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Title Quality adaptation for tile based streaming in DASH
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1 Introduction

This contribution first describes experimentations done with DASH SRD and tile-based streaming and highlights a technical issue regarding quality adaptation when a DASH client streams and displays multiple tiles at a time. Some signalization that can help DASH client in solving this issue is finally proposed for inclusion in the MPD.

2 Problem description

Assuming a streaming client stitching several tiles to build and display a video, the streaming client, when bandwidth varies has to adapt the quality not for a single video stream but for the whole set of tiles that form the video. For videos where a region of interest is provided, the challenge for the streaming client is to preserve a good global quality over the whole video, to have the best quality on the region of interest and to avoid quality jumps between the ROI and surrounding tiles.

The figure 1 below illustrates the case of a video split into spatial tiles, with several quality levels per tile. The issue for the client is to select a good set of tiles: good quality for a user-selected region of interest but also acceptable quality for surrounding tiles so as to avoid unpleasant visual effects at tiles borders, like blocking effects or non-homogeneous compression artifacts.

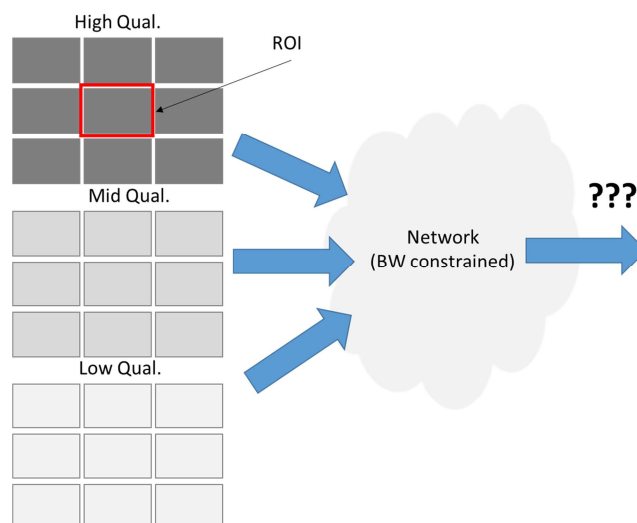


Figure 1: Video encoded for tile-based streaming

In terms of MPD, each tile would be described in its own AdaptationSet with an SRD descriptor indicating the spatial relationship of this tile with respect to a full video and with respect to other tiles from the same content (SRD with the same source_id). An example of such MPD is discussed in section 4.3 of TuC [1]. In this scenario, each AdaptationSet would contain three alternative Representations in terms of quality/bitrate (as on the left of above figure).

While streaming such content, a DASH client has (too) many possible selections in terms of Representations described in the MPD to stream and display the video resulting from the selection of a set of tiles.

One possibility could be for the content creator to describe some configurations that provide a good quality, but this may be painful due to the potentially great number of combinations. (This point is discussed in TuC [1]).

As well, letting the client do the adaptation by itself would not be so easy and will result in different quality of experience depending on the adaptation logic implemented by the client.

We therefore think some signaling in the MPD can be useful to help the client automatically select a good set of tiles.

3 Proposal

In order to guarantee a consistent user experience across DASH clients, the content creator needs to indicate some guidance on the selection of spatially related content, especially in terms of quality. For that, the MPD should provide signaling means to associate media components having a quality level that the content creator considers as equivalent.

3.1.1 Cross adaptation set quality signaling

The existing @qualityRanking in Representation element could be used for that. Unfortunately, its scope is limited to one AdaptationSet; i.e. it allows an ordering of Representations according to a quality level inside a single AdaptationSet.

Our use case requires relating the quality of Representations across AdaptationSets. One possibility to allow that can be to signal that @qualityRanking semantic is overloaded to apply across Adaptation Sets by the inclusion of a new descriptor at Period level (or even at MPD level if the quality ranks do not change from one Period to another). Such descriptor could be expressed as follows:

```
<SupplementalProperty schemeIdUri="urn:mpeg:dash:quality_equivalence" value=" 1, 2" />
```

Where the new @schemeIdUri value indicates that the attribute @qualityRanking provides a cross AdaptationSet quality Ranking and the value attribute provides an identifier for this @qualityRanking overloading and the list of the AdaptationSets concerned by this @qualityRanking overloading.

For example, in the MPD snippet below, the new descriptor would indicate that, for the given Period, Representation with id "1.1" and Representation with id "2.1" can be considered equivalent in terms of quality. (If people are not comfortable with the overload of @qualityRanking, a new attribute can be defined).

```

<MPD>
<Period >
  <SupplementalProperty schemeIdUri="urn:mpeg:dash:quality_equivalence" value="1, 2"/>
  <AdaptationSet contentType="video" id="1"... >
    <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2014" value="0, 0, 0, 1, 1, 2, 2"/>
    <Representation id=« 1.1 » bandwidth=«1000» qualityRanking=« 0 » /*best Quality*/ ...>
    ...
  </Representation>
  <Representation id=« 1.2 » bandwidth=«500» qualityRanking=« 1 » /*mid Quality*/ ...>
  ...
</Representation>
  <Representation id=« 1.3 » bandwidth =«250 » qualityRanking=« 2 » /*low Quality*/ ...>
  ...
</Representation>
</AdaptationSet>
  <AdaptationSet contentType="video" id="2" ...>
    <SupplementalProperty schemeIdUri="urn:mpeg:dash:srd:2014" value="0, 1, 0, 1, 1"/>
    <Representation id=« 2.1 » bandwidth=« 1000 » qualityRanking=« 0 » /*best Quality*/ ...>
    ...
  </Representation>
  <Representation id=« 2.2 » bandwidth =« 800 » qualityRanking=« 1 » /*mid Quality*/ ...>
  ...
</Representation>
  <Representation id=« 2.3 » bandwidth =« 500 » qualityRanking=« 2 » /*low Quality*/ ...>
  ...
</Representation>
  <Representation id=« 2.4 » bandwidth =« 250 » qualityRanking=« 3 » /*lowest Quality*/ ...>
  ...
</Representation>
</AdaptationSet>
...
</Period>
</MPD>

```

3.1.2 Quality adaptation rule indication

A second indication that can help the client in selecting a good set of tiles to preserve overall quality of the reconstructed video is an indication from the content creator of quality degradation pattern. For example, the content creator may indicate that there should be no more than 1 of quality difference (in quality ranking unit) between the one or more tiles corresponding to the ROI and its surrounding tiles. To express this, we propose another descriptor as follows:

`<SupplementalProperty schemeIdUri="urn:mpeg:dash:max_quality_degradation" value="1"/>`

This descriptor, as for the previous one, can be placed at MPD level or at Period level. The value of the `@schemeIdUri` attribute indicates a suggested maximum quality degradation between one tile and its neighbor tiles. The attribute `@value` indicates first the target set of Adaptation Sets with comparable quality and then a quality difference value, so that when playing a set of Representations of the same media type from different Adaptation Sets, the client should not select adjacent Representations having a difference in quality ranking greater than 1. For example, this would lead to such adaptation scenario when available bandwidth decreases. Without this rule, the client could have selected the Representation for the ROI at quality Q and quality Q-2 for surrounding tiles, which may lead to jumps in quality around the ROI borders.

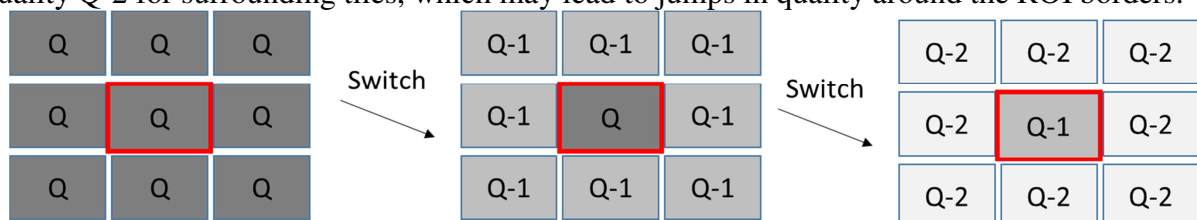


Figure 2: Adaptation strategy with max quality degradation < 2

4 Recommendation

We recommend MPEG DASH group to consider this additional signaling to help client selection when content components from multiple Adaptation Sets are selected to be displayed at the same time.

5 References

- [1] w16223, “*Technologies under considerations for DASH*”, MPEG#115, Geneva, June 2016.