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1 Introduction

At MPEG#116 meeting, the contribution m39255 [1] proposed to introduce new DASH descriptors for better controlling the adaptation in terms of quality when more than one Adaptation Set of a given media type are being streamed simultaneously. While m39255 introduced these descriptors through the example of tile-based streaming, one question was then whether other use cases than SRD and tiles related ones could benefit from such descriptors. This contribution provides new use cases highlighting potential issues in quality control and how the proposed descriptors could help to solve these issues.

2 Use cases depending on quality control

2.1 Motivation

While traditionally DASH clients select and play one Representation from one Adaptation Set of a given media type, more advanced use cases start to appear involving multiple Representations from multiple Adaptation Sets of a given media type . This introduces some complexity for clients' adaptation logic due to possible combinations of Representations across Adaptation Sets. In particular, when switching is required due to, for example, variations in the available bandwidth, the client will have to select an appropriate set of Representations, potentially from different Adaptation Sets. This makes adaptation logic more complicated than simply switching to the next or to the previous Representation in one active Adaptation Set. This is why we think that additional signaling may be helpful for these advanced use cases. The sections below provide examples of use cases and how the descriptors proposed in [1] can help clients' selection.

2.2 Picture in Picture use case

2.2.1 Problem

This use case involves two videos to be streamed and displayed simultaneously. Assuming there are several alternative Representations for each video, one can see that it leads to several combinations (e.g., 12 in figure below) when quality adaptation and switching is required. If no indication is given in the MPD, the experience may vary from one client to another. For example, one client may decide to try to keep best quality on Video 1 and degrading Video 2. At the reverse, another client may degrade the bigger video (Video 1) to save more bandwidth... Clearly, if there is no indication in the MPD, the experience consistency is not guaranteed. Then,

MPD authors may be interested in either signaling a subset of possible combinations or rules indicating how to adapt the two videos simultaneously. By looking at the MPD below, there is no such indication. The Representation@qualityRanking would not help more since it only ranks Representation inside one AdaptationSet.

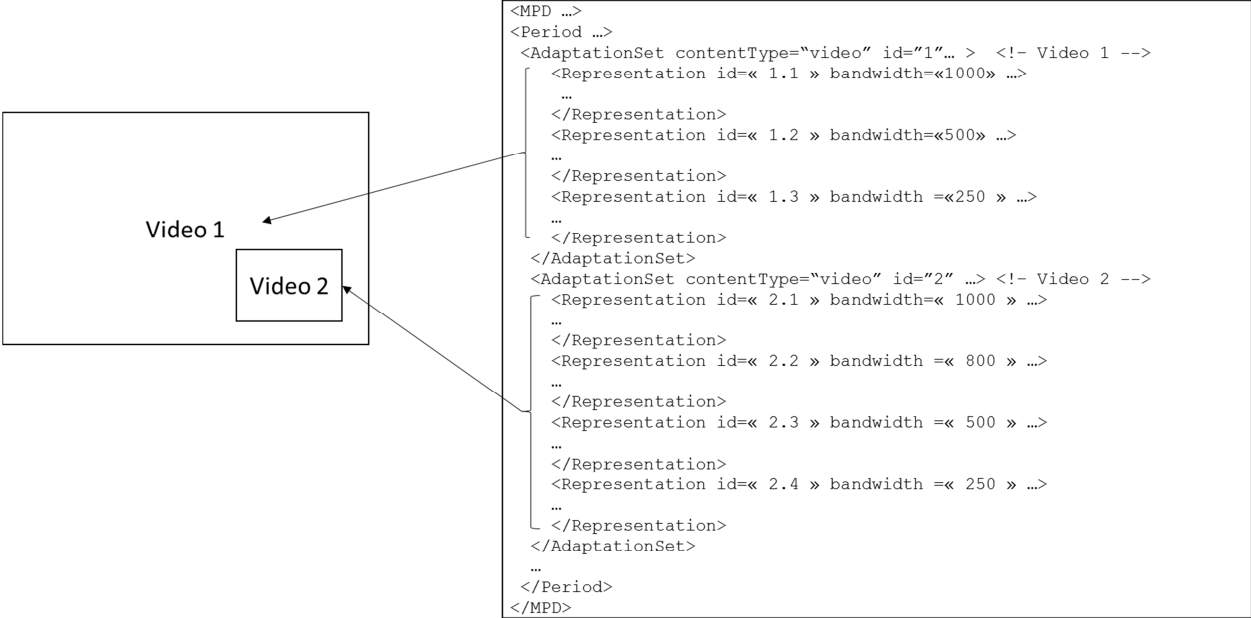


Figure 1: Current MPD (without any descriptor for quality control)

2.2.2 Proposed Solution

By rewriting the above MPD with the two proposed descriptors for quality control (“quality rule” and “quality equivalence”), a client knows which versions of the 2 videos the MPD author suggested to combine together (object of “quality_equivalence” descriptor). Moreover, the client is informed on how to degrade gracefully both videos, as indicated by the first “quality_rule” descriptor with a value=”0” forbidding any difference in terms of quality levels between the 2 videos (i.e switching to a quality level simultaneously for both videos).

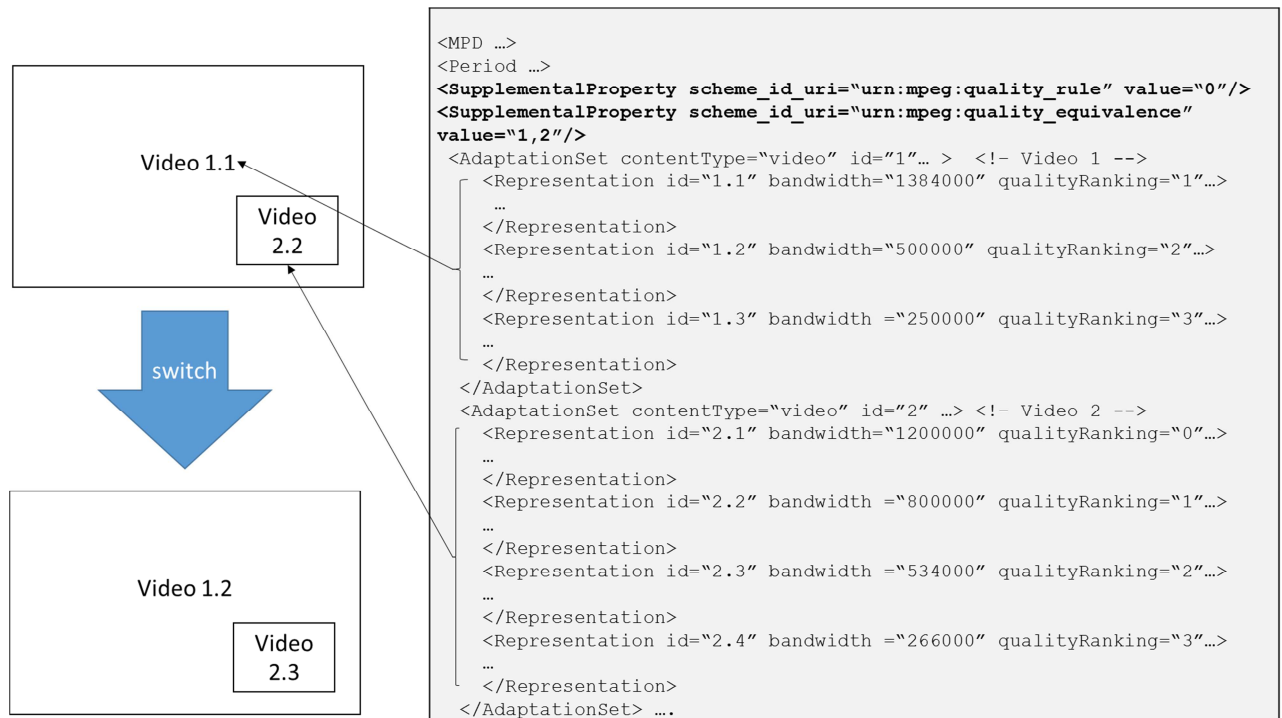


Figure 2: MPD example with the proposed quality control descriptors reusing @qualityRanking

In the above example, the “quality_equivalence” descriptor is proposed as a <SupplementalProperty> with a new @schemeIdUri value that indicates that the @qualityRanking provides a cross AdaptationSet qualityRanking and a “value” attribute that provides the list of the AdaptationSets (as a list of ids) concerned by this @qualityRanking overloading (in previous example, the Adaptation Sets of the two videos). From the example MPD, the author indicates that a client should preferably select one Representation in each Adaptation Set, each Representation having the same @qualityRanking value.

Note: in case it is not desirable to overload the semantic of the @qualityRanking by the new quality_equivalence descriptor (for example to avoid backward compatibility issues), a new attribute can be defined specifically as a quality indication at Representation level. The MPD example below provides an example for such new attribute (called “preselect” here).



Figure 3: MPD example with the proposed quality control descriptors and new @preselect attribute

To summarize:

- the first DASH descriptor above describes a quality control rule (here no quality difference in the set of simultaneously selected Representations)
- the second DASH descriptor defines the list of AdaptationSets onto which the quality control rule applies, the quality values to align Representations across AdaptationSets in terms of quality being provided by the @preselect attribute.

2.3 Multiple videos

The same principle would apply in a use case with mosaic of videos, for example a TV program guide or a video surveillance monitoring system or more generally when multiple videos are streamed and rendered at the same time.

Using only @bandwidth is not sufficient since the bitrate of the video is not directly related to the quality. As well, fixing a bandwidth sharing among the different Adaptation Sets may not be optimal. When one wants to simultaneously stream videos from different Adaptation Sets, potentially from different codecs, a quality equivalence descriptor is required.

2.4 Multiple codecs for the same content

Some recommendations, such as DASH-IF, enforces that a single codec type is used within one AdaptationSet, while allowing several codec types for the same media to be declared in the MPD (for example, a mix of AVCIH264 and HEVC). MPEG-DASH provides the tools to indicate that switching across such AdaptationSets is possible, but lacks the possibility to describe equivalent qualities (for the author) of the various Representations. When switching from a given quality in an AdaptationSet to another AdaptationSet, a client may therefore not be able to select the closest quality in the target AdaptationSet which may result in a more perceivable quality change as desired by the adaptation logic. The proposed quality_equivalence descriptor would help solve this issue.

2.5 Next generation audio use cases

Recent use cases for next generation audio where multiple audio streams can be streamed and rendered at the same time led to the creation of new descriptor and element called Preselection. The Preselection element allows to declare in the MPD a combination of Adaptation Sets that form a specific experience and can be selected for joint decoding and rendering. This combination of AdaptationSets is described in a “preselectionComponents” attribute. The preselectionComponents specifies the ids of the contained elements/content components of this Preselection list as white space separated list in processing order. The first id defines the main element.

While Preselection allows a content creator to declare subsets of media resources (from a bundle) that a client is expected to select jointly to obtain a better user experience, it does not provide any guidance on how to adapt the selected set of resources when the available bandwidth varies. As such, use cases based on Preselection would also benefit from the two “quality_equivalence” and “quality_rule” descriptors.

The example below illustrates how these two descriptors could be used with <Preselection>, especially when the AdaptationSets referenced by the @preselectionComponents contain more than one Representation.

```
<?xml version="1.0" encoding="UTF-8"?>
<MPD ...]>
  <Period ... >
    <SupplementalProperty schemeIdUri="urn:mpeg:dash:max_quality_difference"
value="2"/>
    <SupplementalProperty schemeIdUri="urn:mpeg:dash: quality_equivalence"
value="P1"/>
    <AdaptationSet id="AS1" [...] >
      <!-- Containing 3 alternative Representations 0 for high quality, 1 for mid-quality and 2 for
low quality -->
        <Representation id="1.1" bandwidth="5000000" width="1920" height="1080"
preselect="0"...> ... </Representation>
        <Representation id="1.2" bandwidth="2500000" width="1920" height="1080"
preselect="1"...> ... </Representation>
        <Representation id="1.3" bandwidth="1000000" width="1920" height="1080"
preselect="2"...> ... </Representation>
      </AdaptationSet>
      <!-- Description of other Adaptation Sets, each with alternative Representations, part of the
Preselection " -->
    <AdaptationSet id="AS2" [...]>
    <Preselection id="P1" preselectionComponents= " AS1, AS2..." levels="0, 1, 2"... />
    <!-- This is the content component selection element -->
    ...
  </Period>
</MPD>
```

The above MPD example illustrates how the two “quality-rule” and “quality-equivalence” descriptors can be declared.

First, for quality equivalence, the <SupplementalProperty> with the scheme id uri value to “urn:mpeg:dash:max_quality_equivalence” indicates that the quality equivalence concerns the

Preselection “P1”. then, as on figure 3, the Representation@preselect attribute is used to describe the different quality levels. Optionnally, the Preselection element is extended with a new @levels attribute that is reserved for the description of the list of possible quality levels available in the AdaptationSets referenced by the Preselection. The values listed in @levels correspond to the values in each @preselect attribute of each Representation in the referenced AdaptationSets via the @preselectionComponents.

From the above example, a client can immediately identify three levels of qualities in the Preselection that are “0”, “1” and “2”.

For quality-rule description, in the above example the first SupplementalProperty with the scheme id uri value “urn:mpeg:dash:max_quality_difference” indicates that no set of Representations with more than 2 levels of quality in the Preselection P1 should be selected simultaneously.

To summarize:

- the first DASH descriptor above describes a quality control rule (quality difference lower than 2 quality levels)
- the second DASH descriptor, in combination with the @preselect attribute, indicates which parts of the MPD have some quality equivalence description available and onto which the quality control rule applies. (Note that as for example in section 2.2, @qualityRanking may be used instead of @preselect if we authorize overloading of @qualityRanking semantics).

3 Recommendation

This contribution shows that quality_equivalence and quality_rule descriptors can be useful for use cases where several Representations of a same media type are streamed and rendered simultaneously. We recommend MPEG DASH group to consider this additional signaling to help client selection.

4 References

- [1] m39255, “*Quality adaptation for tile based streaming in DASH*”, MPEG#116, Chengdu, October 2016.