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# Introduction

This contribution proposes an update about the Point Local Reconstruction (PLR) syntax so that it could address technical concern about its parsing, hindering its inclusion in Basic profile.

The main idea of this contribution is to enable the possibility of constraining the PLR tool at patch level. Therefore, the parsing of PLR metadata is simplified, and PLR data size is predictable.

# Existing solution

In the current draft specification [w18670], the PLR data structure, point\_local\_reconstruction\_data(patchIdx, mapIdx), has a block and/or patch granularity. Following the plrd\_level value computed thanks to the plri\_block\_threshold\_per\_patch\_minus1 available in asps\_point\_local\_reconstruction\_information(mapIdx), the PLR mode is defined at patch or block level, as shown in Table 1.

In [w18670], plri\_block\_threshold\_per\_patch\_minus1 is defined as follows:

**plri\_block\_threshold\_per\_patch\_minus1**[ mapIdx ] plus 1 specifies the value representative of the threshold defining the value of plrdLevel. plri\_block\_threshold\_per\_patch\_minus1[ mapIdx ] shall be in the range of 0 to 63, inclusive.

In [w18670], point\_local\_reconstruction\_data(patchIdx, mapIdx) is defined as follow:

|  |  |
| --- | --- |
| point\_local\_reconstruction\_data( patchIdx, mapIdx ) { | **Descriptor** |
| plrdLevel = 1 |  |
| if( BlockCount > plri\_block\_threshold\_per\_patch\_minus1[ mapIdx ] + 1 ) { |  |
| **plrd\_level**[ mapIdx ][ patchIdx ] | u(1) |
| plrdLevel = plrd\_level[ mapIdx ][ patchIdx ] |  |
| } |  |
| if( plrdLevel == 0 ) { |  |
| for( i = 0; i < BlockCount; i++ ) { |  |
| **plrd\_present\_block\_flag**[ mapIdx ][ patchIdx ][ i ] | u(1) |
| if( plrd\_present\_block\_flag[ mapIdx ][ patchIdx ][ i ] ) { |  |
| **plrd\_block\_mode\_minus1**[ mapIdx ][ patchIdx ][ i ] | u(v) |
| } |  |
| } |  |
| } else { |  |
| **plrd\_present\_flag**[ mapIdx ][ patchIdx ] | u(1) |
| if( plrd\_present\_flag[ mapIdx ][ patchIdx ] ) |  |
| **plrd\_mode\_minus1**[ mapIdx ][ patchIdx ] | u(v) |
| } |  |
| } |  |

Table 1 point\_local\_reconstruction\_data as defined in specification D40

By default, the plrd\_level is set to one, indicating the PLR data are coded at patch level. But if the blockCount is superior to plri\_block\_threshold\_per\_patch\_minus1 (comprised between [0..63]), then the plrd\_level is set to zero, indicating the PLR data are coded at block level.

Thus, it is not possible to indicate to the decoder that the PLR tool must be only considered at patch level for all patches and PLR data may require extra parsing especially at low level.

# Proposition

This contribution proposes minor updates in syntax structure so that the PLR metadata can be indicated at patch level for all patches. Consequently, the parsing of PLR data is simplified and PLR data size is predictable when using this patch level indication.

## Semantics update

The value plri\_block\_threshold\_per\_patch\_minus1 is replaced with plri\_block\_threshold\_per\_patch.

The proposed semantic is the following:

**plri\_block\_threshold\_per\_patch**[ mapIdx ] specifies the value representative of the threshold defining the value of plrdLevel. plri\_block\_threshold\_per\_patch\_minus1[ mapIdx ] shall be in the range of 0 to 63, inclusive.

The value plrd\_mode\_minus1 is replaced with plrd\_mode.

The proposed semantic is the following:

**plrd\_mode** [ mapIdx ][ patchIdx ] indicates the point local reconstruction mode for all blocks of the map mapIdx of the patch patchIdx in the current atlas tile group. When plrd\_mode[ mapIdx ][ patchIdx ] is equal to 0, the point local reconstruction process in clause 9.4.2 shall not be applied. plrd\_mode [ mapIdx ][ patchIdx ] shall be in the range 0 to plri\_number\_of\_modes\_minus1[ mapIdx ] plus 1, inclusive.

## Point\_local\_reconstruction\_data update

The proposed update consists of:

- forcing the parsing at patch level when **plri\_block\_threshold\_per\_patch**[ mapIdx ] is set to 0 and,

- arranging the syntax so that when **plri\_block\_threshold\_per\_patch**[ mapIdx ] is set to 0, only a syntax element of fixed size remains.

|  |  |
| --- | --- |
| point\_local\_reconstruction\_data( patchIdx, mapIdx ) { | **Descriptor** |
| if( (BlockCount > plri\_block\_threshold\_per\_patch[ mapIdx ] )  && plri\_block\_threshold\_per\_patch[ mapIdx ] != 0 ) { |  |
| **plrd\_level**[ mapIdx ][ patchIdx ] | u(1) |
| if( plrd\_level[ mapIdx ][ patchIdx ]== 0 ) { |  |
| for( i = 0; i < BlockCount; i++ ) { |  |
| **plrd\_present\_block\_flag**[ mapIdx ][ patchIdx ][ i ] | u(1) |
| if( plrd\_present\_block\_flag[ mapIdx ][ patchIdx ][ i ] ) |  |
| **plrd\_block\_mode\_minus1**[ mapIdx ][ patchIdx ][ i ] | u(v) |
| } |  |
| } else |  |
| **plrd\_mode** [ mapIdx ][ patchIdx ] | u(4) |
| } else |  |
| **plrd\_mode** [ mapIdx ][ patchIdx ] | u(4) |
| } |  |

Table 2 Table 1 point\_local\_reconstruction\_data as defined in the proposal

# Results

Here are the BD-Rate obtained with the implementation of the described proposal on top of V-PCC V7.0 (see[w18666] ) using CTC (see [w18665]).

This proposition is applicable to the category 2 test model of the MPEG 3DG Ad Hoc on Point Cloud Compression for lossy compression.

Results for 32 frames are provided, comparing the proposed syntax with the one-layer TMC2 as anchor.

## C2 lossy geometry, lossy attributes results

For the Queen, Basket and Dancer sequences, the PLR tool is deactivated (2 maps are coded in that case) which excludes those sequence for fair comparison in Table 3 below.

For other sequences, the PLR tool at patch level brings improvements compare to the one-layer anchor:

* For All Intra, proposed patch-only PLR has a gain of 30.5% in D1, 17.1% in D2 and 1.1% in luma compared to one-layer anchor.
* For Random Access, proposed patch-only PLR has a gain of 27.6% in D1, 16.6% in D2 and 0.6% in luma compared to one-layer anchor.



Table 3 – BDBR one-layer anchor versus R7.0 with proposed PLR,

lossy conditions, 32 frames

# Conclusions

All results show that the implementation of PLR even at patch level brings improvement in terms of BD-Rate compare to TMC2 one-layer R7.

Also, the proposal facilitates the parsing of PLR metadata which has been highlighted as a major hindrance for its integration into the Basic profile.

As the PLR tool at patch level brings significant improvements, we recommend to integrate PLR tool in the Basic profile (when combined with Rec1 and possibly Rec Unconstrained), as described in Table C of Annex A of [w18670] with the following constraint **plri\_block\_threshold\_per\_patch = 0**.

# References

[[w18670](http://wg11.sc29.org/doc_end_user/current_document.php?id=70092&id_meeting=179)] Text of ISO/IEC DIS 23090-5 Video-based Point Cloud Compression, Gothenburg, SWE, July 2019, ISO/IEC JTC1/SC29 WG11.

[w18665] Common Test Conditions for PCC, Gothenburg, SWE, July 2019, ISO/IEC JTC1/SC29 WG11.

[[w18666](http://wg11.sc29.org/doc_end_user/current_document.php?id=70088&id_meeting=179)] V-PCC Test Model v7, Gothenburg, SWE, July 2019, ISO/IEC JTC1/SC29 WG11.