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Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 12: Image File Format

Technologies de l'information — Codage à haute efficacité et livraison des medias dans des environnements hétérogènes —
Partie 12: Format de fichier d'image

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Foreword

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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 ISO documents 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).

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

A list of all parts in the ISO/IEC 23008 series can be found on the ISO website.

Introduction

The Image File Format is designed to enable the interchange of images and image sequences, as well as their associated metadata. It forms part of a family of specifications that are box-structured and is built using tools defined in the ISO base media file format. This document specifies both structural brands that can be used with any codec and brands specific to High Efficiency Video Coding (HEVC). The file format specified in this document is referred to as the High Efficiency Image File Format (HEIF). When the requirements of the HEVC-specific brands are obeyed, the file format can be referred to as the HEVC Image File Format.

Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 12: Image File Format

1 Scope

The formats defined in this document enable the interchange, editing, and display of images, as well as the carriage of metadata associated with those images.

The Image File Format builds on tools defined in ISO/IEC 14496-12 to define an interoperable storage format for a single image, a collection of images, and sequences of images.

This document specifies brands for the storage of images and image sequences conforming to High Efficiency Video Coding (HEVC).

NOTE The storage of HEVC video sequences is out of scope and is handled by ISO/IEC 14496-15.

This format defines normative structures used to contain metadata, how to link that metadata to the images, and defines how metadata of certain forms is carried.

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 10918-1:1994, *Information technology Digital compression and coding of continuous-tone still images — Part 1: Requirements and guidelines*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding*

ISO/IEC 14496-12:2015, *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 base media file format*

ISO/IEC 23008-2:2015, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14496-12 and the following apply.

For the purposes of Annex B and Annex E, the terms, definitions, and abbreviated terms specified in ISO/IEC 14496-15 apply.

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

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

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

3.1.1
alternate group
group of *entities* (3.1.10) that are alternatives to each other and out of which only one should be selected for processing

3.1.2
associated image item
image item (3.1.17) that is associated with the *item property* (3.1.26) through the `ItemPropertiesBox`

3.1.3
auxiliary image
image (3.1.15) that may not be intended to be displayed but provides supplemental information, such as transparency data, complementing a respective *master image* (3.1.27)

3.1.4
coded image
coded representation of an *image* (3.1.15)

3.1.5
coded image item
item (3.1.25) whose data is a *coded image* (3.1.4)

3.1.6
crop-rotate-mirror derived image item
derived image item (3.1.8) of type `'iden'` that is not associated with any other types of *essential item properties* (3.1.11) than `'irot'`, `'clap'` and `'imir'`

3.1.7
derived image
representation of an *image* (3.1.15) as an *operation* (3.1.31) on other images

3.1.8
derived image item
item (3.1.25) whose data is a *derived image* (3.1.7)

3.1.9
descriptive item property
item property (3.1.26) that describes rather than transforms the associated item

3.1.10
entity
item or track

3.1.11
essential item property
item property (3.1.26) that readers are required to process

3.1.12
HEVC image item
image item (3.1.17) of type `'hvc1'` or `'lhv1'`

3.1.13
hidden image
image (3.1.15) that is not intended to be displayed

3.1.14
hidden sample
sample that is not intended to be displayed

3.1.15
image
one or more arrays of pixels of different colour components described by an *image item* (3.1.17) or a sample

3.1.16
image collection
set of *images* (3.1.15) stored as *items* (3.1.25) of a single file according to this specification

3.1.17
image item
coded image item (3.1.5) or *derived image item* (3.1.8)

3.1.18
image property
item property (3.1.26) for an *image item* (3.1.17)

3.1.19
image sequence
sequence of *coded images* (3.1.4) which may be associated with advisory timing and in which images may use *inter prediction* (3.1.22)

3.1.20
image sequence track
track that contains an *image sequence* (3.1.19)

3.1.21
input image
image (3.1.15) that is used as an input for the *operation* (3.1.31) of the *derived image item* (3.1.8)

3.1.22
inter prediction
prediction derived in a manner that is dependent on data elements (e.g. sample values or motion vectors) of *images* (3.1.15) other than the current image

3.1.23
intra coding
coding of an *image* (3.1.15) that may use *intra prediction* (3.1.24) and does not use *inter prediction* (3.1.22)

3.1.24
intra prediction
prediction derived from only data elements (e.g. sample values) of the same decoded image

3.1.25
item
data that does not require timed processing, as opposed to sample data, and is described by the boxes contained in a `MetaBox`

3.1.26
item property
descriptive or transformative information about an *item* (3.1.25) as stored in the item properties array

3.1.27
master image
image that is stored as an *item* (3.1.25) and is not an *auxiliary image* (3.1.3) or a *thumbnail image* (3.1.37)

3.1.28
master image sequence
sequence of images that is stored as an *image sequence track* (3.1.20) and is not an *auxiliary image* (3.1.3) sequence or a thumbnail *image sequence* (3.1.19)

3.1.29
metadata item
item (3.1.25) containing metadata that may for example describe an *image item* (3.1.17)

Note 1 to entry: ISO/IEC 14496-12 uses the terms item and metadata item interchangeably to refer to an item of any type. This document overrides the metadata item definition of the ISO base media file format.

3.1.30
non-essential item property
item property (3.1.26) that readers are allowed to ignore

3.1.31
operation
for a *derived image item* (3.1.8), manipulation, identified by the item type, that produces a *reconstructed image* (3.1.34) from a set of *input images* (3.1.21)

3.1.32
output image
image (3.1.15) that results when the *reconstructed image* (3.1.34) of the *image item* (3.1.17) is transformed according to the *transformative item properties* (3.1.39) of the *image item* (3.1.17)

3.1.33
pre-derived coded image
coded image (3.1.4) that has been derived from one or more other images

3.1.34
reconstructed image
image (3.1.15) that results when the *coded image item* (3.1.5) is decoded or when the *operation* (3.1.31) of the *derived image item* (3.1.8), if any, is applied

3.1.35
reference image
image (3.1.15) that may be used as a reference for *inter prediction* (3.1.22) of another image

3.1.36
source image item
image item (3.1.17) referred to by the `'dimg'` item reference from the *derived image item* (3.1.8) or from another derived image item that is a source image item for the derived image item

Note 1 to entry: In other words, an image item is a source image item for a derived image item when it is required for deriving the output image of the derived image item.

Note 2 to entry: The definition of the source image item is recursive: an image item is a source image item for a particular derived image item, when the output image of the image item is used as an input image for any derived image item in the `'dimg'`-item-reference-linked chain of derived image items ending at that particular derived image item, inclusive.

3.1.37
thumbnail image
smaller-resolution representation of an *image* (3.1.15)

3.1.38
time-parallel sample
sample in the reference track that has the same or, when a sample with the same decoding time is not available, the closest preceding decoding time relative to that of the particular sample in the particular track

3.1.39
transformative item property
item property (3.1.26) that transforms the reconstructed representation of the item content

Note 1 to entry: A transformative item property may, for example, specify rotation by 90°, 180°, or 270° of a reconstructed image of an image item.

3.2 Abbreviated terms

ASCII	American Standard Code for Information Interchange
AVC	Advanced Video Coding
DCF	Design rule for Camera File system
Exif	Exchangeable Image File Format
HDR	High Dynamic Range
HEIF	High Efficiency Image File Format
HEVC	High Efficiency Video Coding
MD5	Message Digest algorithm 5
MIME	Multi-purpose Internet Mail Extensions
NAL	Network Abstraction Layer
PPS	Picture Parameter Set
RBSP	Raw Byte Sequence Payload
SEI	Supplemental Enhancement Information
SPS	Sequence Parameter Set
TIFF	Tagged Image File Format
URN	Uniform Resource Name
UTF-8	Universal Character Set Transformation Format — 8-bit
VCL	Video Coding Layer
VPS	Video Parameter Set
XML	Extensible Markup Language
XMP	Extensible Metadata Platform

4 Overview

The Image File Format specifies the following two forms of storage:

a) the storage of a single coded image or a collection of independently coded images, possibly with derived images;

b) the storage of image sequences, which can be indicated to be displayed as a timed sequence or by other means, such as a gallery of images, and in which the coded images may be dependent on other coded images in the same sequence.

A file may use both structures and may also use the structures of the ISO base media file format, enabling a single file to be constructed to meet a variety of needs (e.g. a single image for printing and a record of the image burst that was used to synthesize that image).

In general, the single image support is used for simpler cases, particularly when neither timing nor coding dependency is required. If advisory timing or other tools from the ISO base media file format available for tracks are needed (e.g. sample grouping), or images have been coded with inter prediction, then the second approach is needed.

Brands are defined in order to specify what is required to be present in the file, and what reader support is required to decode under that brand (including support for features that are optional for writers). External specifications may also define brands, which may impose additional constraints on the files or the readers. The brands with which a file is compatible are recorded in the file in the usual way using the `FileTypeBox` (`'ftyp'`).

This document is organized as follows.

Clause 5 specifies general requirements on files and file readers conforming to the Image File Format.

Clause 6 specifies the file structures for the storage of a single image and an image collection. Additionally, general requirements that shall be supported in all files using the Image File Format for the storage of a single image or an image collection are specified.

Clause 7 specifies the file structures for the storage of image sequences. Additionally, general requirements that shall be supported in all files using the Image File Format for the storage of image sequences are specified.

Clause 8 specifies the metadata structures for a single image, an image collection, and image sequences.

Clause 9 specifies enhancements to the ISO base media file format (ISO/IEC 14496-12) and may be moved into that specification in the future. Clauses 6, 7, and 8 include particular subclauses of Clause 9 by reference into their specifications.

Clause 10 specifies structural brands for a single image and an image collection, as well as image sequences. Requirements on both files and file readers are specified.

Annex A specifies the format for storing Exif, XMP, and MPEG-7 metadata in files conforming to the Image File Format. Storage of Exif, XMP, or MPEG-7 metadata in files conforming to the Image File Format shall conform to the specifications of Annex A.

Annex B specifies the format for encapsulating HEVC-coded images, image collections, and image sequences according to the Image File Format. Annex B also specifies HEVC-specific brands for a single image and an image collection as well as image sequences. Requirements on both files and file readers are specified. Storage of HEVC-coded images, image collections, and image sequences in files conforming to the Image File Format shall conform to the specifications of Annex B.

Annex C and Annex D specify the MIME type registration for a single image or an image collection, and image sequences, respectively, for the structural and HEVC-specific brands. When MIME types are used for files conforming to the HEVC-specific Image File Format brands, the MIME types shall conform the specifications of Annex C and Annex D for a single image or an image collection, and image sequences, respectively.

Annex E specifies the format for encapsulating AVC-coded images, image collections, and image sequences according to the Image File Format. Storage of AVC-coded images, image collections, and image sequences in files conforming to the Image File Format shall conform to the specifications of Annex E. Annex F and Annex G specify the MIME type registration for a single image or an image collection, and image sequences, respectively, for the AVC-specific brands. When MIME types are used for files conforming to the AVC-specific Image File Format brands, the MIME types shall conform the specifications of Annex F and Annex G for a single image or an image collection, and image sequences, respectively.

Annex H specifies the format for encapsulating JPEG-coded images, image collections, and image sequences according to the Image File Format. Storage of JPEG-coded images, image collections, and image sequences in files conforming to the Image File Format shall conform to the specifications of Annex H.

Annex I contains guidelines on defining new image formats and brands.

Annex J contains informative examples of single image and image collection file structures conforming to the Image File Format.

Annex K provides guidelines for a player operation for progressive refinement and file structures enabling progressive refinement.

Throughout this document, statements appearing with the preamble "NOTE" are informative and are not an integral part of this specification.

5 General requirements

5.1 General requirements on files

All files shall conform to the definitions for an object-structured file as defined in ISO/IEC 14496-12:2015, Clause 4.

5.2 General requirements on readers

The following are the requirements for all readers conforming to this document.

1) They shall be able to parse object-structured files formatted according to the definitions for an object-structured file as defined in Clause 4 of the ISO base media file format.

2) They shall parse the `FileTypeBox` and confirm that one or more brands that they support are included in the list of compatible brands. If there are no such brands, the reader should terminate parsing of the file.

3) They shall be able to recognize and discard boxes that are not required to be supported under the specification identified by the brand(s) under which they are operating.

5.3 Multi-purpose files

Files may be identified as compatible with other standards (using brands) than those defined in this document.

NOTE A file identified as compatible with other standards (using brands) contains the boxes specified by those standards.

5.4 Other boxes

In addition to the required boxes (and their required content), other boxes from the ISO base media file format, or other box-structured specifications, may be included as needed.

6 Single image and image collection

6.1 General

Images can be stored as items using the support for untimed data storage, called the `MetaBox` for historical reasons, in the ISO base media file format. A file may contain any number of image items.