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# General considerations

## Purpose of this document

This exploration document and/or its technologies may eventually evolve into one or more of the following outcomes:

* Technical Report that describes the mapping between ISOBMFF, CMAF, and DASH terms and concepts.
* ISOBMFF extensions to indicate a track grouping that is equivalent to a CMAF Switching Set and a DASH Adaptation Set
* ISOBMFF extensions equivalent to indicating switching between DASH Adaptation Sets
* ISOBMFF extensions allowing hierarchical track grouping, for applications such as signaling preselections of DASH Adaptations Sets.

## Background

Some structural functionalities in DASH and ISOBMFF have not been fully harmonized. The file format typically assumes that all tracks are contained in a single file and a single movie header documents all tracks included in the file, but also provides the relationship of these tracks for presentation. A few file format functionality that are relevant include:

* Each media stream is contained in a track specialized for that media type (audio, video, etc.), and is further parameterized by a sample entry.
* Each sample entry:
  + contains the codingname (format) of the exact media type (i.e., the type of the decoder needed to decode the stream) and any parameterization of that decoder needed.
  + The codingname takes the form of a four-character code (4CC).
  + There are defined sample entry formats not only for MPEG-4 media but also for the media types used by other organizations using this file format family.
  + To avoid "collisions", sample entry formats are registered at the [MP4 registration authority](https://mp4ra.org/).
* Tracks have assigned media-specific properties/annotation (codec, width, height, etc.)
* Tracks may have relationships to other tracks. E.g.:
  + **Track references**: track N uses or refers to track(s) K (hint, chap, scale)
  + **Track groups**: Tracks in the same group share a common feature
  + **Track Selection**: Provides selection information for alternate tracks
    - New features have been added or about to be added, such as dependencies, Pre-selection, etc.
  + **Track alternatives**: Tracks (or sub-tracks) may be identified as alternatives to each other, and there is support for declarations to identify what aspect of the track can be used to determine which alternative to present, in the form of track selection data.
* Samples of a track may be encrypted
* Tracks have random access samples

Some of the ISOBMFF technologies are not used by CMAF or DASH, as CMAF and DASH rely heavily on the concept of late binding, i.e. each track is stored in a separate file, as shown in Figure 1 below.

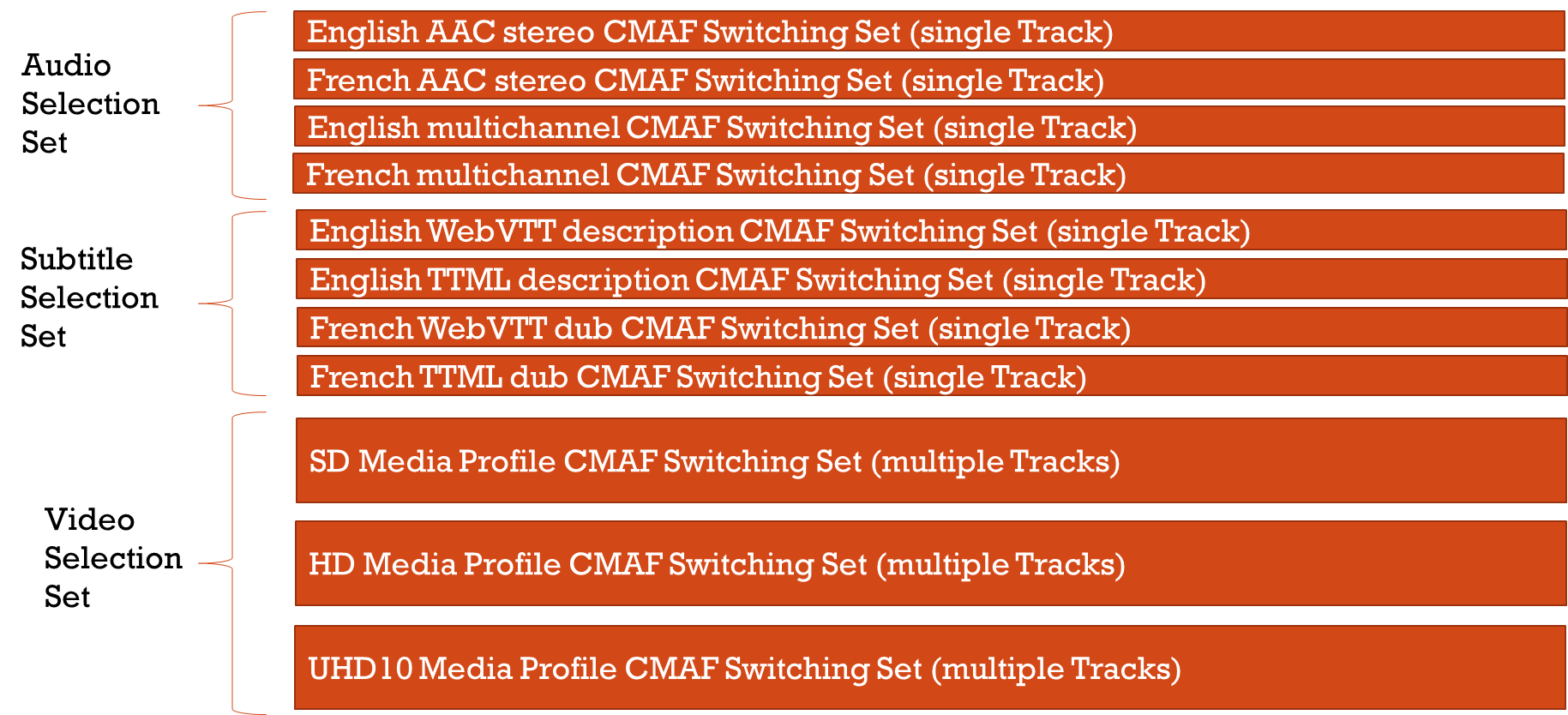


Figure 1: Example of CMAF selection sets (from CMAF specification)

In a streaming environment, this avoids combinatorial complexity or useless downloads, as clients only select the relevant tracks for the current situation, and only download these tracks and do synchronized playout. MSE-based HTML-5 playback allows exactly this. However, this results in each track having its own ISOBMFF/MP4 file, and suddenly certain concepts of the ISOBMFF are no longer applicable, because:

1. The requirements for the file to have unique track identifiers are not carried forward
2. Each file includes its movie header and the relationship between the tracks cannot be expressed

In a streaming environment, the information contained in a movie header for many tracks needs to be populated to the manifest so that the client can select the tracks based on this information.

CMAF specifies so called CMAF addressable mdeia objects that can be referenced as resources by a manifest and are used for conceptual grouping on top of the definitions in ISOBMFF. Such concepts are:

* CMAF Presentation
* CMAF Tracks
* CMAF Selection Sets
* CMAF Switching Sets
* CMAF Aligned Switching Sets
* CMAF Groups
* Depending on switching sets
* Etc.

For example, in CMAF it is not specified that all tracks in a CMAF switching track shall conform to a track group according to the ISOBMFF.

## Processing Diagram

Packaging for Streaming   
(parameters: segment duration, low latency, …)

Packaging for local playback   
(losing delivery aspects: segmentation, availability, …)

Figure 2: Simplified file conversion processing diagram

Different potential processes exist for converting ISOBMFF content into CMAF/DASH delivery and vice versa. Processing use cases may for example be:

1. A content provider has generated CMAF content for a movie or a CMAF presentation. For storage efficiency reasons, the content provider wants to store the entire CMAF presentation in an ISOBMFF file format that is compatible with the existing file format. At the same time, the content provider wants to re-generate the CMAF Presentation when for example it is converted into a DASH/HLS streaming session.
2. A receiver wants to record a streamed DASH Presentation into an ISOBMFF file format compatible file with minimum changes.

Other cases may be defined.

## Requirements and scenarios

* It should be possible to store a CMAF presentation in a multi-track MP4 file and recover a CMAF presentation from this multi-track MP4 file.
* Using the DASH Profile for CMAF content it should be possible to generate a DASH Media Presentation (MPD and Segments) using such a recovered CMAF Presentation. Based on this, it should be possible to generate a DASH Media Presentation from a multi-track MP4 file.
* It should be possible to offer the same presentation options than the MPD offers in a local MP4, including bitrate variations (for debugging purposes but also battery efficiency use cases).

*We need to consider live cases, where you would only get the MP4 init segment (with multiple tracks in it), can you produce an MPD from that only? Not having the media segments you cannot know in advance if they are aligned and thus cannot produce the proper MPD grouping, without additional signaling. Hence, there needs to be a property assigned to multiple tracks that provides in the movie header the information that the tracks will be produced in an aligned fashion.*

## Previous work summary

Document WG03N867 ([MDS22609](https://dms.mpeg.expert/doc_end_user/current_document.php?id=87755&id_meeting=194)) summarizes the exploration before the MPEG#144 meeting. This document is the result of the contributions to and discussions at the MPEG#144 meeting and only focuses on the results of the contributions and discussions during this meeting.

# Proposals

## Signaling the CMAF switching sets and DASH adaptation sets in ISOBMFF

### Use case

The use case allows signaling the properties of a group of the ISOBMFF tracks in an ISOBMFF file. The main common use cases are:

1. A CMAF switching set/DASH adaptation set consists of two or more tracks
2. A switchable group of CMAF switching sets/two or more DASH adaptation sets that are seamlessly switchable.
3. An alternate group of CMAF switching sets/ DASH adaptation sets in which the player selects one CMAF switching set/DASH adaptation set and plays the content. If the player decides to switch to a new switching set, the switching is not necessarily seamless.
4. Dependable CMAF switching sets/DASH adaptation sets where one CMAF switching set is not decodable without another CMAF switching set.

### Signaling the CMAF switching sets and DASH adaptation sets in ISOBMFF (based on m65284, [m65071](https://dms.mpeg.expert/doc_end_user/current_document.php?id=89692) and [m66323](https://dms.mpeg.expert/doc_end_user/current_document.php?id=91222))

Latest discussion can be found at [MPEG GitLab](https://git.mpeg.expert/MPEG/Systems/FileFormat/isobmff/-/issues/261).

**Syntax**

aligned(8) class SwitchingGroupBox  
extends EntityToGroupBox('swit', version=0, flags){  
 unsigned int(1) seamless\_switch\_flag;  
 unsigned int(1) timed\_aligned\_flag;  
 unsigned int(2) init\_type;  
 unsigned int(4) reserved;  
 if (flags & 0x001000) utf8string tag;  
 if (flags & 0x002000) utf8string structural\_brand;  
 if (flags & 0x004000) utf8string mediaprofile\_brand;  
 Box boxes[]; // optional other boxes e.g. ExtendedLanguageBox  
}

**Semantics**

seamless\_switch\_flag equal 1 indicates that the entities of this group are seamlessly switchable with each other, i.e. each entities is an alternative encoding of the same source content and switching any two of them at any moment during the playback would result in the continuation of playback of the source content that are seamless. The exact definition of the seamless switching is defined by the structural brand and/or media profile brand.

time\_aligned\_flag equal 1 indicates the tracks which directly or indirectly belong to this group are timed aligned at the substructural level (e.g. fragment/segment/subsegment), i.e. any two corresponding substructure elements of any two tacks have the same start time and duration. The nature of the substructure and the exact definition of time alignment are defined by the structural brand and/or the media profile brand.

init\_type with the following values:

* 0: The first entity in this group can be used to initialize a decoder for decoding any track that directly or indirectly belongs to this group.
* 1: Every track directly or indirectly belonging to this group can be used to initialize a decoder for decoding any track that directly or indirectly belongs to this group.
* 2: Every track which directly or indirectly belongs to this group is self contained for initializing a decoder for decoding its content.
* 3: reserved

tag specifies the additional information about the entity group which may be used for selection purposes for the decoder. For MPEG-H Audio the value of this field shall contain the whitespace-separated list of mae\_GroupIDs that are contained in the described switching group.

structural\_brand specifies the structural brand of all direct and indirect entities of this group.

mediaprofile\_brand specifies the media profile brand that all direct and indirect entities of this group conform to.

### Comments during MPEG#144 and MPEG#145

1. We welcome additional clarifications on the following:
   1. Coverage of grouping from DASH: Adaptation sets, switchable adapations sets
   2. Coverage of grouping from CMAF: CMAF switching sets, aligned CMAF switching sets, CMAF selection sets.
   3. Can semantics be written in a ‘pure’ ISOBMFF terminology?

The following terms seem to be used by ISOBMFF:

* + 1. Switch (between tracks)
    2. Selection and switching
    3. Timeline alignment (of tracks), presentation timeline aligned zero point.
    4. Initialization segment, segments, movie fragment, subsegment,
  1. Where should this be standardized? ISOBMFF/CMAF/DASH

If it is intended to be used in the most general way, in ISOBMFF. It can be added to CMAF, if the main use case is believed to be only CMAF and DASH.

* 1. Missing parameters

1. "timed aligned at the substructural level" may still be too vague.
2. Brands in ISOBMFF are four-character codes. Why is utf8string used in mediaprofile\_brand rather than unsigned int(32) mediaprofile\_brand?
3. The definition of the seamless switching is potentially problematic since a player implementer may interpret this s.t. it can switch tracks "at any moment during the playback", i.e. also at non-sync samples. This may break playback for some codecs. I would propose to get rid of the "at any moment" and add an additional flag saying whether a switch is only possible at sync samples or not.
4. With preselections we decided to use this Box boxes[]; and explain which boxes are intended in the semantics, see clause 8.18.4.1. Would this be an option?
5. Should we add a note saying what the value of init\_type should be in case all tracks belonging to the group have track\_in\_movie set to 0?

## Signaling DASH descriptors in ISOBMFF (based on [m65349](https://dms.mpeg.expert/doc_end_user/current_document.php?id=89970))

[GitLab discussion](https://git.mpeg.expert/MPEG/Systems/FileFormat/isobmff/-/issues/246).

### Usecase

The DASH specification uses the DASH descriptors to annotate media streams with various properties.

The upcoming DASH REaP specification proposes “Storage Track Identifiers” for its “Track format for storage of live archives”. These track identifiers are defined as counterparts for DASH and CMAF constructs. Within the file format, it is proposed to utilize the ‘kind’-Box by setting the schemeIdUri string to the respective identifier.

The File Format specification with its TrackKindBox offers an obvious solution to carry such data, but as defined today it is restricted in its feature coverage.

### Identified Problems with TrackKindBox

Considering the possibilities offered by DASH’s DescriptorType, the ISOBMFF TrackKindBox has several drawbacks:

* **Location**: While the TrackKindBox (‘kind’) is restricted to be used on tracks only, some of the DASH DescriptorType-derived elements may be present on different levels as well (e.g. on Period-level: AssetIdentifier, SupplementalProperty). Therefore, this limitation of the TrackKindBox prohibits its usage as a coequal signaling method.  
  If the TrackKindBox is envisioned to be used for the beforementioned generalized purposes, its location needs to be allowed at various other locations as well.
* **Naming**: A DASH packager and manifest generator operated on a “master” ISOBMFF file would require detailed knowledge about each possible scheme definition to write the appropriate DASH element.  
  Sometimes such generation based on implicit knowledge is difficult (e.g. both the DASH Role and Accessibility elements utilize the same schema definition), sometimes this might not be possible at all (comparing e.g. SupplementalProperty or EssentialProperty descriptors).
* **Grouping**: The possibilities offered by the @id attribute optionally available with DASH DescriptorType-derived elements cannot be implemented with the TrackKindBox.
* **Scope:** Furthermore, considering a DASH packager workflow, if the TrackKindBox would be used for the carriage of identifiers as proposed by the DASH REaP draft, such identifiers rather require getting deleted by DASH segmenters/packagers (or they are to be ignored by a player/client). To accomplish this, a packager requires knowledge of each possible schema it might ever see. Such full coverage of definitions is rather error-prone, considering that region-specific or private definitions might occur.

### Proposal

It is recommended that the file format group decides on how the TrackKindBox is to be used in the future and whether other derived boxes would be desirable. For instance, a very generic and maybe too broad solution was already provided as m64293.

As far as controlling packager operation is concerned, a dedicated box targeting packagers only might elegantly avoid the problems of the scope of an identifier, such as:

**Packager Identifier**

**Definition**

Box Type: '????'  
Container: UserDataBox, AudioElementBox or PreselectionGroupBox  
Mandatory: No  
Quantity: Zero or more

The PackagerIdentifierBox labels a track with its role or kind.

It is derived from and has the same syntax as the TrackKindBox: It contains a URI, possibly followed by a value. If only a URI occurs, then the property is defined by that URI; if a value follows, then the naming scheme for the value is identified by the URI.

The PackagerIdentiferBox is intended to be used to guide streaming segmenters/packagers. While segmenters are expected to remove these Boxes when generating their output files or segments, players are expected to ignore them.

**Syntax**

aligned(8) class PackagerIdentifierBox  
extends KindBox('????', version = 0, 0)  
{}

### Comments during MPEG#144

1. How do we want to map DASH Adaptationset-level descriptors into the new EntityGrouping approach (see clause 2.1), given the mismatch between descriptorType and the kind box?