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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.

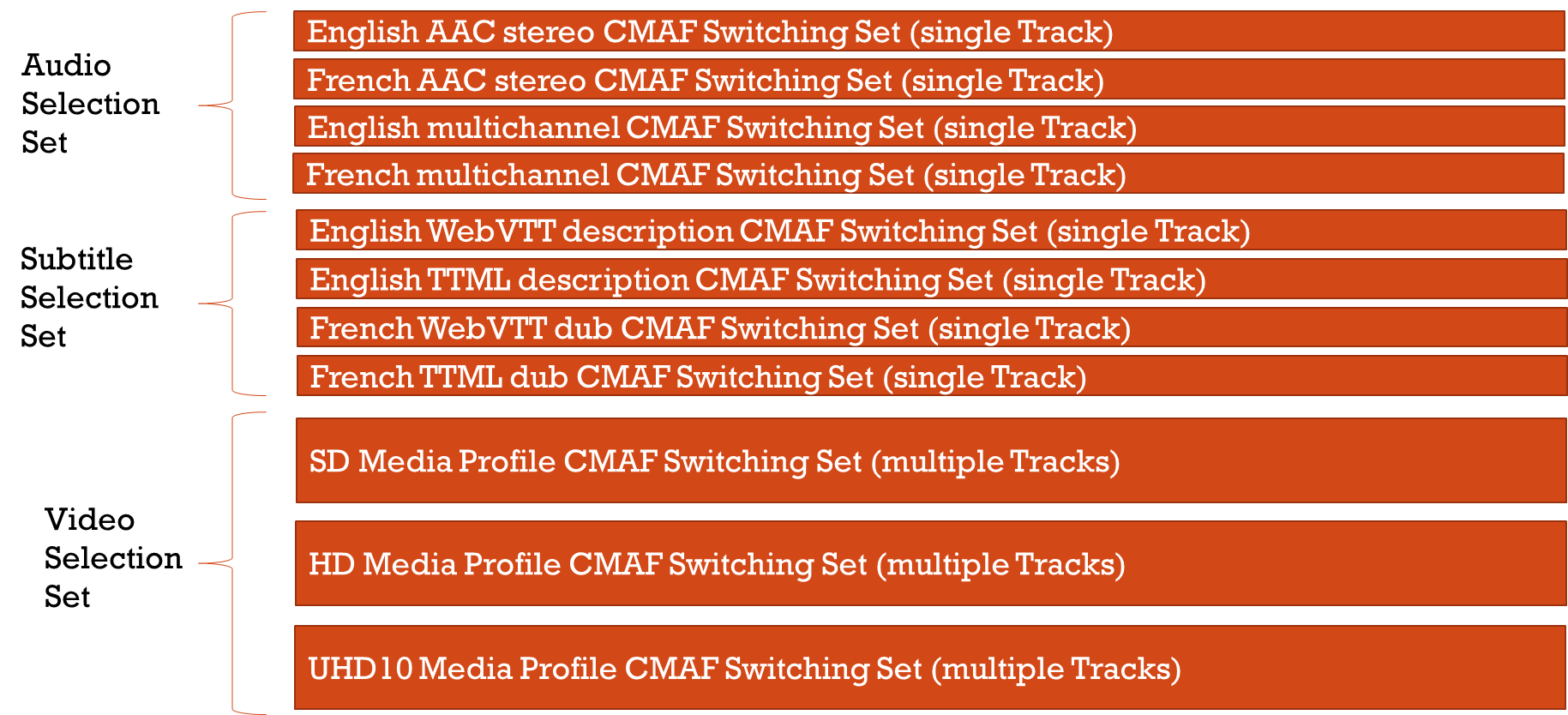


Figure 1: Example of CMAF selection sets (from CMAF specification)

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 DASH descriptors in ISOBMFF (based on m65349 and m67836)

[Git discussion](https://git.mpeg.expert/MPEG/Systems/FileFormat/isobmff/-/issues/246) 1.

[Git discussion 2](.%20https:/git.mpeg.expert/MPEG/Systems/FileFormat/isobmff/-/issues/287).

### 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 KindBox parameters carry the following DASH descriptor attributes:

1. KindBox’s schemeURI to include the URI intended to be the DASH descriptor’s schemeIdUri, optionally followed by only one of the following strings to indicate the target DASH descriptor, separated with a white space.

Note: In the case of not including the string for the Target DASH descriptor, the DASH Supplemental Descriptor is used.

|  |  |
| --- | --- |
| **String** | **Target DASH descriptor** |
| ContentProtection | ISO/IEC 23009-1, 5.8.4.1 |
| Role | ISO/IEC 23009-1, 5.8.4.2 |
| Accessibility | ISO/IEC 23009-1, 5.8.4.3 |
| Rating | ISO/IEC 23009-1, 5.8.4.4 |
| Viewpoint | ISO/IEC 23009-1, 5.8.4.5 |
| Framepacking | ISO/IEC 23009-1, 5.8.4.6 |
| Audiochannelconfiguration | ISO/IEC 23009-1, 5.8.4.7 |
| Essential | ISO/IEC 23009-1, 5.8.4.8 |
| Supplemental | ISO/IEC 23009-1, 5.8.4.9 |
| AssetIdentifier | ISO/IEC 23009-1, 5.8.4.10 |
| UTCTiming | ISO/IEC 23009-1, 5.8.4.11 |
| OutputProtection | ISO/IEC 23009-1, 5.8.4.12 |

1. KindBox’s value to include the string intended to be included in the DASH descriptor’s value, optionally followed by the string intended to be used as the DASH descriptor’s id, separated with a white space:

@value = [Dash-Descriptor-Value=<scheme>] [sp [DASH-Desciptor-Id=<id>]]

where scheme and id are intended to be included as the values of the DASH descriptor's @value and @id attributes, respectively.

The strings "Dash-Descriptor-Value=" and "Dash-Descriptor-id=" are not permitted to be used as a part of the <scheme> or <id>s.

Note: If the string is not provided for the DASH descriptor’s id, the assigned DASH descriptor’s id shall be unique among the descriptors ids used for the same element.

### Comments during MPEG#144

1. What about appending the @id *after* the *descriptor name* as part of the schemeIdUri field?

i.e.: schemeIdUri=<scheme> [<name> [<id>]]

Of course, this makes the id dependent on a descriptor name, which is (in my understanding) a reasonable restriction.

1. This approach of defining the SupplementalProperty as "default" is problematic since a packager would not know, whether:
2. the respective Kind box is expected to trigger a DASH descriptor (and the kind box being removed from the init segment) or
3. the kind box shall stay in the init segment and is not expected to show up as descriptor

Defining a "default" per option b as described above would make more sense to me since this does not harm legacy implementations.

Given that REaP goes to 2ndDIS, let's capture this issue as note in TuC and put it on our agenda for next meeting as well.