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| **Joint Collaborative Team on 3D Video Coding Extension Development**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  3rd Meeting: Geneva, CH, 17–23 Jan. 2013 | Document: JCT3V-C1106 |

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| *Title:* | **Description of Core Experiment 6 (CE6) on Depth Intra Coding** | | |
| *Status:* | Output Document | | |
| *Purpose:* | Core Experiment Description | | |
| *Author(s) or Contact(s):* | Philipp Merkle | Email: | [philipp.merkle@hhi.fraunhofer.de](mailto:philipp.merkle@hhi.fraunhofer.de) |
| *Source:* | CE coordinator | | |

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# Abstract

This document describes Core Experiment 6 on depth intra coding (CE6) to be performed for the 4th JCT-3V meeting.

# Introduction

The goal of this Core Experiment (CE) is to investigate the methods for depth intra coding proposed to the 3rd JCT-3V meeting. This CE covers AVC-based proposals under sub-experiment CE.A and HEVC-based proposals under sub-experiment CE.H. All tools under test for the 4th JCT-3V meeting are in sub-experiment CE6.H. The corresponding test model is described in JCT3V-C1005, including intra prediction modes and residual coding methods specific to depth, such as DMM, region boundary chain, SDC and DLT.

The objective of tools under test in CE6.H is simplification and improvement of existing depth intra coding methods.

# Participants

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| --- | --- | --- | --- | --- |
| **Participant** | **Person** | **Email address** | **P** | **C** |
| HHI | P. Merkle | [philipp.merkle@hhi.fraunhofer.de](mailto:philipp.merkle@hhi.fraunhofer.de) | X | X |
| Aachen University | F. Jäger | [jaeger@ient.rwth-aachen.de](mailto:jaeger@ient.rwth-aachen.de) | X | X |
| LGE | J. Heo | [jin78.heo@lge.com](mailto:jin78.heo@lge.com) | X | X |
| Samsung | I. Lim | [ilsoon.lim@samsung.com](mailto:ilsoon.lim@samsung.com) | X | X |
| MediaTek | K. Zhang J. An J.-L. Lin Y.-W. Chen Y.-L. Chang Y.-W. Huang | [Kai.Zhang@mediatek.com](mailto:Kai.Zhang@mediatek.com) [Jicheng.An@mediatek.com](mailto:Jicheng.An@mediatek.com) [jl.lin@mediatek.com](mailto:jl.lin@mediatek.com) [yiwen.chen@mediatek.com](mailto:yiwen.chen@mediatek.com) [yulin.chang@mediatek.com](mailto:yulin.chang@mediatek.com) [yuwen.huang@mediatek.com](mailto:yuwen.huang@mediatek.com) | X | X |
| Ghent University-iMinds | S. van Leuven | [sebastiaan.vanleuven@ugent.be](mailto:sebastiaan.vanleuven@ugent.be) |  | X |
| GIST | Y. Song Y.-S. Ho | [ysong@gist.ac.kr](mailto:ysong@gist.ac.kr) [hoyo@gist.ac.kr](mailto:hoyo@gist.ac.kr) |  | X |

(P=proponent, C=cross checker)

# Tools Under Test for Sub-experiment CE6.H

## Context reduction and binarization for SDC

In this tool test the combination of [JCT3V-C0143](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=584) and [JCT3V-C0067](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=506) in terms of binarization and context reduction are studied.

**Description:**

The CABAC contexts that are used for SDC as described in JCT3V-B0036 are partially redundant, unused or independently defined for each segment of an SDC coded block. [JCT3V-C0143](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=584) proposes to remove the differentiation of contexts for each segment in a block. Moreover, the contexts for the sdc\_residual\_sign\_flag are removed completely. The number of contexts for sdc\_pred\_mode and sdc\_residual\_abs\_minus1 is also reduced.

In [JCT3V-C0067](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=506) an alternative method for residual index coding in SDC is proposed that concatenates the two basic binarization schemes ‘unary’ and ‘FL’ and reduces the number of contexts relative to the current method. Moreover, the number of contexts for residual\_flag and residual\_sign\_flag is reduced.

**Tests:**

In this tool test the following modifications to SDC regarding context reduction and binarization will be evaluated:

1. Change contexts for SDC according to [JCT3V-C0143](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=584).
2. Change binarization and contexts according to [JCT3V-C0067](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=506).
3. Combined changes of test 1 and test 2.

Source code containing the implementation of test 1 will be made available by Aachen University to participants of this tool test by 2013/03/01 based on 3D-HTM-6.0. In case the implementation changes after delivery, e.g. for further optimizing the performance, updates will be made avaialable to participants of this tool test.

**Participants:**

Aachen University (test 1)

LGE (test 2, test 3)

## DLT for DMM deltaDC coding

In this tool test possible further improvements of deltaDC coding for DMM described in [JCT3V-C0034](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=467) by combining it with DLT are studied.

**Description:**

The following modifications of the deltaDC method for DMM according to [JCT3V-C0034](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=467) were adopted at the 3rd JCT-3V meeting: Instead of operating with a QP-dependent quantization for the partition offset values, the proposed method omits the quantization and operates with full depth precision. At the encoder the optimum offset values are estimated by a VSO-based minimum distortion search. In order to obtain the coding gain for full depth precision without a considerable increase in encoder complexity, a hierarchical (2-step) encoder search with coarse and fine quantization is applied. Furthermore, a fix for the initialization type of DMM contexts is provided.

At the encoder the values of the DLT are derived by analyzing a pre-defined number of frames from the input video sequence. Consequently, each DLT index maps to a valid depth values based on the original uncompressed depth map. The DLT values are signaled to the decoder in the SPS. Consequently, for SDC coding partition offset values are estimated and signaled to the decoder as DLT indices instead of full precision depth values.

**Tests:**

In this tool test the following modifications to deltaDC coding for DMM regarding combination with DLT will be evaluated:

1. Change the representation of partition offsets to depth values represented by DLT indices instead of full precision depth values. DLT indices are signaled the same way as current deltaDC values.
2. Same as test 1., but signaling DLT indices the same way as current SDC.

**Participants:**

HHI (test 1, test 2)

## Signaling and binarization of DLT

In this tool test [JCT3V-C0093](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=532) and [JCT3V-C0142](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=583) as well as their combination are studied in terms of signaling and binarization of DLT, with emphasis on flexible slice-level signaling, e.g. in all slices of a random access unit.

**Description:**

Currently the DLT values are sent in the SPS, but slice layer signaling is more appropriate. Therefore, DLT signalling is modified in [JCT3V-C0093](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=532): the SPS signaling is moved to intra-slice layers, in order to make the DLT robust to varying scenes. The DLT is constructed for every intra-slice and coded in the intra-slice header. For P- and B-slices, no new DLT is constructed and coded, but the DLT of the last intra-slice is used.

Currently all values in the DLT are coded with exp-Golomb codes, which take more than 65% of data in the sequence parameter set (SPS) averagely. [JCT3V-C0142](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=583) proposes a range constrained bit map (RCBM) method for coding the DLT values with a simple bit map.

**Tests:**

In this tool test the following modifications to DLT regarding signaling and binarization will be evaluated:

1. Change DLT construction and signaling according to [JCT3V-C0093](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=532), i.e. for every intra-slice.
2. Same as test 1., but extend DLT construction and signaling to all slices in random access units.
3. Change the binarization of DLT values according to [JCT3V-C0142](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=583).
4. Combined changes of test 1 and test 3.
5. Combined changes of test 2 and test 3.

Source code containing the implementation of test 1 and test 2 will be made available by Samsung to the other participants of this tool test by 2013/02/15 based on 3D-HTM-5.0.1 and by 2013/03/01 based on 3D-HTM-6.0. In case the implementation changes after delivery, e.g. for further optimizing the performance, updates will be made avaialable to participants of this tool test.

**Participants:**

Samsung (test 1, test 2)

MediaTek (test 3, test 4, test 5)

# Core Experiment Conditions

## Software

Sub-experiment CE6.H will use the 3D-HTM-6.0 software that is recommended in JCT3V-C1100. Proponents are requested to provide software that can be compiled under Windows and Linux platforms.

## Test Sequences, Bit Rates and Coding Conditions

The CE will use the test sequences, configuration and conditions that are recommended in JCT3V-C1100. Moreover, proponents and cross checkers are required to provide simulation results for the following two configurations:

1. Random access configuration as specified in JCT3V-C1100.
2. All-intra configuration (configuration files to be provided by CE coordinator).

## Evaluation of CE Results

The performance measurements are evaluated by switching on and off individual tools to identify their relative performance. The following measurements are considered to be used in this core experiment. A corresponding Excel sheet for reporting the simulation results will be provided by the CE coordinator.

**Coding Performance Measurements:** PSNR values shall be computed for the decoded texture views relative to original texture views and for the synthesized views relative to the synthesized views based on uncompressed texture and depth. The 4-point BD-rate according to common test conditions is used to report the results for random access as well as all-intra configuration.

**Complexity measurements:** For the complexity measurement, the reference software and the reference software with the proposed method implemented will be executed on the same machine with the same configuration and the computational time will be measured. A time ratio will then be calculated between the reference software and the reference software with the proposed method implemented.

## Timeline

2013/01/31 Final description of CE and proposals available  
2013/02/22 Reference software 3D-HTM-6.0 available   
2013/04/06 Make source code, simulation results and draft text available for all proponents and cross- checks  
2013/04/13 Document registration and upload deadline (register documents and upload simulation and cross check results for CE and related proposals)  
2013/04/19 CE summary report available