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# Introduction

In the MPEG#127 meeting, ISO/IEC 23090-10 (Carriage of Point Cloud Data) reached committee draft (CD) stage ‎[1]. One important aspect that is still missing in the CD is MPEG-DASH signalling of point cloud media to support adaptive streaming of point clouds. A number of contributions on MPEG-DASH signalling of V-PCC content were presented in MPEG#126 and MPEG#127, including: m47436 ‎[2], m49109 ‎[3], and m49110 ‎[4]. It was agreed to include the XML elements and attributes proposed in these contributions into the technologies under consideration (TuC) for carriage of PC data ‎[5]. Moreover, m49109 ‎[3] was discussed in a joint session between the DASH subgroup and the Systems subgroup on PCC carriage and DASH experts supported the proposed solution of using MPEG-DASH PreSelections for signalling V-PCC media and grouping the component adaptation sets since these adaptation sets are meant to be consumed together.

This document provides an example of how the technologies described in Section 10 of the TuC ‎[5] can be used to signal V-PCC content in the MPEG-DASH media presentation descriptor (MPD) and recommends moving these technologies to the DIS version of ISO/IEC 23090-10.

# Example of V-PCC Media and MPD

In this example, the video-coded components of a V-PCC sequence are available in two different resolutions. Note that the resolution of the occupancy map component may not necessarily be identical to that of the geometry and attribute components. For each resolution of the video-coded bitstream of the geometry or attribute components, two versions of the bitstream are available (encoded at different bitrates).

Let OA and OB be the two occupancy map resolutions. Similarly, let GA and GB be the two available geometry resolutions and AA and AB be the two attribute resolutions. Since each geometry and attribute resolution is available at two different bitrates, let us denote these as GA,1, GA,2, GB,1, GB,2, AA,1, AA,2, AB,1, and AB,2. Occupancy map OA is compatible with GA,1, GA,2, AA,1, and AA,2. While occupancy map OB is compatible with GB,1, GB,2, AB,1, and AB,2.

Following Section 10.2 in the TuC, each resolution of the geometry and attribute components can be signaled by a separate AdaptationSet with two representations, one for each bitrate. Each occupancy map resolution is also signaled using a separate AdaptationSet with a single representation. Each AdaptationSet of the occupancy, geometry, and attribute components includes a VPCCComponent descriptor with the @component\_type attribute set to the corresponding value. Finally, the V-PCC track which includes the atlas bitstream is signaled with an AdaptationSet with a single representation.

Compatible component adaptation sets, along with the main AdaptationSet, are grouped together in two preselections in the MPD. To indicate that these adaptation sets are referenced in at least one preselection, a preselection descriptor without the @value attribute is signaled in each AdaptationSet. Each preselection shall include a VPCC descriptor that indicates at least the mandatory @pcId attribute. The values assigned to the @pcId attributes of the two preselections are identical, indicating that both preselections belong to the same point cloud content.

The main V-PCC AdaptationSet shall contain the Initialisation Segment for the complete experience. Therefore, in the case of an ISOBMFF container, the initialization segment shall contain TrackBoxes for the V-PCC track as well as the tracks of all versions of the V-PCC components (all resolutions and bitrates).

Figure X illustrates the different adaptation sets and their relation to the preselections that represent the point cloud content described in this example.

A skeleton for the complete MPD file that signals the point cloud content described in this example is given below.

<Period>

<!-- Main V-PCC AdaptationSet -->

<AdaptationSet id="1" codecs="vpc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<Representation>

...

</Representation>

</AdaptationSet>

<!-- Occupancy Map -->

<AdaptationSet id="2" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="occp" />

</EssentialProperty>

<Representation>

...

</Representation>

</AdaptationSet>

<AdaptationSet id="3" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="occp" />

</EssentialProperty>

<Representation>

...

</Representation>

</AdaptationSet>

<!-- Geometry -->

<AdaptationSet id="4" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="geom" />

</EssentialProperty>

<Representation>

...

</Representation>

<Representation>

...

</Representation>

</AdaptationSet>

<AdaptationSet id="5" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="geom" />

</EssentialProperty>

<Representation>

...

</Representation>

<Representation>

...

</Representation>

</AdaptationSet>

<!-- Attribute -->

<AdaptationSet id="6" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="attr" />

</EssentialProperty>

<Representation>

...

</Representation>

</AdaptationSet>

<AdaptationSet id="7" codecs="resv.pccv.hvc1">

<EssentialProperty schemeIdUri="urn:mpeg:dash:preselection:2016" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:component">

<vpcc:component component\_type="attr" />

</EssentialProperty>

<Representation>

...

</Representation>

</AdaptationSet>

<!-- Preselections -->

<Preselection id="1" tag="1" preselectionComponents="1 2 4 6" codecs="vpc1">

<!-- VPCC Descriptor -->

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:vpc" pcId="1" numLayers="2" numTileGroups="1" />

</Preselection>

<Preselection id="2" tag="2" preselectionComponents="1 3 5 7" codecs="vpc1">

<!-- VPCC Descriptor -->

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:vpcc:2019:vpc" pcId="1" numLayers="2" numTileGroups="1" />

</Preselection>

</Period>

# Recommendation

It is recommended to adopt Sections 10.1 to 10.5 from the TuC and the MPD example given in this contribution for inclusion in ISO/IEC 23090-10 DIS.

# References

1. N18606, “Text of ISO/IEC CD 23090-10 Carriage of PC Data”, MPEG 127, July 2019
2. m47436, “[VPCC] DASH Signaling for V-PCC”, MPEG 126, March 2019
3. m49109, “DASH Signaling for V-PCC Tile Groups”, MPEG 127, July 2019
4. m49110, “On DASH Signaling for V-PCC”, MPEG 127, July 2019
5. N18607, “Technologies under Consideration on Carriage of PC Data”, MPEG 127, July 2019
6. N18312, “Revised text of ISO/IEC FDIS 23009-1 3rd edition”, MPEG 125, January 2019