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Information technology — Multimedia application format (MPEG-A) —

Part 22:
Multi-image application format (MIAF)

Technologies de l'information — Format pour application multimédia (MPEG-A) —

Partie 22: Format pour application à images multiples (MIAF)

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Foreword

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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 23000 series can be found on the ISO website.

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

Introduction

This document specifies a multimedia application format, the Multi-Image Application Format (MIAF), that enables precise interoperability points for creation, reading, parsing and decoding of images embedded in the High Efficiency Image File (HEIF) format. The MIAF specification fully conforms to the HEIF format and only defines additional constraints to ensure higher interoperability.

The HEIF specification (ISO/IEC 23008-12) defines a file format for the inclusion of one or more images, possibly with one or more sequences of images, with associated metadata and their relationship to each other. While the HEIF specification defines the file format and general requirements for the included coding formats, it does not define specific interoperability points by which capturing devices, editing applications, storage systems, cloud and delivery networks, and playback devices and applications can interoperate with each other.

This document, by defining specific constraints on the HEIF format, limiting the supported encoding types to a set of specific profiles and levels, requiring specific metadata formats, and defining a set of brands for signalling such constraints, defines precise interoperability points which enable the industry to deploy particular uses of the HEIF specification to improve interoperability.

This document defines the normative requirements for MIAF files as well as for MIAF readers and renderers.

Information technology — Multimedia application format (MPEG-A) —

Part 22:
Multi-image application format (MIAF)

1 Scope

This document specifies the Multi-Image Application Format (MIAF), which contains coded images, groups and sequences of images along with their metadata and the information about their relations to each other, all embedded in the High Efficiency Image File (HEIF) format.

This document builds on the HEIF specification and defines the following:

— a set of additional constraints on ISO/IEC 23008-12 (HEIF) specification, to simplify its file format options;

— specific alpha plane formats;

— a set of specific profiles and levels for the supported coding formats;

— a set of specific metadata formats;

— a set of brands, including application brands indicating conformance with specific profiles;

— a set of rules for extending MIAF format to support additional coding formats, profiles, levels and metadata.

This document also defines the normative behaviour for a MIAF reader and MIAF renderer.

The MIAF specification is intentionally written to be extensible, and to allow for forward compatibility. The format is also permissive of the presence of other data, such as coding formats, metadata, and derived images.

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 14496-3, *Information technology — Coding of audio-visual objects — Part 3: Audio*

Rec. ITU-T H.264 | ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Advanced video coding*

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 base media file format*

Rec. ITU-T T.802 | ISO/IEC 15444-3, *Information technology — JPEG 2000 image coding system — Part 3: Motion JPEG 2000*

ISO 16684-1, *Graphic technology — Extensible metadata platform (XMP)— Part 1: Data model, serialization and core properties*

ISO/IEC 23000-19, *Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media*

ISO/IEC 23001-14, *Information technology — MPEG systems technologies — Part 14: Partial file format*

Rec. ITU-T H.265 | ISO/IEC 23008-2, *Information technology — High efficiency coding and media delivery in heterogeneous environments — High efficiency video coding*

ISO/IEC 23008-12, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 12: Image File Format*

JEITA CP-3451, Exchangeable image file format for digital still cameras

3   Terms and definitions

For the purposes of this document, the terms and definitions given in Rec. ITU-T H.264 | ISO ISO/IEC 14496-10, Rec. ITU-T H.264 | ISO ISO/IEC 23008-2, ISO/IEC 14496-12, ISO/IEC 23008-12 and the following apply.

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

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

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

3.1
alpha plane
image specifying the transparency information of the master image

Note 1 to entry: When the resolution of an alpha plane differs from that of the master image, MIAF renderers are expected to rescale the alpha plane to the resolution of the master image, but the rescaling operation is not specified exactly and thus the exact behaviour of different MIAF renderer implementations can differ.

3.2
depth map
image that contains information relating to the distance of the surfaces of scene objects from a viewpoint

3.3
MIAF application brand
brand indicating that a *MIAF file* (3.5) conforms to a specific *MIAF profile* (3.8) and that *MIAF readers* (3.9) and *MIAF renderers* (3.12) that only implement the features required by that MIAF profile can process the MIAF file

3.4
MIAF auxiliary image item
image item that provides auxiliary visual information but is not normally independently rendered

Note 1 to entry: The requirements are in subclause 7.3.5.

3.5
MIAF file
file containing one or more image and/or image sequence and/or video tracks

Note 1 to entry: A MIAF file is constrained to conform to clause 7.

3.6
MIAF master image item
image item that may be rendered

3.7
MIAF image item
MIAF master image item (3.6), *MIAF auxiliary image item* (3.4) or *MIAF thumbnail image item* (3.10)

3.8
MIAF profile
set of restrictions on a *MIAF file* (3.5)

Note 1 to entry: These are typically restrictions on the media coding format/profile/level, content protection scheme, or on quantitative measures. MIAF profiles enable interoperability between MIAF files and MIAF readers.

Note 2 to entry: A MIAF file may conform to multiple MIAF profiles. A MIAF reader or MIAF renderer may be capable of processing one or more MIAF profiles.

3.9
MIAF reader
entity that reads and parses *MIAF files* (3.5), identifies the type of image coding and metadata, and decodes the coded streams for the coding types/profiles/levels that it supports

3.10
MIAF thumbnail image item
image item that is referenced using the thumbnail reference type

Note 1 to entry: The requirements for a MIAF thumbnail image item are specified in subclause 7.3.3.

3.11
MIAF player
entity including a *MIAF reader* (3.9) and a *MIAF renderer* (3.12)

3.12
MIAF renderer
entity that renders the output of *MIAF reader* (3.9) into a *visual context* (3.15), taking into account associated metadata (e.g. colour information) and auxiliary image data (e.g. alpha planes)

3.13
primary image
image identified as the *primary item* (3.14) in the file-level `MetaBox`

3.14
primary item
item as identified by the `PrimaryItemBox` in the file-level `MetaBox`

3.15
visual context
visual rendering surface such as a screen buffer, which may already contain visual material, and onto which an image can be rendered

4   Abbreviations

AVC   Advanced Video Coding (as specified by Rec. ITU-T H.264 | ISO/IEC 14496-10)

HEIF   High Efficiency Image File format (as specified by ISO/IEC 23008-12)

HEVC   High Efficiency Video Coding (as specified by Rec. ITU-T H.265 | ISO/IEC 23008-2)

MIAF   Multi Image Application Format (as specified by this document)

5 Document organization and conventions

Clause 6 specifies general concepts and processing of MIAF files.

Clause 7 specifies general requirements that apply to all profiles. These requirements are split in two ways:

— requirements at the file format structure level, and requirements at the 'abstraction layer' that the file format structures create; and

— requirements for both still images, image sequences and video.

Clause 8 specifies constraints which are shared by one or more profiles.

Clause 9 specifies the coding format(s) that are required to be supported in any player, independent of any profile.

Clause 10 specifies the brands that indicate conformance to the normative requirements of this document, common to all profiles (as documented in the clauses preceding the annexes), and the applicable file extensions.

Annex A specifies the profiles, each of which imposes a set of specific restrictions which shall be followed for enabling interoperability between MIAF files and MIAF readers.

This document derives variables that are named by a mixture of lower case and upper case letters and without any underscore characters. Variables starting with an upper case letter are derived for the current syntax structure and all depending syntax structures. Variables starting with an upper case letter may be used in the specification for dependent syntax structures without mentioning the originating syntax structure of the variable. Variables starting with a lower case letter are only used within the clause in which they are derived.

6 MIAF concepts and processing of MIAF files

6.1 General

This clause describes the overall encoding, packaging, parsing and decoding architecture as well as the data structure (concepts of image, image sequence, video, metadata, etc.).

This document places requirements on

— the format of files;

— the action of a process that reads and parses a file, and produces output images (a "reader");

— the action of a process that renders the output images (a "renderer").

Figure 1 illustrates a possible processing model to handle MIAF files. A MIAF reader gets a MIAF file as input. In addition, the caller process or application provides inputs on how the file is intended to be processed. The MIAF reader produces output images that are provided to the MIAF renderer for displaying. The rendering takes place on a visual context, such as a screen buffer, and is controlled by the caller process or application.
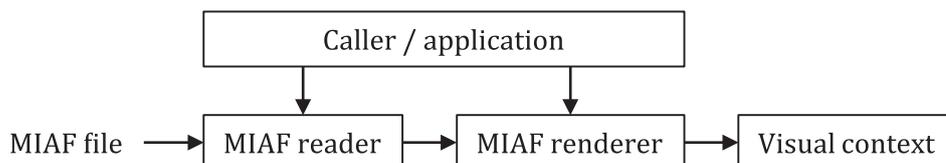
Figure 1 — Processing of a MIAF file

6.2   MIAF data object model

The data object model consists of the boxes at the file format layer, and the two abstraction layers that those boxes create:

— image items, with their properties, and relationships (expressed by item references);

— image sequences and/or video, with the sample entry setup information, and their relationships (expressed by track references).

These two abstraction layer models can be linked by references and entity groups.

Image items are suitable when neither timing nor coding dependency is required. If either timing is required or the coding scheme takes advantage of inter-picture prediction, an image sequence track or a video track is used. A key difference between image sequence tracks and video tracks is that, in image sequence tracks, the timing is advisory. Consequently, it is suggested that MIAF files contain image sequence tracks when timing is not meaningful or essential for playback — for example, images captured with exposure or focal bracketing.

6.3   MIAF image items

A MIAF image item is an item that conforms

a)   to the box-level requirements for items in subclause 7.2.1;

b)   to the requirements for items in subclause 7.3;

c)   to the requirements of a defined MIAF codec profile;

d)   and for which a MIAF brand appears in the FileTypeBox.

6.4   MIAF thumbnail image items

A MIAF thumbnail image item is an item that

a)   is referenced as a thumbnail image from a MIAF master image item;

b)   conforms to the box-level requirements for items in subclause 7.2;

c)   conforms also to the requirements for items in subclause 7.3;

d)   conforms either to a profile that a MIAF reader conforming to the profile of the associated master image item is required to support, or to the requirements of a format defined in clause 9;

e)   is unprotected;

f)   has its image data stored in the same file as the MIAF master image item for which it is a thumbnail.

6.5   MIAF auxiliary image item

A MIAF auxiliary image item is an item that

a)   conforms to the box-level requirements for items in subclause 7.2;

b)   conforms also to the requirements for items in subclause 7.3;

c)   conforms to the requirements for auxiliary items in subclause 7.3.5;

d)   conforms either to the requirements of the same MIAF codec profile as the MIAF master image item for which it is an auxiliary image, or to the requirements of a format defined in clause 9.

A MIAF auxiliary image may have alternates.

6.6   MIAF reader processing model

A MIAF reader is an entity capable of:

a)   concluding which image item(s) or track(s) of a MIAF-conforming file are to be output based on given input parameters;

b)   decoding image items(s) or track(s) to be output;

c)   generating the output pictures from the decoded pictures (e.g. by applying transformative image properties); and

d)   outputting the output pictures and file metadata associated with the output pictures.

Inputs to a MIAF reader are:

—   a file with a `FileTypeBox` containing at least one brand specified in this document;

—   optionally one of the following:

  —   `item_ID` of the item to be output (psItemId),

  —   `track_ID` of the track to be output (psTrackId),

  —   a selection between a static image (psImagePreferredFlag equal to 1) or track (psImagePreferredFlag equal to 0) to be output,

    NOTE 1   When neither psItemId nor psTrackId is provided as input, a default image item or track is selected as specified in this clause.

—   optionally constraints, such as the maximum width and height of an image item or track;

—   optionally one or more of the following roles of the image or track to be output:

  —   master (default),

  —   thumbnail,

  —   auxiliary, which may be further classified by the type.

    NOTE 2   More than one role can be provided as input for example to instruct a MIAF reader to return both an image item and its alpha plane (when present).

Outputs of a MIAF reader are:

—   the output image(s) of the track(s) or item(s) that was (were) requested as input or selected by the MIAF reader as specified below, not including any non-output samples as defined in ISO/IEC 14496-12;

—   in the case that any tracks are present, the composition times for each output sample, with any associated edit list;

—   the metadata associated with the output image(s), including the content of the `ColourInformationProperty` or `ColourInformationBox`.

    NOTE 3   When a MIAF reader is requested to provide auxiliary images as output, the output image(s) of the MIAF reader include output images of auxiliary image item(s) or decoded samples of auxiliary track(s) of any type, when no input of auxiliary picture type is given to the MIAF reader, or of the type matching that given as input to the MIAF reader.

A `track_ID` or `item_ID` value seedId is derived using the following ordered steps:

— If neither psItemId nor psTrackId is provided as input, the following applies:

  — If there is an alternate group including the primary item of the file, the following applies:

    — If psImagePreferredFlag is provided as input and is equal to 0, the tracks in the alternate group are examined in the order they are listed in the alternate group and seedId is set equal to the `track_ID` value of the first track that the MIAF reader is able to decode and that fulfils the constraints provided as input, if any.

    — Otherwise, if psImagePreferredFlag is provided as input and is equal to 1, the items in the alternate group are examined in the order they are listed in the alternate group and seedId is set equal to the `item_ID` value of the first item that the MIAF reader is able to decode and that fulfils the constraints provided as input, if any.

    — Otherwise (psImagePreferredFlag is not provided as input), the tracks and items in the alternate group are examined in the order they are listed in the alternate group and seedId is set equal to the `track_ID` or `item_ID` value of the first track or item that the MIAF reader is able to decode and that fulfils the constraints provided as input, if any.

    NOTE 4   The selection of an entity from an alternate group can be implemented in a MIAF reader as follows. At least the initial part of the file is retrieved for inspection — enough to cover the `FileTypeBox`, and `MetaBox` and possibly the `MovieBox` (if any). The `MetaBox` is then inspected to find the identification of the primary item, and any of its alternatives indicated by an alternate group. If there are alternatives, the MIAF reader selects the first such entity listed in the alternate group that the MIAF reader can support — with regards to compatible coding format, existence of protection, and so on, and that fulfils the constraints provided as input, if any.

  — Otherwise, the following applies:

    — If psImagePreferredFlag is not provided as input, or is equal to 1, seedId is set equal to the `item_ID` value of the primary item.

    — Otherwise, seedId is set equal to the `track_ID` value of any track conforming to this document and fulfils the constraints provided as input, if any.

— Otherwise, if psItemId is provided as input, seedId is set equal to psItemId.

— Otherwise, seedId is set equal to psTrackId.

A list of `track_ID` or `item_ID` values to be decoded, selectedIds, is derived as follows:

— If seedId represents a `track_ID` and one or more roles are provided as input, selectedIds is a list of `track_ID` values such that both of the following are true for each list element selectedIds[listIdx]:

  — selectedIdsx[listIdx] is equal to seedId or the `track_ID` value of any auxiliary and thumbnail tracks associated with the track having `track_ID` equal to seedId;

  — the track with the `track_ID` value equal to selectedIds[listIdx] has a role that is given as input.

— Otherwise, if seedId represents an `item_ID` and one or more roles are provided as input, selectedIds is a list of `item_ID` values such that both of the following are true for each list element selectedIds[listIdx]:

  — selectedIds[listIdx] is equal to seedId or the `item_ID` value of any auxiliary and thumbnail items associated with the item having `item_ID` equal to seedId;

  — the item with the `item_ID` value equal to selectedIds[listIdx] has a role that is given as input.

— Otherwise, selectedIds is a list that has one and only one list element that is set equal to seedId.

NOTE 5   selectedIds can contain multiple items, such as a master image item and its thumbnail image item, when more than one role is given as an input to a MIAF reader.

A MIAF reader shall conclude an error when any of the following occurs:

—   selectedIds contains no `track_ID` or `item_ID` values;

—   one or more roles are provided as input and selectedIds contains a `track_ID` or `item_ID` value of a track or item that has a role other than those provided as input.

NOTE 6   A MIAF reader retrieves enough of the data-portion of the file (identified by offsets and sizes in the data already retrieved) to enable the decoding and reconstruction of the output image(s) or image sequence(s) or video(s), represented by the image items or tracks identified by selectedIds.

A MIAF reader decodes each track or item identified by the values in selectedIds and provides as output the output images of the decoded image items or the decoded samples, including the application of transformations.

1.   Derive output image(s) from the image item(s) to be output, if any, as specified in ISO/IEC 23008-12.

2.   Decode image sequence or video track(s) to be output, if any, and apply matrix of `TrackHeaderBox` and `CleanApertureBox` to the decoded pictures to generate pictures to be output.

For each output image, the MIAF reader returns metadata, such as the colour information property or equivalent metadata. For each track identified by the values in selectedIds, the MIAF reader returns the composition times of the output images and the edit list, if any, applying to the track.

NOTE 7   Decoding of an image item can involve image derivation, or the application of transformative properties applied in sequence.

6.7   MIAF renderer processing model

Inputs to a MIAF renderer are:

—   the output image(s) of the item(s) or the sample(s) of the track(s) that were provided as output by the MIAF reader;

—   in the case that any tracks are present, the composition times of the output samples, with their associated edit lists;

—   the metadata associated with the output image(s), including the content of the `ColourInformationProperty` or `ColourInformationBox`;

—   a visual context, such as a bitmap representing a displaying window prior to rendering the output image(s).

NOTE 1   When the output image(s) provided as output by the MIAF reader include(s) auxiliary image(s), this (these) auxiliary image(s) is (are) also provided as input to the MIAF renderer.

Outputs of a MIAF renderer are:

—   A new visual context subsequent to rendering the output image(s) into the provided visual context.

Profiles or application brands may specify the operation of the MIAF renderer. When profiles or application brands do not specify the operation of the MIAF renderer and no other information of the MIAF renderer operation is available, the MIAF renderer should operate as follows.

If an output image given as input to the MIAF renderer resulted from an image item, the following processing steps are applied once to produce the updated visual context. Otherwise, if output image(s) given as input to the MIAF renderer resulted from a video track, the following processing steps are applied multiple times using the timing provided by the edit list, if any, or composition times, otherwise.

NOTE 2   Colour properties and other descriptive properties are expected to be used to enable display matching.

NOTE 3   No default rendering for an image sequence track is specified. A proper rendering of an image sequence track depends on the use case or capturing scenario for the image sequence track.

If both a master image and an associated alpha plane are provided as inputs to the processing model, the following applies:

— When the width or the height of the alpha plane differs from the width or the height of the master image, respectively, the alpha plane is resized to have the same width and height as those of the master image.

— If the master image is not pre-multiplied, the visual context is updated by performing the following operation for each co-located pixel of the master image and the visual context:

$$v_u = m \times \alpha + v_i \times (1 - \alpha)$$

— Otherwise (the master image is pre-multiplied), the visual context is updated by performing the following operation for each co-located pixel of the master image and the visual context:

$$v_u = m + v_i \times (1 - \alpha)$$

where

v_u is a pixel value in the updated visual context;

m is a pixel value in the master image;

α is an alpha plane value, scaled into the range of 0 (fully transparent) to 1 (fully opaque), inclusive;

v_i is a pixel value in the visual context given as input to the process.

Otherwise (no alpha plane with a master image is provided as input to the processing model), the master image is opaquely overlaid on the visual context.

7   MIAF file general requirements

7.1   General

A MIAF file shall conform to the requirements specified by ISO/IEC 23008-12 (which in turn references requirements in ISO/IEC 14496-12).

A MIAF reader shall process all normative parts of a MIAF file.

NOTE   A MIAF file can contain data additional to that defined by this document. A MIAF reader is expected to ignore and/or skip the data it does not understand, and continue processing the received file.

7.2   Box-level requirements

7.2.1   Box-level requirements on image items

7.2.1.1   General

A summary of the boxes in MIAF that support image items is in Table 1. Indentation is used to represent which boxes are enclosed in others. The names are the formal syntax names of the boxes. The clause numbers indicate subclauses of this document that provide requirements and restrictions on those boxes.

Table 1 — Box overview and nesting for image items

Box overview and nesting for image items				
FileTypeBox			7.2.1.2	file type and compatibility
BoxFileIndexBox			7.2.1.3	file index
MetaBox			7.2.1.4	metadata
	HandlerBox		7.2.1.5	handler, declares the metadata (handler) type
	DataInformationBox		7.2.1.6	data information box, container
		DataReferenceBox	7.2.1.6	data reference box, declares source(s) of metadata items
	ItemLocationBox		7.2.1.7	item location
	ItemProtectionBox		7.2.1.8	item protection
	ItemInfoBox		7.2.1.9	item information
	PrimaryItemBox		7.2.1.10	primary item reference
	ItemPropertiesBox		7.2.1.11	item properties
	ItemReferenceBox		7.2.1.12	item reference
	ItemDataBox		7.2.1.13	item data
	GroupsListBox		7.3.12	entity grouping
		EntityToGroupBox	7.3.12	
MediaDataBox			7.2.1.13	media data container

Boxes documented in ISO/IEC 23008-12, ISO/IEC 14496-12 or ISO/IEC 23001-14 are shown in Table 1. Other boxes may be present in the file but they shall not affect the processing of any images that are required or conditionally required by this document.

Any MIAF file has the following constraints:

— The file shall conform to the constraints of the 'mif1' brand specified in ISO/IEC 23008-12;

— When the file contains an image sequence track, the file shall conform to the constraints of the 'msf1' brand specified in ISO/IEC 23008-12.

— When the file contains a video track, the file shall conform to the constraints of any brand specified in ISO/IEC 14496-12.

— The file-level MetaBox shall always be present (see 7.2.1.4).

— The HandlerBox shall be the first contained box within the MetaBox.

— Both 16-bit and 32-bit item_IDs may be present.

7.2.1.2 FileTypeBox

The FileTypeBox shall contain, in the compatible_brands list, the following (in any order):

— 'mif1' (specified in ISO/IEC 23008-12).

— brand(s) identifying conformance to this document (specified in Clause 10).

The `FileTypeBox` should also contain brands that identify the MIAF profile(s), to which the file conforms (specified in Annex A or externally), and possibly other brands to which the file conforms.

Files shall also carry a compatible brand to identify the MIAF profile to which the file conforms, as defined in Annex A or external specifications.

7.2.1.3 Box file index

A `BoxFileIndexBox` that shall conform to the specification in ISO/IEC 23001-14 may be present after the `FileTypeBox` to provide an index of the file. Any editing operation on the file which changes box sizing or placement shall update this index or remove it.

NOTE   Alternatively or additionally, `BoxFileIndexBox` can be delivered out-of-band e.g. by using the optional `fileindex` MIME media parameter specified in ISO/IEC 23001-14.

7.2.1.4 MetaBox

The `MetaBox` shall be present at the file-level.

NOTE   This also means that a file that is primarily a sequence will still have at least a primary image item in the `MetaBox` (e.g. for printing).

The `XMLBox` and `BinaryXMLBox` shall not be used in a `MetaBox`.

7.2.1.5 HandlerBox

The file-level `MetaBox` shall be identified as carrying images by carrying in the associated `HandlerBox` the value required by ISO/IEC 23008-12 (which is `'pict'`).

7.2.1.6 DataInformationBox and DataReferenceBox

Profiles may limit the use of data references for image items.

7.2.1.7 ItemLocationBox

MIAF image items are constrained as follows:

— `construction_method` shall be equal to 0 for MIAF image items that are coded image items.

— `construction_method` shall be equal to 0 or 1 for MIAF image items that are derived image items.

7.2.1.8 ItemProtectionBox

MIAF image items shall not reference any item protection, i.e. the image data shall be unprotected. These boxes may be present but shall only be used to define the protection of other data (image items that are not MIAF image items, or metadata).

7.2.1.9 ItemInfoBox

Version 0 or 1 of this box is required by ISO/IEC 23008-12.

NOTE   The naming of items using the `item_name` field is permitted but not required, hence the `item_name` can be an empty string.

7.2.1.10 PrimaryItemBox

ISO/IEC 23008-12 requires that the `PrimaryItemBox` identify the primary image (see subclause 7.3.2 below).

7.2.1.11 ItemPropertiesBox

Both 7 and 15 bit `property_index` values may be present.

7.2.1.12 ItemReferenceBox

There are no additional restrictions on this box.

7.2.1.13 ItemDataBox and MediaDataBox

Item bodies of coded image items shall not be present in the `ItemDataBox`; all body data for coded images (including thumbnails) shall be in a `MediaDataBox`. Exif and XMP metadata shall also be in a `MediaDataBox`.

The body data for metadata and thumbnail items should precede the item body for the primary item and other large item bodies in the `MediaDataBox`. The body data needed to decode, understand (i.e. presentational metadata) and present (e.g. including item derivation) the primary item should precede any other data in the `MediaDataBox`.

7.2.2 Box-level requirements on image sequences and video

7.2.2.1 Data references

Profiles may limit the use of data references for image sequences and video.

7.2.2.2 Content protection

Content protection (protected sample entries) shall not be used for sequences that are required, conditionally required or explicitly permitted by this document, i.e. all such sequences shall be unprotected.

7.2.2.3 Movie fragments

Movie fragments as defined in ISO/IEC 14496-12 may be used in image sequence and video tracks and shall be supported by the MIAF reader.

7.2.2.4 CodingConstraintsBox

ISO/IEC 23008-12 mandates this box for `'pict'` tracks; it may also be present for `'vide'` tracks.

7.3 Item level requirements on image items

7.3.1 General

Items and item properties other than those documented by this document may be present in the `MetaBox` at file level but they shall not affect the decoding or presentation of MIAF image items.

It is recommended that the size of items and properties other than those specified in this document be minimized. The item bodies of these other items should be stored after the item bodies of those defined by this document; similarly, the other item properties should follow the item properties required by this document.

7.3.2 Primary item

The primary item shall be a MIAF master image item.

When a profile specified in Annex A is listed in the `FileTypeBox`, there shall be an image item that conforms to that profile and is among the set of items comprised of the primary item and its alternates.

NOTE   Subclause 7.2.2.2 requires that that item be unprotected.

7.3.3   MIAF thumbnail images

One or more MIAF thumbnail image items should be associated as thumbnails with all MIAF master image items (by using the mechanisms defined in ISO/IEC 23008-12).

For each profile of this document whose brand is listed in the `FileTypeBox`, among the set of items identified as a thumbnail related to the primary item or its alternates, there shall be a MIAF thumbnail image item one that uses either a coding format permitted by that profile, or a format defined in clause 9.

The recommended size for a MIAF thumbnail image item is 320 pixels in its largest dimension.

There shall be no greater than a factor of 200 between the total number of pixels in a MIAF thumbnail image item and the next larger MIAF thumbnail image item, or the associated MIAF master image item if there is no larger MIAF thumbnail image item.

7.3.4   MIAF master image items that are not the primary item

Master image items that are not the primary item and not required for generating the output image of the primary item may be present, but should be present only if it is expected that the application environment can make use of multi-branded files efficiently. It is recommended that alternative coding formats be represented by a choice of image file in a higher-level context (e.g. the picture element in HTML5).

Master image items representing multiple resolutions of the same content may be present, but should be present only if it is expected that the application environment can make use of the multiple resolutions. A file with multiple master image items representing the same content may be arranged to conform to the progressive application brand specified in subclause 10.2.

7.3.5   MIAF auxiliary image items

7.3.5.1   General auxiliary image items

The constraints provided in this subclause are applicable to auxiliary images stored as image items or as part of image sequences or video.

The following `aux_type` values, for images, or `aux_track_type`, for tracks, of the `AuxiliaryTypeProperty` (respectively `AuxiliaryTypeInfoBox`) are defined:

— "`urn:mpeg:mpegB:cicp:systems:auxiliary:alpha`" for alpha planes

— "`urn:mpeg:mpegB:cicp:systems:auxiliary:depth`" for depth maps.

Other values may be defined in future or derived specifications.

NOTE   The use of the URN '`urn:mpeg:hevc:2015:auxid:xxx`' is discouraged and the use of the above codec-independent URNs is preferred.

MIAF readers shall support all auxiliary images and be capable of outputting any auxiliary images associated with the output image(s) with their type (notably depth-map and alpha-plane auxiliary images). MIAF renderers shall interpret alpha planes and should support alpha blending using alpha-plane auxiliary images. This is especially important for image overlays. There is no required or recommended behaviour for MIAF renderers for other types of auxiliary images, including depth maps. Limits and requirements on auxiliary images may be expressed by specific profiles.

Other auxiliary images may be present and may be ignored by the MIAF reader and MIAF renderer.

Depth maps and alpha planes should be encoded in monochrome format (i.e. 4:0:0 chroma format) if possible; if they are encoded in colour, they shall be encoded in a colour format with a luma plane and chroma planes, e.g. as 4:2:0 YCbCr, in which case only the luma plane is relevant, and the chroma planes shall be ignored by the MIAF renderer.

7.3.5.2 Alpha auxiliary image items

The semantics provided in this subclause are applicable to auxiliary images stored as image items or as part of image sequences or video.

The following semantics apply to alpha planes:

— sample value 0 means that the co-located pixel in the master image is transparent (i.e. will not be displayed);

— the maximum sample value (e.g. 255 for 8-bit sample values) means that the co-located pixel in the master image is opaque, i.e. fully covers the background image;

— the sample values of the alpha plane divided by the maximum value (e.g. by 255 for 8-bit sample values) provides the multiplier to be used to obtain the intensity for the associated master image.

NOTE   The term "sample value" used above is to be interpreted as "luma sample value" if encoded with separate luma and chroma planes.

An item reference (respectively track reference) of type 'prem' from the master image item (respectively master image sequence track) to the auxiliary image item (respectively auxiliary image sequence track) signals that the master image(s) is (are) pre-multiplied by the alpha value. If the item or track reference is not present, the master image(s) is (are) not pre-multiplied by the alpha value. For further detail on the interpretation of alpha planes, see subclause 6.7.

7.3.6   Item properties

7.3.6.1   General

The following properties shall be supported as defined in the processing models, by the combination of the MIAF reader (see subclause 6.6) and the MIAF renderer (see subclause 6.7):

— decoder configuration,

— image spatial extents,

— pixel aspect ratio,

— colour information,

— pixel information,

— relative location,

— image properties for auxiliary images,

— clean aperture,

— rotation, and

— mirroring.

7.3.6.2   Decoder configuration

Decoder configuration properties are required by some coding formats and even when optional should be used when possible, to indicate the coded nature of the images.

7.3.6.3　Image spatial extents

ISO/IEC 23008-12 requires that every image item be associated with a property of this type. The MIAF reader passes this information as metadata to the MIAF renderer.

7.3.6.4　Colour information property

All image items, both coded and derived, should be associated with a colour information property.

The handling of colour information by the system (i.e. colour management) is outside the scope of this document; a renderer takes this information into account when rendering the image(s).

The colour property shall be parsed by MIAF readers, including all colour types (on-screen i.e. `colour_type` equal to `'nclx'`, constrained and unconstrained ICC profiles), and passed as metadata to the MIAF renderer. The MIAF renderer receives a visual context with a colour property, and the output of the MIAF reader with a colour property; the way that a MIAF renderer handles the colour properties is out of scope.

Only if the colour space of the image is sRGB or sYCC (as in IEC 61966-2-1) the colour property may be omitted; all other images shall have an explicitly declared colour space via association with a property of this type.

If a coded image has no associated colour property, the default property is defined as having `colour_type` equal to `'nclx'` with properties as follows:

— For YCbCr encoding, sYCC should be assumed as indicated by `colour_primaries` equal to 1, `transfer_characteristics` equal to 13, `matrix_coefficients` equal to 1, and `full_range_flag` equal to 1.

— For RGB encoding, sRGB should be assumed as indicated by `colour_primaries` equal to 1, `transfer_characteristics` equal to 13, `matrix_coefficients` equal to 0, and `full_range_flag` equal to 1.

If a derived image has no colour information, then the default colour information is defined by the derivation.

The colour information property takes precedence over any colour information in the image bitstream, i.e. if the property is present, colour information in the bitstream shall be ignored.

7.3.6.5　Pixel aspect ratio

This property shall be supported by the MIAF renderer and may be associated with any image item.

The default pixel aspect ratio of an image, in the absence of association with a `PixelAspectRatioBox` property, is 1:1 (i.e. "square"). This value of pixel aspect ratio is the mandatory value for all images mandated or conditionally mandated by this document, i.e. all images conformant with this document shall have a pixel aspect ratio of 1:1.

This information shall be output by the MIAF reader as metadata and interpreted by the MIAF renderer.

7.3.6.6　Pixel information

The pixel information property shall be associated with every image that is displayable (not hidden) and should be associated with all images, and shall be supported by the MIAF renderer. This information shall be output by the MIAF reader as metadata and interpreted by the MIAF renderer.

7.3.6.7　Clean aperture, rotation and mirror

The clean aperture (cropping) property may be associated with any image and shall be supported by the MIAF reader. The clean aperture property is restricted according to the chroma sampling format of

the input image (4:4:4, 4:2:2, 4:2:0, or 4:0:0); the cropping shall select an integer number of samples for all planes. In effect, this means that:

— when the image is 4:0:0 (monochrome) or 4:4:4, there is no restriction;

— when the image is 4:2:2, the horizontal cropped offset and width shall be even numbers;

— when the image is 4:2:0, both the horizontal and vertical cropped offsets, and heights and widths, shall be even numbers.

The rotation property may be associated with any image and shall be supported by the MIAF reader.

NOTE 1   After rotation, images sometimes need chroma re-sampling.

The mirror property may be associated with any image and shall be supported by the MIAF reader.

These properties, if used, shall be indicated to be applied in the following order: clean aperture first, then rotation, then mirror.

NOTE 2   In video and image sequence tracks, clean aperture is defined to be applied before the track matrix.

7.3.7   Content light level property

This property provides information about the light level in the content. The contents of this property are exactly the same as the contents of the Content light level sample entry box described in subclause 7.4.4.2, and the same semantics apply.

7.3.8   Mastering display colour volume property

This property provides information about the colour primaries, white point, and mastering luminance in the content. The contents of this property are exactly the same as the contents of the "Mastering display colour volume" sample entry box described in subclause 7.4.4.3, and the same semantics apply.

7.3.9   Transformations and derived items

The image grid, overlay, and identity derivations shall be supported by the MIAF reader.

All transformative properties associated with coded and derived images required or conditionally required by this document shall be marked as essential, and shall be from the set that are permitted by this document or the applicable profile. No other essential transformative property shall be associated with such images.

7.3.10   Metadata

Metadata of type Exif as specified by JEITA CP-3451 may be present in the file and shall be output by the MIAF reader; this means that a reader shall be able to transfer this data to the application. There is no need for a reader to understand the details of the metadata. There should be no image transformations expressed by Exif (rotation, mirroring, etc.) indicated in the Exif metadata, in files encoded according to this document. If present, they shall be ignored by a MIAF renderer, i.e. not cause a change in the presentation of associated images by a MIAF player.

Metadata of type XMP as specified by ISO 16684-1 may be present in the file and shall be output by the MIAF reader; this means that a reader shall be able to transfer this data to the application. There is no need for a reader to understand the details of the metadata.

7.3.11   Derived images and derived image items

7.3.11.1   General

A MIAF file may include any derived image defined in ISO/IEC 23008-12 with the constraints defined here.

A MIAF player shall process all derived images of the types identified in subclause 7.3.9.

The maximum derivation chain is shown in the following list; the Identity, Grid and Overlay derivations are optional. All derivation chains shall originate from one or more coded images. An identity derivation shall not be derived immediately from another identity derivation. If derivations occur, they shall be in this order:

— mandatory coded image(s)

— optional identity derivation (subclause 7.3.11.2)

— optional grid (subclause 7.3.11.4)

— optional identity derivation (subclause 7.3.11.2)

— optional overlay (subclause 7.3.11.3)

— optional identity derivation (subclause 7.3.11.2)

7.3.11.2 Identity derived image

Any derived image item of the `item_type` value `'iden'` shall not be derived from an image item of `item_type` value `'iden'`.

NOTE   Identity derivations are useful when it is desired to have the base image and an image to which transformative properties have been applied, both visible as separate items in the file. If this is not needed, transformative properties can be associated with the base image itself.

7.3.11.3 Overlay derived image

A MIAF file may include overlay images, i.e. derived image items with `item_type` value `'iovl'`.

All input items to an overlay shall have the same explicit or default colour information. If the inputs do not have the default colour information identified in subclause 7.3.6.4 then the overlay item shall have explicitly associated colour information. Colour information associated with the overlay item shall be the same as the colour information of the inputs.

7.3.11.4 Grid derived image

7.3.11.4.1 General

A MIAF file may include grid images, i.e. derived image items with `item_type` value `'grid'`.

All input images of a grid image item shall use the same coding format, chroma sampling format, and the same decoder configuration (see subclause 7.3.6.2).

A MIAF file may have a grid of `'iden'` image items with the limitation that each such identity image item has to refer directly to a coded image.

All input items to a grid shall have the same explicit or default colour information. If the inputs do not have the default colour information identified in subclause 7.3.6.4 then the grid shall have explicitly associated colour information. Colour information associated with the grid shall be the same as the colour information of the inputs.

The input images of a grid image item shall be encoded such that each can be independently decoded (a concept sometimes referred to as 'system tiles', to distinguish it from any tiling structure defined within a codec).

7.3.11.4.2 Grid tile size

The tile size is restricted according to the chroma sampling format of the input images; the cropping shall select an integer number of samples for all planes, and result in an output image that also includes an integer number of samples for all planes. In effect, this imposes the following constraints on the horizontal tile offset (i.e. the number of luma samples from the left boundary of the picture to the left boundary of the tile), the vertical tile offset (i.e. the number of luma samples from the top boundary of the picture to the top boundary of the tile), the tile width, the tile height, the output image width, and the output image height:

— when the images are in the 4:4:4 or 4:0:0 chroma sampling format, there is no restriction;

— when the images are in the 4:2:2 chroma sampling format, the horizontal tile offsets and widths, and the output width, shall be even numbers;

— when the images are in the 4:2:0 chroma sampling format, both the horizontal and vertical tile offsets and widths and heights, and the output width and height, shall be even numbers.

Any grid image in a MIAF file shall also conform to the following constraints (see Figure 2 for definition). A tile here means the output of the coding system that delivers an independent image as input to the grid, and is distinct from any tile constructions within the coding layer.

— The `tile_width` shall be greater than or equal to 64, and should be a multiple of 64.

— The `tile_height` shall be greater than or equal to 64, and should be a multiple of 64.

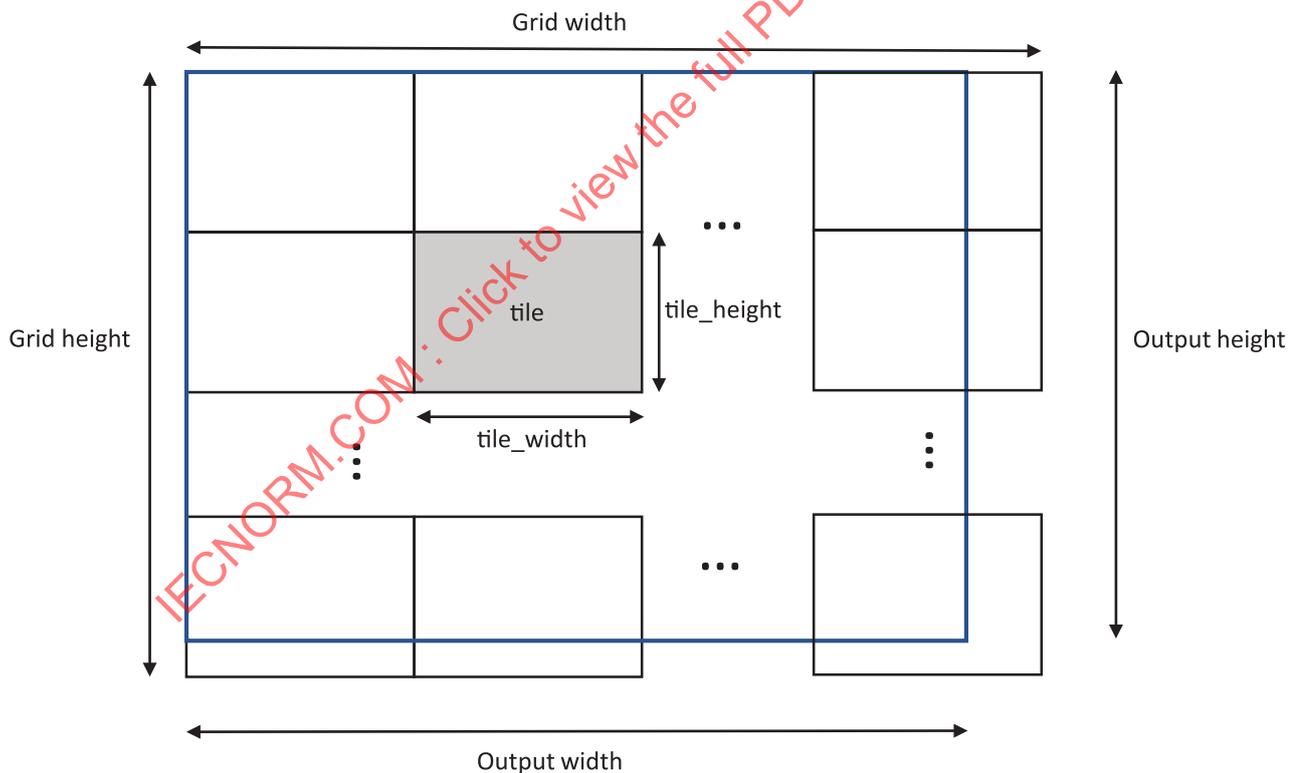NOTE   The maximum tile size is effectively set by the limits of the codec profile.

Figure 2 — Tile structure for a grid image

7.3.12 Image grouping

7.3.12.1 General

A MIAF file may include a `GroupsListBox` containing entity groups of items with the following constraints.

A MIAF reader shall process all the following groupings: alternative images (as defined in ISO/IEC 14496-12), stereo image (as defined in ISO/IEC 23008-12), and equivalent entities (as defined in ISO/IEC 23008-12).

7.3.12.2 Alternative images

Alternative images shall be supported by the MIAF reader, which shall support selecting an alternative that it is capable of decoding, and should support selecting the most suitable image from the set of images it is capable of decoding.

Examples of alternative images are:

— different bit depth;

— different resolution;

— different codec profile.

NOTE   Subclause 7.3.4 constrains alternative codings.

7.3.12.3 Stereo image

Stereo images may be supported; if not supported, or if a monoscopic image is desired (e.g. for printing), the primary item should be used.

7.4 Track-level requirements on image sequences and video

7.4.1 General

A MIAF file may include image sequences and video. Examples are burst, animations, "living images".

The coding format of the video track(s) and any image sequence track(s) shall be one that is permitted by one of the MIAF profiles with a brand listed in the `FileTypeBox`. Metadata tracks may be present.

7.4.2 Track reference types

A MIAF reader shall process the following track reference types:

— thumbnail sequence, 'thmb' (as documented in ISO/IEC 23008-12);

— alpha and depth auxiliary sequences, 'auxl' (as documented in ISO/IEC 23008-12);

— metadata, 'cdsc' (as documented in ISO/IEC 14496-12), though there is no requirement on processing the metadata.

Thumbnail or auxiliary sequences shall conform either to the requirements of the same MIAF codec profile as the MIAF image sequence or video to which it is linked, or to the requirements of a format defined in clause 9.

7.4.3 Video track-level requirements

Those visual tracks that are related to the `PrimaryItem` or to an item related to the `PrimaryItem` can have a visual `width` and `height` recorded in the `TrackHeaderBox` that is different from the visual size of the primary item.

The use of the `matrix` field of the `TrackHeaderBox` shall represent only no transformation (identity matrix), or vertical or horizontal mirroring and/or rotations of 90°, 180° or 270°.

7.4.4 Video track sample entry boxes

7.4.4.1 Cropping

The `CleanApertureBox` may be used for cropping and shall be supported by the MIAF reader.

7.4.4.2 Content light level

7.4.4.2.1 Definition

This box may be used to provide information about the light level in the content and may be present in a `VisualSampleEntry`. It is functionally equivalent to, and described in, the Content light level information SEI message in Rec. ITU-T H.265 | ISO/IEC 23008-2, with the addition that the provisions of CTA-861-G, in which zero in some cases codes an unknown value, may be used.

NOTE   This is a `Box`, not a `FullBox` (similar to `PixelAspectRatioBox`).

7.4.4.2.2 Syntax

```
class ContentLightLevelBox extends Box('clli'){

   unsigned int(16) max_content_light_level;

   unsigned int(16) max_pic_average_light_level;

}
```

7.4.4.3 Mastering display colour volume

7.4.4.3.1 Definition

This box may be used to provide information about the colour primaries, white point, and mastering luminance in the content and may be present in a `VisualSampleEntry`. It is functionally equivalent to, and described in, the mastering display colour volume SEI message in Rec. ITU-T H.265 | ISO/IEC 23008-2, with the addition that the provisions of CTA-861-G, in which zero in some cases codes an unknown value, may be used.

NOTE   This is a `Box`, not a `FullBox` (similar to `PixelAspectRatioBox`).

7.4.4.3.2 Syntax

```
class MasteringDisplayColourVolumeBox extends Box('mdcv'){

   for (c = 0; c<3; c++) {

      unsigned int(16) display_primaries_x;

      unsigned int(16) display_primaries_y;

   }
```

```
    unsigned int(16) white_point_x;

    unsigned int(16) white_point_y;

    unsigned int(32) max_display_mastering_luminance;

    unsigned int(32) min_display_mastering_luminance;

}
```

7.4.5   Audio track-level requirements

An audio track may be present if a picture or video track is present; the audio track may have alternatives. When present, audio tracks shall have the same duration as the video or image sequence track, and at least such audio track shall obey the following constraints:

— Each stream shall be coded as either a variant of AAC as defined in ISO/IEC 14496-3 (see following list), or as uncompressed two's-complement.

— If uncompressed audio is chosen, it shall be mono or stereo audio and shall conform to the format `'twos'` as defined in Rec. ITU-T T.802 | ISO/IEC 15444-3.

— If AAC is chosen, then:

  — Each AAC elementary stream shall be encoded using MPEG-4 AAC-LC, HE-AAC Level 2, or HE-AACv2 Level 2. Use of the MPEG-4 HE-AACv2 is recommended for 32 kbps or lower.

  — When using HE-AAC and HE-AACv2 bitstreams, explicit backwards compatible signalling shall be used to indicate the use of the spectral bandwidth replication (SBR) and parametric stereo (PS) coding tools.

  — AAC shall not exceed two audio channels.

  — AAC elementary streams shall not exceed 48 kHz sampling rate.

7.4.6   Auxiliary video track-level requirements

When alpha planes are used, the constraints specified in subclause 7.3.5.2 apply; and for every sample of the master image sequence or video track, there shall be a sample of the alpha plane track with the same composition time. The width and height of the decoded alpha plane pictures shall be the same as the width and height of the pictures of the associated video track, respectively.

7.5   Association of image items and tracks

When a picture or video track is present, its relationship to the primary item should be indicated. In particular, the entity groups `'altr'` or `'eqiv'` as documented in ISO/IEC 14496-12 or ISO/IEC 23008-12 should be used.

When the `'eqiv'` entity group is used, the matching `'eqiv'` sample group is used to indicate the equivalent sample, as documented in ISO/IEC 23008-12.

7.6   Metadata

A MIAF file may include the following metadata types, associated with the items present in the file-level `MetaBox`, or present in the `MetaBox` at track level for tracks, stored as specified in ISO/IEC 23008-12:

— Exif: Metadata of type Exif as specified by JEITA CP-3451 may be present in the file.

— XMP: Metadata of type XMP as specified by ISO 16684-1 may be present in the file and, if present, shall be stored as defined in ISO/IEC 23008-12 and shall be formatted as defined in ISO 16684-1.

A MIAF reader shall be able to retrieve metadata information and pass the metadata to the application/ environment (metadata processing is out of scope for MIAF).

If the same metadata property is present inside both a MIAF container box and coded image, the MIAF container box information takes precedence.

8 Shared conditions and requirements

8.1 General

The conditions and requirements in this clause are shared by selected, but not all, profiles. The profiles indicate which of them apply. Each condition has a name, that is the subclause title.

8.2 Self-containment

8.2.1 Image items

The body data for all image and metadata items required, conditionally required, or explicitly permitted under this format shall be carried in either the `ItemDataBox` or a `MediaDataBox`.

MIAF image items shall use `data_reference_index==0`, i.e. the image data shall be contained in the same file as the `MetaBox`.

8.2.2 Image sequences and video

External data references in the `DataReferenceBox` shall not be used for image sequences or videos that are required, conditionally required, or explicitly permitted by this document, i.e. those sequences/ videos shall be self-contained.

8.3 Single-layer

Among the primary item and its alternates, there is an image item that is a coded image item not requiring decoding of multiple layers or a derived image item directly and indirectly referring to only such coded image items that do not require decoding of multiple layers.

A MIAF reader may ignore all enhancement layers of images if they are present in a MIAF file. Support for the layer selection property is not required.

8.4 Grid-limit

When an overlay or grid derived image item is the primary item or in an alternate group that also contains the primary item, if the sum of the pixel counts of the input images of the derived image item exceeds 128 000 000 pixels there shall be an alternate such image of the same type (i.e. overlay or grid) in the same group, or thumbnail, whose sum does not exceed 128 000 000 pixels.

There shall be no greater than a factor of 200 between the total number of pixels in the overlay, grid image or thumbnail that is less than 128 000 000 pixels, and the next larger alternative.

8.5 Single-track

For any type of track (video, audio, image sequence, metadata, etc.), there shall either be exactly one track of that type not identified as an auxiliary or thumbnail track, or all tracks of that type not identified as an auxiliary or thumbnail track shall form a single group of alternates, i.e. after any alternate track selection has been performed, there is at most a single track of any given type.

8.6 Edit-lists

If edits are used, they shall conform to the following constraints, and MIAF readers and MIAF renderers shall support edit lists that conform to these constraints.

The edit list shall have one or two "media edit" entries that map media time into presentation time. They may be preceded by an "empty edit" that inserts "empty time" into the presentation timeline.

The constraints on the media edit are:

— repeating edits may be used; either all tracks shall indicate a 'looping' edit, or none;

— the `media_rate` shall take either a value greater than 0 and up to and including 1 (forward play), or minus 1 (normal speed reverse play);

— when there are two 'media edits', one shall specify forward playback and the other reverse, over the same media time-range;

— if an edit list is used to specify reverse playback (a negative `media_rate`) of some media, there shall be a sync sample (as defined by ISO/IEC 14496-12) at least every 4 frames, or more often.

NOTE 1   Audio playback of any form is not mandatory, including audio playback at rates other than 1 (normal forward play).

NOTE 2   A pair of edits can be used to indicate that the media be played forwards from beginning to end, and then in reverse end to beginning, all possibly looped.

NOTE 3   In accordance with ISO/IEC 14496-15, sync samples are followed, in decoding order, only by such samples that can be decoded correctly when the decoding is started from the sync sample.

8.7 Matched-duration

If multiple tracks are present in the file, they shall have the same duration, and edit lists may be needed to achieve this.

9 Profile-independent image item and sequence coding

The JPEG format as documented in ISO/IEC 23008-12

— shall be supported by the MIAF reader for image items;

— should be supported by a MIAF reader for video and image sequence tracks.

10 Brands and file extensions

10.1 General

Files conforming to the general restrictions in clause 7 shall include the brand 'miaf' in the compatible_ brands in the FileTypeBox. Under this brand, a FreeSpaceBox as defined in ISO/IEC 14496-12 may be present as permitted by that specification, including at top level. It is recommended that the use of FreeSpaceBoxes be minimized in files that are expected to be transmitted over networks.

This clause specifies MIAF application brands that may be indicated in FileTypeBox in addition to MIAF profiles to indicate that the file conforms to some additional constraints.

A MIAF file shall use the filename extensions specified by HEIF to identify the presence of specific image coding formats, as summarized in Table 2.

Table 2 — Informative summary of filename extensions

Coding format	Extension—single image	Extension—sequence
HEVC	.heic or .hif	.heics or .hif
AVC	.avci	.avcs
Any	.heif or .hif	.heifs of .hif

When a MIAF file also conforms to the constraints of any codec-specific brands specified in ISO/IEC 23008-12, the MIAF file should carry those codec-specific brands in the `FileTypeBox`.

10.2 Progressive application brand

This application brand enables players to decode and render a MIAF image file progressively while it is being received. The constraints of this application brand are such that progressive image refinement is perceived when rendering image items in the order that they appear in the file.

The presence of the progressive MIAF application brand indication (`'MiPr'`) in the `FileTypeBox` enables a MIAF player to operate in either or both of the following ways:

— With an HTTP GET request for the byte range of the first 128 000 bytes, a MIAF player receives at least the file-level `MetaBox`, and a thumbnail image item of the primary item. The MIAF player can display the thumbnail image item as a preview of the primary item, while the remaining file is being downloaded.

— Progressive refinement refers to displaying the image content of a file in successive steps while downloading the file, where each step improves the perceived image quality over that of the previous step and replaces the image content of the previous step in the same displaying window. When the MIAF player receives a progressive MIAF file gradually, progressive refinement is obtained by displaying the decoded entities of the alternate group containing the primary item successively, in the order of the entities within the file.

`'MiPr'` in the `compatible_brands` in the `FileTypeBox` specifies that a file conforming to `'miaf'` brand also conforms to the following constraints:

— The `MetaBox` shall follow the `FileTypeBox`. There shall be no intervening boxes between the `FileTypeBox` and the `MetaBox` except at most one `BoxFileIndexBox`.

— The `MediaDataBox` shall not occur before the `MetaBox`.

— At most one top-level `FreeSpaceBox` is allowed, which, if present, shall be between the `MetaBox` and the `MediaDataBox`. There shall be no other top-level `FreeSpaceBox` in the file.

— The primary image item conforms to a MIAF profile.

— There is at least one MIAF thumbnail image item present for the primary image item and the coded data for the thumbnail image items precede in file order the coded data for the primary item.

— The maximum number of bytes from the beginning of the file to the last byte of the coded data for at least one of the thumbnail images of the primary item, or the primary item itself, is 128 000 bytes.

    NOTE   For tracks with long duration, movie fragments can be used to write also a `MovieBox` that meets the byte count limit above.

— When the primary item is included in an alternate group, the data needed for reconstructing entities in the alternate group shall have an order within the file that results into perceived progressive refinement when the MIAF player displays the decoded entities of the alternate group successively, in the order of the entities within the file, on the same displaying window, scaled to the same spatial resolution.