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**ISO/IEC JTC 1/SC 29/WG 11**

**CODING OF MOVING PICTURES AND AUDIO**

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**OnLine – June-July 2020**

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| **Source:** | **3DG** |
| **Title:** | **Description of Core Experiment 13.29 for G-PCC on geometry quantization QP** |

# Abstract

This document provides the description of the core experiment 13.29 on geometry quantization QP for G-PCC.

A geometry quantization step size derivation was adopted in the 131st MPEG meeting in June-July 2020. The number of QP points for every doubling of step size may be chosen as 1, 2, 4 or 8 and this indication is signalled in the bitstream. In addition, it was identified that a potential mismatch occurs when geometry scaling is enabled with lifting scalability. This core experiment is intended to evaluate the implementational efficiency/simplicity of in-tree geometry quantization and analysing the interaction between lifting scalability and geometry quantization.

# CE 13.29 Geometry quantization QP control

## Mandates

* Evaluate the trade-off between implementation efficiency/simplicity and the functionality provided by in-tree geometry quantization
* Evaluate subjective quality of non-uniform quantization
* Study methods to solve the potential mismatch(es) produced when geometry quantization is enabled with lifting scalability

Related changes to the G-PCC Specification Text [2] shall be reported.

## Participants, description of tools, and implementation notes

The following people are participating in this CE. Their specific roles are detailed in the next section. Proposals are based on the following input contributions:

1. m54697, [G-PCC][CE13.29-related] Additional results of CE13.29 and step-size derivation methods
2. m54598, [G-PCC] Confirmation report on interaction between geometry scaling and scalable lifting

Proponents and cross-checkers are as follows:

### Test 1.1

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### Test 1.2

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### Test 2

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## Information on proposed tool/tests

### Test 1 (On in-tree quantization step sizes)

#### In-tree geometry quantization in TMC13v11

The in-tree geometry quantization in GPCC allows the positions of points belonging to be represented as a quantized value, thus providing a trade-off between quality and bitrate. The in-tree geometry quantization, as currently specified, is applied at a particular octree depth. The QP used to code the positions are signalled in the bitstream. Based on the adoption [4] in the 131st MPEG meeting, TMC13v11 allows a configurable number of QP steps per doubling of step size; this is controlled by a parameter, qpDivFactorLog2, which is signalled in the GPS. The number of QP points per doubling of step size for various values of qpDivFactorLog2 is specified in the table below:

|  |  |
| --- | --- |
| qpDivFactorLog2 | # QP points per doubling of step size |
| 0 | 8 |
| 1 | 4 |
| 2 | 2 |
| 3 | 1 |

For all the qpDivFactorLog2 values, the step size derivation is kept the same as scaling process as 8 QP points for doubling of step size; this is done by adjusting the QP value before calculation of the shift bits and the scaling process. The scaling process is specified as follows:

The shift value sh is calculated as:

qpScaled = qp << qpDivFactorLog2   
sh = qpScaled >> 3

The scaling process is specified as follows:

scaled\_x = (x \* ( 8 + qpScaled % 8 ) << sh + 4 ) >> 3

#### Test 1.1

In-tree geometry quantisation impacts various coding tools. In part, the determination of sub-tree depths requires additional computation and state stored in the node buffer. Furthermore, some coding tools (for instance, angular coding) are incompatible with in-tree geometry quantisation. It has been suggested that using a power-of-two step size may result in a simpler implementation and extend compatibility to incompatible tools. It has further been suggested that external quantisation may be a more appropriate alternative, thereby allowing simpler tree coding.

#### Test 1.2

This test studies the performance of power-of-two step size compared to having more finer step sizes as supported by TMC13v11. The number of QP points for every doubling of step size may be 1, 2, 4 or 8 in TMC13v11. When only 1 QP point is allowed for every doubling of step size, the resultant scaling step sizes are powers-of-two. This test studies how keeping only powers-of-two affects the functionality of the in-tree quantization in TMC13v11.

### Test 2

This test checks whether the combination of the two tools – geometry scaling and lifting scalability - works by changing the geometry scaling QP for the selected test sequence(s). When lifting scalability is enabled, the number of decoded attribute values for each attribute assumed in LoD generation is compared with the number of decoded geometry points to verify that they match. If the scalable LoD generation and partial octree decoding are consistent, then these numbers are expected to match.

## Information for conducting tests

### Software

TMC13v11 shall be used for these experiments. The proposed tools shall be implemented on top of TMC13v11.

### Test configurations for Test 1.1

Evaluation will proceed by modifying TMC13v11 to optimise for the use of both power-of-two quantisation step sizes and the complete removal of in-tree quantisation, in both cases removing or simplifying computations and state where applicable. The changes made will be reported and studied to determine to what extent they are compatible with the current draft. The compression performance of power-of-two quantisation shall be determined using a QP sweep over all test content.

### Test configurations for Test 1.2

The performance of in-tree quantization where only powers-of-two step sizes are used is compared with other step sizes. Different values of parameter qpDivFactorLog2 in TMC13v11 will be used to choose the different number of QP values per doubling of step sizes. A QP sweep of the allowed QP range, and an analysis of bit rate variation and the subjective quality will also be studied. The in-tree geometry quantization will be applied at node sizes, similar to the tests in [5]. The TMC13v11 software will be updated to apply the quantization at a node size. The tests would be conducted on the lossy-geometry lossy-attribute configuration for a selected subset of sequences.

### Test configurations for Test 2

The C1 AI configuration of the selected sequence is used for testing. The configuration is same as the CTC except to set enable geometry scaling, enable spatial scalability, and disable QtBt.

To enable geometry scaling, the following option will be set.

* positionQuantisationEnabled=1
* positionBaseQp=1 to 10
* mergeDuplicatedPoints=1

To enable spatial scalability, the following option will be set.

* aps\_scalable\_enable\_flag=1

To disable QtBt, the following option will be set.

* qtbtEnabled=0

Full and partial decoding will be performed with the following decoding options:

* skipOctreeLayers=0 (no skip)
* skipOctreeLayers=1 to 3 (skip LoD)

## CE 13.29 Coordinator

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# Timeline

* **2020-07-17**: Expected date for TMC13v11 release;
* **2020**-**07-17**: Expected date for release of finalized CE description;
* **2020-08-14 [TMC13v10 + 4 weeks]**:Deliver source code and results for cross-check;
* **2020-08-21 [TMC13v10 + 5 weeks]**:Deliver cross-check results;
* **2020-xx-xx**: MPEG document upload deadline (refer to updates from 3DG for document upload deadline)

# References

1. “*G-PCC Test Model v11*”, ISO/IEC JTC1/SC29/WG11 Doc. N19517, OnLine, June-July 2020
2. “*G-PCC Future Enhancements*”, ISO/IEC JTC1/SC29/WG11 MPEG2019 Doc. w19522, OnLine, June-July 2020
3. “*Common Test Conditions for PCC*” ISO/IEC JTC1/SC29/WG11 N19324, Alpbach, Austria, April 2020
4. *“[G-PCC][CE13.29-related] Additional results of CE13.29 and step-size derivation methods*”, ISO/IEC JTC1/SC29/WG11 MPEG2020 Doc. m54697, OnLine, June-July 2020
5. *“[G-PCC] CE13.29 report on geometry quantization QP control*”, ISO/IEC JTC1/SC29/WG11 MPEG2020 Doc. m54610, OnLine, June-July 2020