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1 Introduction

During the 111th MPEG meeting, the draft Text of ISO/IEC FDIS 23008-12 Carriage of Still Image and Image Sequences was issued. This contribution discusses specific aspects of the draft related to the use of items for data other than images or metadata blocs, typically for derived images or initialization. It proposes a small technical change to the structures defined in the draft to respect the typical ISOBMFF design rules and to enable more efficient processing.

2 Current situation

In the current draft, derived images (and decoder initialization data) are declared as items with a reference to the image items they are using (or from the image that uses it). This leads to a complex item structure with cross references.

For example, the simple indication of a rotation angle for an image requires a complex structure (1 item plus 1 item reference) and associated complex processing (iloc processing with ‘idat’ or potentially separate ‘mdat’, with potential offset and extent processing). This is only for 2 bits of information!

Another similar example is finding the width and height of an image. A parser has to follow the ‘init’ reference from the image item to the image entry item, then to fetch the ‘mdat’ or ‘idat’, to extract the bytes from there and to parse the width and height as an 'ispe' box.
We believe that for the success of the standard these basic use cases should be solved more simply.

This situation is also problematic because, as opposed to what the draft introduction indicates, the file is box-structured but important data (rotation angle, clean aperture …) is hidden in 'mdat' or 'idat' boxes. As a consequence, simple file analyzers (such as MP4Box[1], MP4Box.js[2], MP4Parser[3], MP4Reader[4] …) will not be able to parse those boxes without having to do complex file processing (i.e. iloc processing).

[1] http://gpac.wp.mines-telecom.fr/mp4box/
[2] https://github.com/gpac/mp4box.js
[3] http://mp4parser.com/
[4] http://www.thinmultimedia.co.kr/products/MP4Reader.html

As a general design rule, we believe items should be reserved for storing data that is not ISOBMFF-defined and box-structured. It should be reserved for data such as HEVC data, Exif data … that a box parser does not need to parse. This is a typical design rule in the ISOBMFF that a parser can process all the systems information to understand the content of the file without requiring fetching the possibly large mdat boxes.

Finally, the current design mixes composition information (grid, overlay) with media information (image declaration). Composition information signaling should be possible but it is probably not the main use case for IFF and should not constrain the format for simple use cases (simple image storage, possibly with rotation).

3 Proposal

3.1 Overview

The basic idea of the proposal is to:

- allow ISOBMFF readers to parse all system information without having to fetch an 'idat' or 'mdat' box;
- while allowing information sharing between images such as decoder configuration, auxiliary configuration, image properties (rotation, …) to avoid inefficient storage. Such sharing is made possible without using sharing of byte ranges as required in the current item-based solution;
- limit the number of items by using items only for media data or metadata that is not ISOBMFF-defined (e.g. Exif, MPEG-7…). Such design makes the parsing of the file simpler and eases the high-level understanding of the file format.

This proposal is an adaptation of the following previous proposals:

- M33221: Storage of HEVC Tiled Images in the Image File Format

That contribution proposed to extend the Item Info Entry structure to add information about the image tiling. A problem was that it still used items to store system information (tiling information) and therefore 'iloc', 'idat' and/or 'mdat' processing.

- M34354: On HEVC Still Image File Format

That contribution proposed to add information to the init item to avoid creating new items. It is however not sufficient.

- M35844 Review of use cases on the Image File Format

That contribution proposed to define new VirtualItems , ie. items that are only used for reference by other items and that do not use 'iloc' and the associated processing; and to derive such base class to create virtual items for derived images. This approach is a good approach and is reused.

- M36123 Alternate Syntax for mutualizing effects in the Image File Format

That contribution proposed to store effect information as child of the 'meta' box. That part of the proposal is reused.

- M35826v3 Miscellaneous cleanups for ISO/IEC 23008-12

That contribution also proposed to modify the Item Information Entry to add information, thereby reducing the number of items. It did not however allow information sharing.

This contribution proposes a merge of the above solutions and is based on the following key aspects:

- all system-level item information is boxed, accessible to a parser without fetching any' ‘mdat’ or ‘idat’ box and included in or referred by the item information entry (!);
- items using 'mdat' or 'idat' boxes are created only for media data or metadata that is not ISOBMFF-defined and box-structured .

The changes are:

- a new box (similar to the `EffectDeclarationBox` of M36123) called `SharedItemPropertiesBox` ('sitp') is defined to contain box-structured information that is shared among items
- a modification of the Item Info Entry (similar to what was proposed in M35826 and M33221) to associate box-structured properties with an item. That information may be directly stored in the 'infe' box or stored in the 'sitp' box and referenced from the 'infe' box. Note that inclusion of boxes in ‘infe’ is not a “new” feature in ISOBMFF as it is already supported for FEC info through “FDItemInfoExtension”, but this is not supported in version >= 2 of infe (!!)
- a new box (`SampleDescriptionEntryReference 'sder'`) to allow sharing of the same initialization data between an image item and a sample in a track.

3.2 Impact on current spec

See attached edited spec.

3.3 Usage examples

3.3.1 Single Image

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC', 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
```

3.3.2 Single Image with rotation

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC', 'ispe', 'irot'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
```

3.3.3 Single Image with rotation and clean aperture

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC', 'ispe', 'clap', 'irot'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
```

3.3.4 Multiple Images with the same dimensions but different HEVC configurations

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC'
         item properties indices: 0
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties: 'hvcC'
         item properties indices: 0
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties: 'hvcC'
         item properties indices: 0
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties: 'hvcC'
         item properties indices: 0
   SharedItemPropertiesBox:
      0) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

3.3.5 Multiple Images with the same HEVC configuration and dimensions

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 0, 1
```

```
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 0, 1
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

3.3.6 Multiple Images with the same HEVC configuration and dimensions but different rotations

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'irot'
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties: 'irot'
         item properties indices: 0, 1
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties: 'irot'
         item properties indices: 0, 1
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties: 'irot'
         item properties indices: 0, 1
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

3.3.7 Multiple Images in a grid

The grid image is declared as an item, the grid description being enclosed in the corresponding information item entry.

NOTE: the item_type for item 5) could be 'dimg' and the same for grid, overlay … and all the others. That would simplify even more the spec.

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 5;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      5) item_type = 'grid', itemID=5, item_protection_index = 0 (unused)
         item properties: 'grid'
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
   ItemReferenceBox:
      type='dimg', fromID=5, toID=1,2,3,4;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

An alternative description would consist in placing also the ‘grid’ description in the SharedItemProperties

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 5;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      5) item_type = 'dimg', itemID=5, item_protection_index = 0 (unused)
         item properties indices: 2
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
      2) 'grid'
```

```
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
   ItemReferenceBox:
      type='dimg', fromID=5, toID=1,2,3,4;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

3.3.8 Multiple Images in a rotated grid

In this example, image operators are embedded in the information item entry.

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 5;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      3) item_type = 'hvc1', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      4) item_type = 'hvc1', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 0, 1
      5) item_type = 'grid', itemID=5, item_protection_index = 0 (unused)
         item properties: 'grid', 'irot'
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
      itemID = 3, extent_count = 1, extent_offset = P1, extent_length = Q1;
      itemID = 4, extent_count = 1, extent_offset = P2, extent_length = Q2;
   ItemReferenceBox:
      type='dimg', fromID=5, toID=1,2,3,4;
      MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
   HEVC Image (at file offset P2, with length Q2)
   HEVC Image (at file offset P3, with length Q3)
```

3.3.9 Multiple Images with overlay

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 3;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
```

```
      3) item_type = 'iovl', itemID=3, item_protection_index = 0 (unused)
         item properties: 'iovl'
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P0, extent_length = Q0;
   ItemReferenceBox:
      type='dimg', fromID=3, toID=1,2;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P1, with length Q1)
```

3.3.10 One image and its rotated version

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 3;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC', 'ispe'
      2) item_type = 'irot', itemID=2, item_protection_index = 0 (unused)
         item properties: 'irot'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
   ItemReferenceBox:
      type='dimg', fromID=2, toID=1;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
```

3.3.11 Two derived images with same rotation

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 3;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      3) item_type = 'dimg', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 2
      3) item_type = 'dimg', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 2
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
      2) 'irot'
```

```
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = W, extent_length = X;
      itemID = 2, extent_count = 1, extent_offset = Y, extent_length = Z;
   ItemReferenceBox:
      type='dimg', fromID=3, toID=1;
      type='dimg', fromID=4, toID=2;
MediaDataBox:
   HEVC Image (at file offset W, with length X)
   HEVC Image (at file offset Y, with length Z)
```

3.3.12 Tiled Images

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0
         item properties: 'ispe' (W,H)
      2) item_type = 'hvt1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
         item properties: 'rloc'
      3) item_type = 'hvt1', itemID=3, item_protection_index = 0 (unused)
         item properties indices: 0, 1
         item properties: 'rloc'
      4) item_type = 'hvt1', itemID=4, item_protection_index = 0 (unused)
         item properties indices: 0, 1
         item properties: 'rloc'
      5) item_type = 'hvt1', itemID=5, item_protection_index = 0 (unused)
         item properties indices: 0, 1
         item properties: 'rloc'
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe' (Wt, Ht)
   ItemLocationBox:
      itemID = 1, extent_count=1, extent_offset=X, extent_length=Q0+Q1+Q2+Q3;
      itemID = 2, extent_count=1, extent_offset=X,          extent_length=Q0;
      itemID = 3, extent_count=1, extent_offset=X+Q0,       extent_length=Q1;
      itemID = 4, extent_count=1, extent_offset=X+Q0+Q1,    extent_length=Q2;
      itemID = 5, extent_count=1, extent_offset=X+Q0+Q1+Q2, extent_length=Q3;
   ItemReferenceBox:
      type='tbas', fromID=2, toID=1;
      type='tbas', fromID=3, toID=1;
      type='tbas', fromID=4, toID=1;
      type='tbas', fromID=5, toID=1;
MediaDataBox:
   HEVC Image (at file offset X, with length Q0+Q1+Q2+Q3)
```

3.3.13 Auxiliary Image with same HEVC configuration and dimensions as the master image

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties indices: 0, 1
      2) item_type = 'hvc1', itemID=2, item_protection_index = 0 (unused)
         item properties indices: 0, 1
         item properties: 'auxC'
   SharedItemPropertiesBox:
      0) 'hvcC'
      1) 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
      itemID = 2, extent_count = 1, extent_offset = P, extent_length = Q;
   ItemReferenceBox:
      type='auxl', fromID=2, toID=1;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   HEVC Image (at file offset P, with length Q)
```

3.3.14 Image with Sub-sample description

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'hvcC', 'ispe', 'subs'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
```

3.3.15 Shared HEVC config between track and item

```
FileTypeBox:   major-brand = 'heic', compatible-brands = 'heic, mp41'
MetaBox: (container)
   HandlerBox: hdlr = 'pict'
   PrimaryItemBox: itemID = 1;
   ItemInfoBox:
      1) item_type = 'hvc1', itemID=1, item_protection_index = 0 (unused),
         item properties: 'sder' (track: 1, sample_desc_index: 1), 'ispe'
   ItemLocationBox:
      itemID = 1, extent_count = 1, extent_offset = X, extent_length = Y;
Movie Box: (container)
   Movie header, tracks (including track 1 with at least 1 sample desc), etc.
as required by MP4
MediaDataBox:
   HEVC Image (at file offset X, with length Y)
   Media data as needed by the movie (some may be shared with the image data)
```

4 Conclusion

We recommend MPEG to adopt the attached edits to the current draft and to reissue an FDIS draft or to re-ballot the text as a new DIS text if NB comments are deemed necessary.