

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

**Coding of moving pictures and audio**

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**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

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

**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC 1/SC 29/WG 11 N19328**

**Alpbach, AT, April. 2020**

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| **Source:** | **3DG** |
| **Title:** | **G-PCC Future Enhancements** |

The docment is provided as the attachment (N19328 clean ver.).

# Abstract

[Ed. Notes (G-PCC Future Enhancements

* m52951 [GPCC] Division-free RAHT coding scheme
* m52956 [GPCC][CE13.22 related] On decoupling planar and IDCM in angular mode
* m52958 (m51596) [GPCC] [CE 13.22] Report on azimuthal coding mode
* m52976 (m52345) [GPCC] [CE 13.30] Report on buffer optimization for planar mode
* m52995 [GPCC][new] Increasing internal precision of inter-depth prediction for RAHT
* m52996 [GPCC][new] Optimization of RAHT coefficients by the attribute encoder
* m53055 (m51011) [GPCC] Division-free RAHT coding scheme
* m53288 (m52331) [G-PCC] CE13.15 report on LoD generation with distance from centroid for spatial scalability
* m53328(m52327)[G-PCC] CE13.11 report on Intra occupancy prediction
* m53337(m52720)[G-PCC][CE13.33] Report on coding of transform coefficients
* m53354(m52315)[G-PCC] CE13.15 report on geometry reconstruction for spatial scalability
* m53355(m52314)[G-PCC] CE13.31 report on NN search for spatial scalability
* m53362(m52823)[G-PCC][New Proposal] on weight derivation of spatial scalability
* m53385 [GPCC][new] On bypassed bit coding and chunks
* m53389(m52522)G-PCC CE13.29 report on in-tree geometry quantisation
* m53390 G-PCC EE13.35 report on qtbt partition signalling
* m53391(m52515)G-PCC EE13.8 report on low-latency coding for automotive/mapping applications
* m53421 [G-PCC][New Proposal] Fixing neighbor context accessing in QTBT
* m53495 [G-PCC][New Proposal] Definition of node size restriction
* m53497 [G-PCC][New Proposal] On interaction between Implicit QTBT and Scalable lifting
* m53538 [G-PCC][New][EE13.8 related] Predictive tree encoding modifications
* m53541 [G-PCC][New] High Level Syntax and Specification Modification
* m53542 [G-PCC][New] Entropy ContinuationÂ flag for Low Latency Coding
* m53561(m52392) [G-PCC] [EE13.8 related] Skip sorting process based on Morton code for low delay attribute coding
* m53619 [G-PCC][New proposal] Division-free Implementation of the Lifting/Prediction scheme
* m53635 [G-PCC][new]On trisoup-syntax signaling cleanup
* m53649 [G-PCC][CE13.29-related][New proposal] Modified scaling step derivation for geometry quantization
* m53650 [G-PCC][New proposal] Global scaling for point clouds
* m53652 [G-PCC][new] Attribute related high level syntax - fixes and improvements
* m53655 [G-PCC][New proposal] Geometry-related HLS refinements to G-PCC
* m53658 [G-PCC][New proposal] General HLS improvements
* m53678 G-PCC: Coding of significant attribute coefficients
* m53679 G-PCC: A raw attribute coder
* m53680 G-PCC: Extensible signalling of attribute descriptions
* m53681 G-PCC: Signalling of default attribute values
* m53682 G-PCC: Geometry octree QP constraints
* m53683 G-PCC: Specification of SPS bounding box and scale factors
* m53684 G-PCC: Review of parallel octree sub-streams
* m53685 G-PCC : Review of slice point count signalling
* m53693 [GPCC][New Proposal] Angular mode simplifications and HLS refinements

[Ed. Notes (DIS Geometry-based PCC)]:

* m51594 [CE 13.22 ] Report on angular coding mode
* m51595 [CE13.22 related] Simplification of geometry mapping in occupancy coding
* m51806 Editorial input on G-PCC draft text
* m52279 CE13.25 report on Triangle soup decoding
* m52280 On Trisoup syntax signalling
* m52311 CE13.15 report on LoD generation for spatial scalability
* m52324 CE13.15 report on LoD generation for spatial scalability
* m52341 EE13.5 Report on Region-wise Quantization Control in Attribute Coding
* m52342 High level syntax cleanup of G-PCC
* m52343 [CE13.22] Report on harmonization of angular coding mode and implicit QTBT
* m52386 CE13.28 report on early termination for RAHT prediction
* m52390 [new proposal] High Level Syntax Modification on Layer QP Delta For Attribute Coding
* m52391 [new proposal] The modification of RAHT process to support 1 point coding in TMC13
* m52392 [new proposal] High Level Syntax modification and skip sorting process based on Morton code for low delay attribute coding
* m52397 [CE13.22] Report on Parallel Octree Coding for Point Cloud Compression
* m52400 [CE13.29 related] Harmonization and fixing in geometry quantization
* m52501 On quantization parameters in G-PCC
* m52513 CE13.6 report on nearest neighbour search order
* m52514 CE13.10 report on chunked entropy streams
* m52521 Minor simplifications and fixes to in-tree geometry quantisation
* m52526 Geometry swizzling dependent syntax elements
* m52527 High-level syntax issues
* m52732 On G-PCC Profile, Level
* m52738 [Bug fix, new proposal] on signaling Lifting scalability in HLS
* m52885 Suggested DoC on ISO/IEC CD 23090-9

[Ed. Notes (G-PCC future enhancements)]:

* accepted DoC changes (see w18895 )
* m51064 [G-PCC] Clarification and Modification of CD syntax and semantics
* m50745 [G-PCC] syntax modification for lifting attribute coding
* m51063 [G-PCC] EE13.5 Report on region-wise quantization control
* m50924 [G-PCC] EE13.6 report on geometry quantization
* m50927 [G-PCC][EE13.6 related] slice based geometry quantization
* m51160 [G-PCC] EE13.7 Report on Interchannel Prediction for Near lossless Coding
* m50741 [G-PCC] CE13.15 report on LoD generation for spatial scalability
* m50773 [G-PCC] CE13.20 report on neighbor’s weight modification on lifting and predicting scheme
* m51040 [G-PCC] CE 13.21 Report on RAHT Quantization
* m50008 [GPCC] CE13.22 report on planar coding mode
* m50921 [G-PCC] CE13.22 report on implicit QTBT partition
* m50922 [G-PCC][CE13.22 related] Harmonization of implicit QTBT and planar mode
* m50009 [GPCC] CE13.23 report on duplicated points in IDCM
* m50669 [G-PCC][New proposal]An improved context selection of a flag in attribute residuals coding
* m51025 [G-PCC][New proposal] G-PCC multi-frame sequence coding
* m51027 [G-PCC][New proposal] G-PCC geometry swizzling

[Ed. Notes (G-PCC Improvements)]:

* m49379 G-PCC CE13.10 report on bypass bin coding
* m49043 [G-PCC] CE13.15 report on LoD generation for spatial scalability
  + Could be part of a profile, e.g. introduce a flag
* m49380 G-PCC CE13.18 report on upsampled transform domain prediction in RAHT
  + Introduce APS depth flag to enable/disable DC prediction
* m49624 [G-PCC] CE13.19 Report on Attribute Layer Quantization Control
* m49144 [G-PCC][New proposal] An improved attribute coding method for low complexity application scenario
  + Rename “SearchRange” to “SearchRangeMinusOne” and update SW to not allow a search range of zero
* m49628 [G-PCC] On the unification of single-layer and multi-layer LoD in TMC13
  + subject of adding the additional condition. Edit the spec to make sure it is consistent.
* m49629 [G-PCC] Modification on LoD generation process in TMC13
  + Resolution: keep only ascending order.
* m49630 [G-PCC] On dependency issue of predicting transform in TMC13
  + Resolution: adopt (condition A is forced to be true).

[Ed. Notes (G-PCC CD)]:

* CE3.4 Tool 1 m46148: Adopt, Tool 2 m46149: Adopt, Tool 3 m46150: SW adoption
* CE13.2 Tool 1 m47398, m46491: Adopt syntax C
* CE13.6 Tool 1 m47402, m46107: Adopt
  + Allow to switch the tool on for certain LoDs , e.g. starting from layer X
* CE13.14 Tool 1 m47732, m44900: Adopt
* CE13.15 Tool 1 m47733, m46188: Adopt
  + Remove the binary LoD
* CE13.16 Tool 1 m47399, m46106
  + QP aspect
    - m47401 [G-PCC] Quantization Parameter table in Attribute Coding
    - m47507 [G-PCC] New contribution on quantization parameter definition
* CE13.17 Tool 1 m47403, m46108:
* m47405 [G-PCC] Bug report on binary tree based LoD and RAHT in TMC13

[Ed. Notes (WD G-PCC v5)]:

* occupancy contextualisation using adjacent child neighbours (m46482, CE3.4 Tool 1 from m44752 and CE3.4 Tool 2 from m44753)
* Tile/Slice HLS support (m45867, CE13.2 Tool 1 m42463: HLS aspect)
* known attribute support for the frame index for the combine frame coding (m46101, CE13.5 Tool 1 m44813: the attribute based approach)
* the simplified attributes prediction strategy for Lifting (m46189, CE13.6 Tool 1 m44899)
* fixed point RAHT (m46209, CE13.14 Tool 1 m44486)
* fixed point Trisoup (m46036, CE13.14 Tool 3 m44706)
* LOD generation using binary tree for Lifting (m45966, CE13.15 Tool 1 m44940)
* Morton code derivation clarification (m46245)
* modification on the update LUT in OBUF (m46402)
* general HLS cleanup (m46530)

[Ed. Notes (WD G-PCC v4)]:

* Optimized Lifting scheme with bottom-up LoD approach and approximation nearest neighbour search (m43781 CE13.1 tool 1)
* Adaptive predictor selection for Lifting scheme (m43665, m44804 CE13.6 tool 1)
* Introduce the entropy coding method used in the Dirac|VC-2 (m43649, m44882 CE13.10 tool 1)
* Intra prediction for the context in the geometry entropy coding (m43600, m44883 CE13.11 tool 1)
* Banalization scheme for attribute transform coefficients (m43780, m44896 CE13.12)
* Trisoup decoding simplification (m44706)
* Optimal Banalization with Update on the Fly (OBUF) for the geometry entropy coding (m44750)
* Banalization with adaptive look up table (A-LUT) for the geometry entropy coding (m43592)
* Contextualization to encode the 3 neighbour information (m44811)

[Ed. Notes (WD G-PCC v3)]:

* Change spec name from WDC13 to G-PCC (N17694)
* Introduce self-contained high level syntax structure (m43953)
* Trisoup syntax update (m43786)
* Optional restriction for neighbour-dependent entropy coding from CE3.4 (m43662)
* adaptive distance-based prediction scheme from CE 13.3 lossless and near-Lossless compression (m43587)
* Introduce look-ahead cube procedure and specify the volume where the search should be done. (m43591)
* having only binary coding from CE13.4 on banalisation of occupancy entropy coding (m43645)
* Encoding of attribute ranges in the header (m43387)

[Ed. Notes (WDC13v2)]:

* Used HEVC-DIS as a template
* Merged WD1of TMC3 and WD1 of TMC1 and accepted changes according to convergence between TMC1 and TMC3 (m42634)
* Added text from HEVC for general sections such as mathematical operations (track changes on)
* Added new abbreviations and definitions (track changes on)
* Few clean up (track changes on)
* Added highlights identifying TMC1 or 3 where relevant.
* Removal of CABAC section occasionally copied from the reference spec.
* mergeDuplicatedPoints signalling to the header (m42690)
* an empty placeholder profiles/levels section into the WD output documents (m42439)
* Syntax tables and semantics from the previous WDC1 and WDC3 are merged.
* bitstream syntax and semantics for RAHT (CE0.1, m42634/m42708)
* CE3.2 Part 2: inferred direct coding mode adopted (m42608)
* CE3.4 occupancy coding using neighbours adopted (m42609)