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1. Introduction

The ability to seamlessly play DASH content from different periods is an interesting feature. Smart players may already have this ability in some situations, for instance using double download, double decoding … However, players with restricted capabilities (e.g. with a single decoder) should be able to do so, at least in some specific scenarios. It would therefore be interesting to signal that possibility in the DASH manifest. This contribution analyses and reviews different options.

2. Analysis and dicussion

a. Client behavior vs. DASH description

To the best of our knowledge, there are two types of DASH players: those which clearly separate the DASH Access Engine from the Media Engine; and those which don't. The second type is for instance the MSE-based players where parsing of media data is done in the access engine (for instance parsing the sidx box, adjusting timestamps, …) prior to forwarding the media to the media engine. Those players are smart players, they can already detect or manipulate the media data so that periods can be seamlessly played. Other players can be modelled in two ideal steps:

- media segments are downloaded (during their availability, based on representation selections and adaptation algorithms) and concatenated without modifications by the access engine;
- the result of the concatenation is then played by the media engine. The concatenation may be physical and the media engine is assumed to be able to detect new initialization segments; or the concatenation may be logical and given to the media engine by a simple playlist.

Seamless period playback signaling should be designed for this second class of players.

b. Single adaptation set, single representation

Consider 2 Periods P1 and P2, with 1 Adaptation Set per Period: A11 in P1 and A21 in P2 with one single media (unmultiplexed) representation per Adaptation Set. So the DASH player wants to play A21 after playing A11.

In this simple case, there are 2 options:

- either a codec re-initilization is needed. In this case, not much can be done to achieve seamless playback.
- or the codec parameters are the same or compatible such that a decoder re-initialization is not needed.

In this latter case, an indication that the media content can indeed be concatenated between A11 and A12 is worthwhile (what is called "period-concatenable" adaptation sets in m33284). However, this does not guarantee seamless playback if the timestamps in the media are not aligned. There may be two configurations of timestamps to handle:

- a gap in presentation: the sum of the timestamp and duration of the AU of A11 is smaller than the first timestamp of A12.
- an overlap in presentation: the sum of the timestamp and duration of the AU of A11 is greater than the first timestamp of A12

Some players may handle gaps seamlessly (i.e. by inserting silence, or increasing the duration of a frame); while some players may not. For instance, in HTML 5 browser supporting MSE, if a player detects a gap in one representation, it may transition to a stalled mode. The size of a gap depends on the media type, on the number of medias being played. The MSE spec indicates that gaps can be detected when the timestamp difference is greater than an audio frame size[1]; or when the timestamp difference is greater than twice the duration of a frame[2].

Similarly, overlaps can be problematic and could require 2 decoders to handle seamless playback.

We propose to signal:

- that the concatenation of media across period is conformant (same initialization segment)
- that the earliest presentation timestamp of the second period is greater than the end presentation time of the first period
- that the difference between the @presentationTimeOffset of the representation of the second period and its earliest presentation timestamp of the second period is equal or smaller than the difference between the first period duration and the media duration in that period (no overlap).

[1] https://dvcs.w3.org/hg/html-media/raw-file/tip/media-source/media-source.html#byte-stream-format-specs

[2] https://dvcs.w3.org/hg/html-media/raw-file/tip/media-source/media-source.html#sourcebuffer-coded-frame-processing

Note that the current DASH spec already allows creating MPD with gaps and overlaps with the @presentationTimeOffset, which may be greater than the earliest presentation time of a segment, but there is no conformance test and it is believed not to be supported by existing players. We therefore also propose to add the following conformance sequences:

Name	Feature
Period-Gap-1	A sequence with 2 periods (1 AdaptationSet, 1 representation, same codec configuration) where the duration of the first period (as defined by the @duration of the first period or the @start of second period) is greater than the duration of the media content in that period
Period-Overlap-1	Similar to Period-Gap-1, but with the duration of the first period is smaller than the duration of the media content in that period
Period-Gap-2	Similar to Period-Gap-1, but with the duration of the first period is equal to the duration of the media content in that period, and with the second period with a @presentationTimeOffset smaller than the ealiest presentation time of the media content in that period.
Period-Overlap-2	Similar to Period-Gap-2, but with the @presentationTimeOffset greater than the ealiest presentation time of the media content in that period.

c. Single adaptation set, single multiplexed representation

The above approach can be adapted taking into account only the reference stream or making it valid for all streams.

d. Single adaptation set, multiple representations

Because in typical cases there is time-alignment between representations in an AdaptationSet, the signaling can be done at the AdaptationSet level instead of the Representation level.

e. Multiple adaptation sets

There is a need to relate AdaptationSets together. This can be done as proposed in m33284 (reusing the same AdaptationSet@id) or with other means (explicit reference of AS@id in a @continuityOf attribute).

3. Conclusion

We propose to include the proposed changes in a TuC document for DASH and to welcome feedback from implementers on the above analysis before inclusion in a DASH amendment.