**3GPP TSG-SA SA4#131-bis-eS4-250446r1**

**Online, 11 – 17 April 2025**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **rev** |  | **Current version:** | **0.3.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network |  |

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| ***Title:*** | pCR on update of V-PCC testing | | | | | | | |
|  |  | | | | | | | |
| ***Source to WG:*** | InterDigital, Sony, Samsung, Nokia, Philips, Deutsche Telekom, Fraunhofer HHI, KDDI, Sony Group Corporation, Huawei | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | |
|  |  | | | | | | | |
| ***Work item code:*** |  | | |  | ***Date:*** | | | 2025-16-04 |
|  |  | | |  |  | | |  |
| ***Category:*** | B |  | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | |
| ***Reason for change:*** | | Make Beyond2D objective and subjective tests complementary to tests from other organisations (e.g. MPEG) and test what has been demonstrated in prototype implementations at release of the TR | | | | | | |
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| ***Summary of change:*** | | Update of the test conditions for dense dynamic point clouds | | | | | | |
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| ***Consequences if not approved:*** | | Test conditions would be less realistic and results would be more difficult to compare with other representation formats | | | | | | |
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| ***Clauses affected:*** | |  | | | | | | |
|  | |  | | | | | | |
|  | | **Y** | **N** |  | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | TS/TR ... CR ... | | |
| ***affected:*** | |  |  | Test specifications | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | TS/TR ... CR ... | | |
|  | |  | | | | | | |
| ***Other comments:*** | | Changes are tracked starting from TR V0.3.0 | | | | | | |
|  | |  | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | |

**== CHANGE 1 (all new) ===**

## 7.3 Scenario 2: Streaming of professionally produced Volumetric Video with single asset containing people

### 7.3.9 Detailed test conditions

#### 7.3.9.1 V-PCC test model and configuration files

The public version of the MPEG V-PCC test model named tmc2 is used to encode and decode dense dynamic point clouds [Vol-26].

Editor’s note: Configuration files to be validated

For using tmc2 in Random Access (RA) mode, MPEG provides configuration files [Vol-27]:

* cfg/common/ctc-common.cfg
* cfg/condition/ctc-random-access.cfg
* cfg/hdrconvert/yuv420toyuv444\_16bit.cfg

For each selected test sequence, a configuration file containing information needed for tmc2 configuration is provided.

#### 7.3.9.2 Rate points and test conditions

In line with the V-PCC verification test [Vol-28], 5 rate points R1 to R5 for Random Access (RA) are used for each test sequence.

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For test sequences with 11-bit geometry precision (vox11) with approximately 2M points/frame the following target bitrates in kbps are used:

* R1: 5000
* R2: 10000
* R3: 20000
* R4: 30000
* R5: 50000

Target bitrates are obtained by selecting values for the V-PCC codec parameters Occupancy Precision, QP Geometry and QP Texture. The values are selected per test sequence and are directly included in the scripts for encoding.

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Editor’s note: In SA4#131-bis-e, it was suggested to use the same QP parameters for all test sequences, meaning that there would be no fixed target bitrates for the rate points. However, QP parameters would still be varied to obtain the 5 rate points. Proposal needs more investigation

In addition to the three codec parameters, a configuration file per test sequence is provided which is used by the encoding scripts.



#### 7.3.9.3 Profiles

The V-PCC verification test [Vol-28] tested various V-PCC profiles such as HEVC Main10 V-PCC Basic Rec2, HEVC Main10 V-PCC Extended Rec2 and VVC Main10 V-PCC Extended Rec2 using test sequences with-10 bit geometry precision. To align with V-PCC prototype implementations at release time of this technical report, focus is on testing of the HEVC Main10 V-PCC Basic Rec0 profile using test sequences with 11-bit geometry precision.

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#### 7.3.9.4 Bitstream Generation, output

The MPEG V-PCC test model is used to encode and decode test sequences as described previously [Vol-26].

To compute metrics, the tool mpeg-pcc-mmetric [Vol-18] is used.

Scripts are provided to:

- Encode each sequence for each condition, rate and profile

- Decode the corresponding sequence

- Compute the metrics

- Generate tables and graphs

Below are examples of command lines for the tested profile for a vox11 sequence:

- to encode a test sequence:

mpeg-pcc-tmc2/release-v25.0/bin/PccAppEncoder \

--config=mpeg-pcc-tmc2/release-v25.0/cfg/common/ctc-common.cfg \

--config=mpeg-pcc-tmc2/release-v25.0/cfg/condition/ctc-random-access.cfg \

--config=mpeg-pcc-tmc2/release-v25.0/cfg/sequence/${test\_sequence}.cfg \

--configurationFolder=mpeg-pcc-tmc2/release-v25.0/cfg/ \

--uncompressedDataFolder=${source\_sequence}/ \

--compressedStreamPath=${test\_sequence}.bin \

--normalDataPath=${source\_sequence}/${source\_sequence}\_%04d.ply \

--frameCount=32 \

--resolution=2047 \

--geometryQP=11 \

--attributeQP=28 \

--occupancyPrecision=2 \

--profileToolsetIdc=0 \

--profileReconstructionIdc=0 \

--mapCountMinus1=0

- to decode a test sequence:

mpeg-pcc-tmc2/release-v25.0/bin/PccAppDecoder \

--startFrameNumber=0 \

--compressedStreamPath=${test\_sequence}.bin \

--reconstructedDataPath=${test\_sequence}\_dec\_%04d.ply \

--inverseColorSpaceConversionConfig=mpeg-pcc-tmc2/release-v25.0/cfg/hdrconvert/yuv420toyuv444\_16bit.cfg

- to compute objective metrics of a test sequence:

mpeg-pcc-mmetric/1\_1\_7/build/Release/bin/mm \

sequence \

--firstFrame 0 \

--lastFrame 31 END \

compare --mode pcc \

--inputModelA source\_sequence\_%04d.ply \

--inputModelB test\_sequence\_dec\_%04d.ply END \

compare --mode pcqm \

--inputModelA source\_sequence\_%04d.ply \

--inputModelB test\_sequence\_dec\_%04d.ply

For each test, outputs are:

- Bitstream file

- Log files containing metrics information

- Encoder log output

- Decoder log output

- Metric log output

A CSV file containing concatenated metrics information for each condition and selected profile is generated for all sequences and rates.

The following information is stored:

- SeqId: identifier of the sequence

- CondId: tested condition (RA)

- RateId: tested rate number [R1..R5]

- nbFrame: number of tested frames

- NbInputPoints: number of points in the source sequence

- NbOutputPoints: number of points in the candidate test sequence

- MeanOutputPoints: mean number of points in the candidate test sequence

- MeanDuplicatePoints: mean number of duplicated points (with same geometry) in the candidate test sequence

- TotalBitstreamBits: size of the bistream in bits

- geometryBits: size of the geometry stream in bits

- metadataBits: size of the metadata stream in bits

- attributeBits: size of the attribute stream in bits

- D1Mean: mseF,PSNR (p2point)

- D2Mean: mseF,PSNR (p2plane)

- LumaMean: c[0],PSNRF

- CbMean: c[1],PSNRF

- CrMean: c[2],PSNRF

- PCQM: PCQM PSNR

- SelfEncoderRuntime: encoder time for current process

- ChildEncoderRuntime: encoder time for child processes

- SelfDecoderRuntime: decoder time for current process

- ChildDecoderRuntime: decoder time for child processes

From this CSV file, an excel spreadsheet is generated to get tables and graphs for interpretation of the results.

Editor’s note: Text to be added on how a user can execute the objective tests based on scripts, including preparation of the content (new annex), installation of TMC2, installation of the metric SW, installation and execution of the scripts.

Editor’s note: Text needs to be added how a user can access the produced results in form of a spreadsheet

#### 7.3.9.5 Videos Generation for subjective tests

The representative renderer [Vol-19] is used to generate videos for the subjective evaluation.

Videos are generated for the 5 selected test sequences and for the 5 rate points each. To evaluate the impact of rendering, each of the 25 videos is rendered in 3 modes as follows:

* Cube mode, neutral background with a color including a floor for the asset making the rendered scene more realistic
* Splat Blend mode, neutral background with a color including a floor for the asset making the rendered scene more realistic
* Splat Blend mode, 3D background model fitting with the test sequence

A camera path and blend parameter/render options adapted to each sequence are provided [Vol-30]. Backgrounds are presented in annex C.X and annex C.2 links the background with the selected test sequences.

A script is provided to generate the videos with the chosen camera path and blend parameter/render options adapted to each sequence and the output is stored as high-quality video sequence of a length as close as possible to 10s.

The generation is done into two steps: first the generation of the RBG raw file with the camera path and then the conversion into YUV or MP4 files.

The video sequences are generated with the following video parameters:

- Video resolution: progressive uncompressed full-range HD format (1920x1080). Note that upsampling by the TV set should be avoided

- Frame rate: The frame rate will be aligned with the frame rate of the test sequence

- Color space: ITU-R BT.709

- Sub-sampling: 4:2:0 YUV 10 bits or x265 fast preset lossless

Editor’s note: Text needs to be added how a user can launch the production of the videos, i.e. prepare the content (new annex E), install the TMC2, install the renderer, install the scripts, etc….

Editor’s note: Text needs to be added how a user can access the produced 75 videos

#### 7.3.9.6 Verification / crosschecks

All produced bitstreams, metric results and produced videos are crosschecked by at least one other SA member to ensure that results are correct.

**== CHANGE 2 (all new) ===**

# 2 References

[Vol-27] MPEG, Random Access configuration, [https://github.com/MPEGGroup/mpeg-pcc-tmc2/blob/master/cfg/](https://github.com/MPEGGroup/mpeg-pcc-tmc2/blob/master/cfg/condition/ctc-random-access.cfg)