**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

**ORGANISATION INTERNATIONALE DE NORMALISATION**

**ISO/IEC JTC1/SC29/WG11**

**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11 MPEG/M50859**

**October 2019, Geneva, CH**

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| **Source** | **Interdigital** |
| **Status** | **Input document** |
| **Title** | **[specification] On the Unification of V-PCC High Level Syntax with Working Draft on Metadata for Immersive Video** |
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# Context

At MPEG127 Gothenburg meeting, input contribution M49590 [1] was reviewed by the joint BoG on V-PCC and MIV [2]. Possible methods of combining the V-PCC CD [3] with the working draft (WD) on Metadata for Immersive Video (MIV) [4] were proposed and commented on.

The signaling of MIV camera parameters list at V-PCC sequence parameter set level was proposed in [1]. This contribution proposes to convey MIV patch information in V-PCC syntax structure as a new patch data unit with minor impact on V-PCC standard.

# Proposal

## Support of MIV projections

The proposed updated V-PCC sequence parameter set is as follows:

|  |  |
| --- | --- |
| vpcc\_parameter\_set() { | **Descriptor** |
| profile\_ter\_level() |  |
| **vpcc\_sequence\_parameter\_set\_id** | u(4) |
| **sps\_miv\_patch\_enabled\_flag** | u(1) |
| if( sps\_miv\_patch\_enabled\_flag ) |  |
| camera\_information() |  |
| **vpcc\_atlas\_count\_minus1** | u(6) |
| for( j = 0; j < vpcc\_atlas\_count\_minus1 + 1; j++ ) { |  |
| **vpcc\_frame\_width**[ j ] | u(16) |
| **vpcc\_frame\_height**[ j ] | u(16) |
| (…) |  |
| occupancy\_information( j ) |  |
| geometry\_information( j ) |  |
| attribute\_information( j ) |  |
| } |  |
| } |  |

camera\_information() syntax is embedding camera\_params\_list( ) MIV syntax which defines the number of cameras, with their extrinsic and intrinsic parameters, as well as the attached depth quantization method and parameters [4].

## Support of MIV patch information

Taking the V-PCC patch data unit syntax as is to carry MIV patch data requires using a subset of syntax elements, with different semantics, for instance: **pdu\_projection\_id** for the MIV camera index instead of the V-PCC projection planes, and **pdu\_3d\_shift\_x(y)** for the patch 2D position in MIV camera views instead of V-PCC 3D bounding box position. Such different naming would at least introduce “some confusion” as pointed out by BoG [2].

This contribution proposes to define new patch mode types for non-predicted and inter-predicted MIV patches, making use of reserved modes:

|  |  |  |
| --- | --- | --- |
| **atdgu\_patchmode** | **Identifier** | **Description** |
| 0 | I\_INTRA | Non-predicted Patch mode |
| 1 | I\_RAW | RAW point Patch mode |
| 2 | I\_EOM | EOM point Patch mode |
| 3 | I\_MIV | MIV Non-predicted Patch mode |
| 4-13 | I-RESERVED | Reserved modes |
| 14 | I\_END | Patch termination mode |

**Patch mode types for I atlas tile groups**

|  |  |  |
| --- | --- | --- |
| **atdgu\_patchmode** | **Identifier** | **Description** |
| 0 | P\_SKIP | Patch Skip mode |
| 1 | P\_MERGE | Patch Merge mode |
| 2 | P\_INTER | Inter predicted Patch mode |
| 3 | P\_INTRA | Non-predicted Patch mode |
| 4 | P\_RAW | RAW Point Patch mode |
| 5 | P\_EOM | EOM Point Patch mode |
| 6 | P\_MIV | MIV Inter-predicted patch mode |
| 7-13 | P\_RESERVED | Reserved modes |
| 14 | P\_END | Patch termination mode |

**Patch mode types for P atlas tile groups**

miv\_patch\_data() and miv\_delta\_patch() syntax structures specific to non-predicted and inter-predicted MIV patch data, respectively, are then parsed when analyzing an “MIV flagged” V-PCC bitstream (**sps\_miv\_patch\_enabled\_flag** equal to 1 in vpcc\_parameter\_set()):

|  |  |
| --- | --- |
| patch\_information\_data( patchIndex, patch\_mode ) { | **descriptor** |
| if( patch\_mode == P\_SKIP ) |  |
| skip\_patch\_data\_unit( patchIndex ) |  |
| else if ( patch\_mode == P\_MERGE ) |  |
| merge\_patch\_data\_unit( patchIndex ) |  |
| else if ( patch\_mode == I\_INTRA || patch\_mode == P\_INTRA ) |  |
| patch\_data\_unit( patchIndex ) |  |
| else if ( patch\_mode == P\_INTER ) |  |
| inter\_patch\_data\_unit( patchIndex ) |  |
| else if ( patch\_mode == I\_RAW || patch\_mode == P\_RAW ) |  |
| raw\_patch\_data\_unit( patchIndex ) |  |
| else if( patch\_mode  = =  I\_MIV ) |  |
| miv\_patch\_data\_unit( patchIndex ) |  |
| else if( patch\_mode  = =  P\_MIV ) |  |
| miv\_delta\_patch\_data\_unit( patchIndex ) |  |
| } |  |

An miv\_patch\_data\_unit() contains the same fields for patch parameters as in MIV specification with naming with different prefix but identical semantics, while miv\_delta\_patch\_data\_unit() would be a straightforward extension to V-PCC like inter patch prediction:

|  |  |
| --- | --- |
| miv\_patch\_data\_unit( patchIndex ) { | **descriptor** |
| **mpdu \_view\_id**[ patchIndex  ] | ue(v) |
| **mpdu\_2d\_shift\_x**[ patchIndex  ] | ue(v) |
| **mpdu\_2d\_shift\_y**[ patchIndex  ] | ue(v) |
| **mpdu\_2d\_size\_x**[ patchIndex   ] | ue(v) |
| **mpdu\_2d\_size\_y**[patchIndex   ] | ue(v) |
| **mpdu\_patch\_shift\_in\_view\_x**[ patchIndex ] | ue(v) |
| **mpdu\_patch\_shift\_in\_view\_y[**patchIndex ] | ue(v) |
| **mpdu\_orientation\_index**[ patchIndex ] | u(1) |
| } |  |

# Conclusion

A solution for unifying V-PCC and MIV specifications, enabling the V-PCC bitstream to convey MIV content was proposed. The proposed unification is at the cost of minimal update of V-PCC syntax, thus minimizing the impact on the standard.

# References

1. Alexis Michael Tourapis, Jungsun Kim, Khaled Mammou, David Singer, Ye-Kui Wang, Hendry, Jill Boyce, Ahmed Hamza, Yong He, “Video-based Point Cloud Coding High Level Syntax: Updates and Unification with the Working Draft on Metadata for Immersive Video”, ISO/IEC JTC1/SC29 WG11 (MPEG) input document M49590, Gothenburg, SE, July 2019.
2. Alexis Michael Tourapis, Bart Kroon, “Report of the JBoG on V-PCC and MIV”, ISO/IEC JTC1/SC29 WG11 (MPEG) input document M49872, Gothenburg, SE, July 2019.
3. “Version 39 of V-PCC SCD”
4. “Working Draft 2 of Immersive Video”, ISO/IEC JTC1/SC29 WG11 (MPEG) output document N18576, Gothenburg, SW, July 2019.