indicates the number of samples of the original encoded signal.

direction indicates the ‘right’, 'up' and 'forward' components of the encoded signal as X, Y and Z coordinates, respectively, in the targeted body part's local coordinate system, mapping the full unsigned int(8) range to [−1,1].

vertex\_count is the number of vertices.

vertex is the index of a vertex from the avatar impacted by the channel's effects.

### Haptic band description box

* + - 1. Definition

Box Type: 'hbnd'

Container: Haptic channel description box ('hchd') or MIHS band sample entry ('mhb1')

Mandatory: No

Quantity: Zero or more if in a haptic channel description box, zero or one if in an MIHS band sample entry

A HapticBandDescriptionsBox contains descriptive information about a haptic band that is part of the haptic channel. If present, the contents of the HapticBandDescriptionsBox shall agree with the corresponding contents (MIHS packets) of the MIHSConfigurationBox.

The band type shall have one of the values documented in Table 11.

Table 11 – Band types

|  |  |
| --- | --- |
| Value | Type |
| 0 | Transient |
| 1 | Curve |
| 2 | Vectorial wave |
| 3 | Wavelet wave |
| 4–7 | *Reserved* |

The curve type shall have one of the values documented in Table 12.

Table 12 – Curve types

|  |  |
| --- | --- |
| Value | Type |
| 0 | Unknown |
| 1 | Cubic |
| 2 | Linear |
| 3 | Akima |
| 4 | Bézier |
| 5 | B-spline |
| 6–15 | *Reserved* |

* + - 1. Syntax

aligned(8) class HapticBandDescriptionBox()  
 extends FullBox('hbnd', version = 0, flags= 0) {  
 unsigned int(16) band\_id;  
 unsigned int(3) band\_type;  
 if (band\_type == 1) {  
 unsigned int(4) curve\_type;  
 }  
 if (band\_type == 3) {  
 unsigned int(8) block\_length\_log;  
 }  
 unsigned int(16) lower\_frequency\_limit;  
 unsigned int(16) upper\_frequency\_limit;  
}

* + - 1. Semantics

band\_id indicates the unique ID of the haptic band.

band\_type indicates the type of data contained in the band as documented in Table 11.

curve\_type indicates the type of interpolation function that should be used by the synthesizer as documented in Table 12.

block\_length\_log indicates the wavelet wave block length as the samples coded using the logarithmic transformation , where *block\_length* is the number of wavelet wave samples.

lower\_frequency\_limit indicates the lower frequency limit of the band in Hertz, mapping the full unsigned int(32) range to [0,10000].

upper\_frequency\_limit indicates the upper frequency limit of the band in Hertz, mapping the full unsigned int(32) range to [0,10000].

### Sample format

* + - 1. Definition

An MIHS sample contains data packets belonging to a temporal unit. See subclause 4.2.3, for further details.

MIHS samples are externally framed and have a size supplied by that external framing; for example, by sample size ('stsz') boxes.

The silent\_flag, temporal\_flag and spatial\_flag are related as follows:

* If silent\_flag is 1, temporal\_flag and spatial\_flag shall both be zero.
* If temporal\_flag or spatial\_flag is 1, silent\_flag shall be zero.
* The temporal\_flag and spatial\_flag may both be 1.
  + - 1. Syntax

aligned(8) class MIHSSample {  
 int i = 0;  
 while (i<sample\_size) { // to end of sample  
 unsigned int(1) silent\_flag;  
 unsigned int(1) temporal\_flag;  
 unsigned int(1) spatial\_flag;  
 unsigned int(3) reserved = 0;  
 unsigned int(4) data\_packet\_layer;  
 unsigned int(5) reserved = 0;  
 unsigned int(17) data\_packet\_payload\_size;  
 bit(data\_packet\_payload\_size\*8) data\_packet\_payload;  
 i += 4 + data\_packet\_payload\_size;  
 }  
}

* + - 1. Semantics

silent\_flag indicates that the data packet does not contain haptics data, in which case data\_packet\_payload\_size shall be zero.

temporal\_flag indicates that the data packet contains temporal haptics data, in which case data\_packet\_payload\_size shall be non-zero.

spatial\_flag indicates that the data packet contains spatial haptics data, in which case data\_packet\_payload\_size shall be non-zero.

data\_packet\_layer indicates whether the data packet can be skipped for low bitrate applications. Zero means the packet must not be skipped, higher values mean the packet may be skipped.

data\_packet\_payload\_size indicates the length in bytes of the data packet payload that follows.

data\_packet\_payload contains the data packet payload formatted according to ISO/IEC 23090-31.

[**Editors' Note:** The currently defined fields have an overhead of 4-bytes per packet for a sample. In typical MIHS streams it is expected to have substantial number of samples during interaction leading to significant bitrate overhead. Reducing this overhead is to be investigated.]

### Haptics presentation dependency sample group

* + - 1. Definition

Group Type: 'mhpg'  
Container: Sample group description box ('sgpd')  
Mandatory: No  
Quantity: Zero or more

The haptics presentation dependency sample group indicates that a group of samples in the MIHS track are intended to be rendered in sync and only along with samples of the corresponding referenced tracks, indicated by a 'sync' track reference box. Samples belonging to this sample group are intended to be presented only when the corresponding referenced tracks are active at the sample presentation time.

NOTE This sample group indicates the content author's intent and is not a renderer requirement.

The grouping\_type\_parameter is not defined for the SampleToGroupBox with grouping type 'mhpg'.

* + - 1. Syntax

aligned(8) class HapticsPresentationDepGroupEntry

extends HapticSampleGroupEntry('mhpg') {  
}

1. (Normative)  
     
   File format toolsets and brands
   1. General

This annex defines what constitutes tools, for the purposes of branding files containing haptic content. A specific brand may require some or all of the tools indicated here. A brand should be chosen that indicates the full level of support required, including any requirements on other specifications (e.g., support for aspects of ISO/IEC 14496-12).

* 1. Encapsulation using only MIHS tracks

The brand 'mih1' may be present among the compatible\_brands of the FileTypeBox. File readers conforming to the 'mih1' brand shall support MIHS tracks specified in subclause 5.2 with the following conditions.

* One or more MIHS tracks are present.
* No MIHS band tracks are present, therefore no 'mhbd' track reference types and no 'mhbd' track grouping types are used.
  1. Encapsulation using MIHS tracks and MIHS band tracks

The brand 'mhb1' may be present among the compatible\_brands of the FileTypeBox. File readers conforming to the 'mhb1' brand shall support MIHS tracks specified in subclause 5.2 with the following conditions.

* One or more MIHS tracks reference MIHS band tracks using 'mhbd' track reference types.
* Referenced MIHS band tracks are grouped using 'mhbd' track grouping types.

1. (Normative)  
     
   MIME types and sub-parameters
   1. MIME types and sub-types

When MIME type is associated with haptic content as described in this document, the MIME type depends on the other media types that may also be present in the content.

* For content with audio, video, and haptics, the MIME type shall be video/mp4, for backward compatibility with existing mp4 files.
* Similarly, for files with audio and haptics, the MIME type shall be audio/mp4.
* For files with haptics only, the MIME type shall be haptics/mp4[[1]](#footnote-2).
  1. Sub-parameters for ‘codecs’ parameter
     1. General

When the ‘codecs‘ parameter of a MIME type is used, as defined in IETF RFC 6381, the sub-parameters in this annex apply when the MIME type identifies a file format of this family and the ‘codecs‘ parameter starts with a sample-entry code from this document.

* + 1. Haptic codec family

When the first element of a value is a code indicating a codec from ISO/IEC 23090-31, as documented in subclause 5.2 ('mih1'), the ‘codecs‘ parameter has the form:

codecs=mih1.oo

where ‘oo‘ is the Object Type Indication value, as defined on the MP4 Registration Authority website’s [Object Types](https://mp4ra.org/#/object_types) page[[2]](#footnote-3).

1. (Informative)  
     
   Multiple MIHS tracks and alternate groups
   1. General

A media file may contain more than one MIHS track. Examples where more than one MIHS track is needed include:

* when MIHS tracks with non-zero values for the alternate\_group in the TrackHeaderBox are used;
* when the bands for different perceptions or channels are segmented differently in time (the data packets within each track must be time-aligned using temporal units as described in subclause 4.2.3.)
  1. Criteria for alternate groups of MIHS tracks

An MIHS track among tracks with the same non-zero value for the alternate\_group in the TrackHeaderBox may be selected based on criteria such as the following:

* the contents of the (optional) BitRateBox in the track‘s MIHSSampleEntry;
* the contents of the perceptions, channels, or other data contained in the track; for example, perception modality, channel device, or channel body mask.

1. (informative)  
     
   Player handling of MIHS tracks
   1. General

Media players that support MIHS tracks should render as much of the haptic content in the tracks as possible. Depending on the capabilities of the available haptic devices, a player may map or transform haptic content; for example:

* from one body part (specified in a channel) to another;
* from one device type or set of device characteristics (specified in a track) to another;
* from one haptic modality (specified in a perception) to another.

A player may be incapable of performing certain transformations, or may decide that certain mappings are inappropriate, and may render none or some of the MIHS tracks rather than all.

1. (informative)  
     
   Haptics support in DASH
   1. General

This annex provides guidelines for delivery of haptic tracks using the ISO/IEC 23009-1.

* 1. Haptics Media MPD signalling

The following elements may be present in AdaptationSet or Representation and set to the following values to signal an MIHS track.

* @codecs='mih1'
* @mimeType='haptic/mp4'

The sub-parameter as described in Annex B may be present in @codecs.

The following element can be present in Representation to signal the bitrate to calculate the bandwidth of all media to be accessed, and to select the quality among multiple MIHS tracks, if provided.

* @bandwith
  1. Basic MIHS track support

This subclause describes single MIHS track support.

* + 1. DASH segment and MPD signalling

The haptics media is encapsulated into a DASH segment. The first sample in the segment or the subsegment is the sync sample, and the following element is present in AdaptationSet or Representation, and set to the flowing value for random access.

@startWithSAP=’1’ (for live profile)

@subsegmentstartWithSAP=’1’ (for on-demand profile)

It is recommended that the haptics media segments or subsegments have approximately the same duration as audio media and video media for random access and efficient segment buffering.

* 1. Multiple MIHS tracks support

In addition to the Basic MIHS track support, this subclause describes multiple MIHS track support in DASH. See Annex C for further information about multiple MIHS tracks.

* + 1. Criteria for alternate groups

An MIHS track among tracks with the same non-zero value for the alternate\_group in the TrackHeaderBox may be selected based on criteria such as the following:

* the contents of the (optional) BitRateBox in the track‘s MIHSSampleEntry;
* the contents of the perceptions, channels or other data contained in the track; for example, perception modality, channel device or channel body mask.
  + 1. MPD signalling for bitrate or quality selection

Use case 1: multiple tracks for bitrate or quality selection (not switching).

* Each haptics track is in one Representaion and single Representaion is in AdaptationSet for bitrate/quality selection.
  + 1. DASH segment and MPD signalling for bitrate switching

Use case 2: multiple tracks for bitrate switching.

* Two or more Representations of haptics track are in AdaptationSet;
* DASH segment or subsegment is structured to conform to the following condition, and the following element is present in AdaptationSet and set to the following value for bitrate switching.

@segmentAlignment='true’ (for live profile)

@subsegmentAlignment='true’ (for demand profile)

* 1. MPD example for ISO Base media file format On Demand profile

In this example, multiple video media tracks, multiple audio media tracks and a single haptic media track are described in the MPD.

<?xml version="1.0" encoding="UTF-8"?>

<MPD

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns="urn:mpeg:dash:schema:mpd:2011"

xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd"

type="static"

mediaPresentationDuration="PT3256S"

minBufferTime="PT1.2S"

profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">

<BaseURL>http://cdn1.example.com/</BaseURL>

<BaseURL>http://cdn2.example.com/</BaseURL>

<Period>

**<!-- haptics -->**

**<AdaptationSet mimeType="haptic/mp4" codecs="mih1" subsegmentStartsWithSAP="1">**

**<Representation id="1" bandwidth="32000">**

**<BaseURL>haptics32.mp4</BaseURL>**

**</Representation>**

**</AdaptationSet>**

<!-- Audio -->

<AdaptationSet mimeType="audio/mp4" codecs="mp4a.40" subsegmentAlignment="true" subsegmentStartsWithSAP="1">

<Representation id="3" bandwidth="128000">

<BaseURL>audio128.mp4</BaseURL>

</Representation>

<Representation id="4" bandwidth="64000">

<BaseURL>audio64.mp4</BaseURL>

</Representation>

</AdaptationSet>

<!-- Video -->

<AdaptationSet mimeType="video/mp4" codecs="avc1.4d0228" subsegmentAlignment="true" subsegmentStartsWithSAP="1">

<Representation id="5" bandwidth="1536000" width="1280" height="720">

<BaseURL>video1536.mp4</BaseURL>

</Representation>

<Representation id="6" bandwidth="2048000" width="1280" height="720">

<BaseURL>video2048.mp4</BaseURL>

</Representation>

</Representation>

<Representation id="7" bandwidth="4096000" width="1920" height="1080">

<BaseURL>video4096.mp4</BaseURL>

</Representation>

</AdaptationSet>

</Period>

</MPD>

1. Once ‘haptics’ is approved as a top-level media type by IETF. There is a proposal to that effect pending with the IETF: <https://datatracker.ietf.org/doc/draft-ietf-mediaman-haptics/01/>. It is expected to be approved as a Standards Track RFC in the next few months. [↑](#footnote-ref-2)
2. The registration of the Object Type for haptics has not been initiated yet; expected shortly. [↑](#footnote-ref-3)