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# Introduction

A Core Experiment on partial access of point cloud data was established in the MPEG#127 meeting ‎[1]. The draft text of ISO/IEC DIS 23090-10 ‎[2] includes a clause on partial access support based on the responses to the CE that were adopted in the MPEG#128 and MPEG#129 meetings. The three-dimensional space may be divided into a number of regions and

In the MPEG#129 meeting, a number of new SEI messages to annotate, label, and add properties to patches and volumetric rectangles were proposed in ‎[3] and adopted in ISO/IEC 23090-5. These SEI messages replace the previously defined volumetric tiling information SEI message and provides extended functionality.

While the newly adopted SEI messages enable partial access and rendering of a V-PCC sequence, the latest draft ISO/IEC DIS 23090-10 only supports carrying the atlas sub-bitstream data in a single track. Therefore, streaming applications are forced to download and decode all atlas information even when the user in interested in certain regions/objects in the V-PCC content.

In this contribution, we propose a solution to the aforementioned problem where atlas patch information for different objects/regions are mapped to atlas tile groups and carried in separate tracks called V-PCC atlas tile group tracks. This approach is similar how similar to how tiled HEVC and L-HEVC video streams are carried in ISO/IEC 14496-15 ‎[4].

# Proposed Solution

In V-PCC, an atlas frame may be divided into one or more tile rows and one or more tile columns, where a tile is a rectangular region in the atlas frame. An atlas tile group contains a number of atlas frame tiles. When the atlas sub-stream of the V-PCC bitstream contains multiple tile groups, each tile group, or a group of tile groups, is encapsulated in a separate track, called an *atlas tile group track*. The atlas tile group track carries NAL units with atlas\_tile\_group\_layer\_rbsp() payloads for one or more atlas tile group, therefore enabling direct access to these tile groups.

Atlas tile group tracks enable mapping patch information for different objects/regions in a point cloud scene to separate V-PCC atlas tile groups and carrying this information in tracks that can be accessed and retrieved independently.

To link the V-PCC track to atlas tile group tracks, a track reference with a new track reference type (e.g., 'pcct') is defined. Track references of the new type are used to link the V-PCC track each of the atlas tile group tracks. Each atlas tile group track is then grouped with other video-coded V-PCC component tracks carrying component information for the tile group(s) in the atlas tile group track using an ISO/IEC 14496-12 track group. The track group definition includes the addresses of the tile groups to which the tracks in the track group are associated.

As the SEI messages proposed in ‎[3] are meant to provide information relevant to the various objects/regions in the CPCS and may change the assignment of patches to objects or regions frequently, these messages shall be carried in the samples of the V-PCC track.

To avoid an explosion in the number of tracks and efficiently support streaming applications, it is proposed to introduce a profile/restriction that fixes the tile group layout in the atlas frames for duration of the sequence when the content is encoded for streaming.

## V-PCC Atlas Tile Group Tracks

A V-PCC tile group track is identified by a VPCCTileGroupSampleEntry sample description. The sample entry type for a V-PCC atlas tile group track shall be 'vpt1'. The definition of VPCCTileGroupSampleEntry is as follows:

Sample Entry Type: 'vpt1'  
Container: Sample Description Box ('stsd')  
Mandatory: No  
Quantity: Zero or more sample entries may be present

class VPCCTileGroupSampleEntry() extends VolumetricSampleEntry ('vpt1'){  
 VPCCTileGroupConfigurationBox config(); // optional  
}

class VPCCTileGroupConfigurationBox extends Box('vptC') {  
 VPCCTileGroupConfigurationRecord() vpccTileGroupConfig;  
}

aligned(8) class VPCCTileGroupConfigurationRecord {  
 unsigned int(8) configurationVersion = 1;  
}

This sample entry describes media samples of a V-PCC tile group track. The VPCCTileGroupSampleEntry shall not contain any VPCCConfigurationBox; this box is found in the main V-PCC track's sample description. Other optional boxes may be included.

The semantics of the fields in VPCCTileGroupSampleEntry are:

compressorname in the base class VolumetricSampleEntry indicates the name of the compressor used with the value "\013VPCC Coding" being recommended; the first byte is a count of the remaining bytes, here represented by \013, which (being octal 13) is 11 (decimal), the number of bytes in the rest of the string.

For any atlas frame carried by samples in a V-PCC track and a number of atlas tile group tracks, all NAL units that apply to the entire frame (e.g., VPCC\_VPS) shall be carried in the V-PCC track. The SampleDescriptionBox of a V-PCC atlas tile group track shall not carry NAL units that apply to any complete atlas frame. The NAL units that do not apply to a tile group shall not be carried in the tile group track containing that tile group.

## Atlas Tile Group Track Sample Format

Samples in an atlas tile group track shall have the same sample format defined in clause 6.4.2.2 in ISO/IEC 23090-10. Samples in the atlas tile group track shall only carry ACL NAL units for the tile group(s) associated with the track.

When no NAL unit is included in a sample in a main V-PCC track (i.e. all the NAL units are in the V-PCC tile group tracks), the size of the sample may be 0, and the sample documents the timing and other sample properties of the sample.

## Grouping Atlas Tile Group Tracks and Component Tracks

V-PCC component tracks associated with an atlas tile group track are grouped together with that track using the track group with a 'vptg' TrackGroupTypeBox as follows (note that TrackGroupTypeBox has a track\_group\_id field defined in ISO/IEC 14496-12):

aligned(8) class VPCCTileGroupBox extends TrackGroupTypeBox('vptg') {   
 unsigned int(8) num\_tile\_groups\_minus1;  
 for (i=0; i<=num\_tile\_groups\_minus1; i++) {  
 unsigned int(16) tile\_group\_id;  
 }  
}

The semantics of the field(s) of VPCCTileGroupBox are:

tile\_group\_id is an id for the V-PCC tile group and shall be identical to ptgh\_address in ISO/IEC 23090-5.

It is proposed to use the VPCCTileGroupBox for grouping tracks associated with 3D spatial regions as a generalization of SpatialRegionGroupBox.

# References

1. N18663, “Description of Core Experiment on Partial Access of PC Data”, MPEG 127, Gothenburg, Sweden, July 2019
2. N19066, “Draft Text of ISO/IEC DIS 23090-10 Carriage of Video-based Point Cloud Compression Data”, MPEG 129, Brussels, Belgium, January 2020
3. m52705, “Object Annotation of Patches and Volumetric Rectangles in V-PCC”, MPEG 129, Brussels, Belgium, January 2020
4. N18241, “Text of ISO/IEC FDIS 14496-15 5th edition”, MPEG 125, Marrakech, Morocco, January 2019