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| **Joint Collaborative Team on 3D Video Coding Extensions**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  5th Meeting: Vienna, AT, 27 July – 02 Aug. 2013 | Document: JCT3V-E0026 |

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| *Title:* | **CE6 Summary Report: Simplified Depth Coding** | | |
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| *Purpose:* | Summary Report | | |
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# Abstract

This document summarizes the proposals and cross check results of CE6, including tools under test according to JCT3V-D1106 as well as related input contributions.

# Introduction

In this document a summary of proposals and cross check results for CE6 is reported. The goal of this Core Experiment (CE) is to investigate tools for simplified depth coding (SDC) for an HEVC-based 3D extension. The proposed tools are evaluated in terms of coding efficiency and computational complexity. The objective of tools under test in CE6 was simplification, harmonization and improvement of existing simplified depth coding methods, such as SDC.

Participants in CE6 are as follows:

|  |  |  |  |  |
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# List of Input Documents

## Tools under Test (7)

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| --- | --- | --- | --- |
| **Participants** | **Doc No.** | **Title** | **Type** |
| RWTH Aachen University | [JCT3V-E0031](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1039) | CE6: Results on Complexity Reduction for Simplified Depth Coding | Proposal |
| Intel | [JCT3V-E0036](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1045) | CE6: Cross check on Results on Complexity Reduction for Simplified Depth Coding (JCT3V-E0031) | Cross Check |
| Intel | [JCT3V-E0032](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1041) | CE6: Results on SDC without per-pixel  prediction | Proposal |
| RWTH Aachen University | [JCT3V-E0033](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1042) | CE6: Cross check on Results on SDC without per-pixel prediction (JCT3V-E0032) | Cross Check |
| MediaTek | [JCT3V-E0181](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1195) | 3D-CE6.h results on direct simplified depth coding in 3D-HEVC | Proposal |
| Hisilicon | [JCT3V-E0264](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1280) | CE6.h: Crosscheck on direct simplified depth coding (JCT3V-E0181) | Cross Check |
| Hisilicon | [JCT3V-E0221](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1235) | CE6.h: CE results on sub-sampling for all SDC blocks | Proposal |
| LG Electronics | [JCT3V-E0198](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1212) | CE 6.h: Crosscheck on CE results on sub-sampling for all SDC blocks (JCT3V-E0221) | Cross Check |
| Hisilicon | [JCT3V-E0222](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1236) | CE6.h: CE results on removal of division operation for SDC | Proposal |
| LG Electronics | [JCT3V-E0199](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1213) | CE 6.h: Crosscheck on CE results on removal of division operation for SDC (JCT3V-E0222) | Cross Check |
| LG Electronics | [JCT3V-E0156](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1170) | CE 6.h: Results on Simplified Inter Mode Coding of Depth | Proposal |
| Hisilicon | [JCT3V-E0262](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1278) | CE6.h: Crosscheck on Simplified Inter Mode Coding of Depth (JCT3V-E0156) | Cross Check |
| Qualcomm | [JCT3V-E0235](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1251) | 3D-CE6.h related: Cross check on simplified Inter mode coding of depth (JCT3V-E0156) | Cross Check |
| LG Electronics | [JCT3V-E0158](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1172) | CE 6.h: Results on Removal of DC from SDC Mode | Proposal |
| Hisilicon | [JCT3V-E0263](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1279) | CE6.h: Crosscheck on Removal of DC from SDC Mode (JCT3V-E0158) | Cross Check |

## Related Contributions (7)

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| --- | --- | --- | --- |
| **Participants** | **Doc No.** | **Title** | **Type** |
| Kwangwoon University (KWU) | [JCT3V-E0117](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1130) | CE6: Simplified DC calculation for SDC | Proposal |
| LG Electronics | [JCT3V-E0194](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1208) | CE6.h: Cross-check on simplified DC calculation for SDC (JCT3V-E0117) | Cross Check |
| NCKU | [JCT3V-E0127](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1141) | CE 6.h-related: Complexity reduction on simplified depth coding (SDC) with subsampling on neighboring reference pixels | Proposal |
| ITRI | [JCT3V-E0139](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1153) | CE6-related: Cross check of Complexity reduction on simplified depth coding (SDC) with subsampling on neighboring reference pixels (JCT3V-E0127) | Cross Check |
| Samsung | [JCT3V-E0147](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1161) | 3D-CE6 related: Simplified depth coding based on most probable mode | Proposal |
| MediaTek | [JCT3V-E0256](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1272) | CE6.h related: Cross-check on simplified depth coding based on most probable mode by Samsung (JCT3V-D0147) | Cross Check |
| MediaTek | [JCT3V-E0165](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1179) | 3D-CE6.h related: Removal of post-filter for DC mode in SDC | Proposal |
| Sharp | [JCT3V-E0254](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1270) | 3D-CE6.h related: cross-check of Removal of post-filter for DC mode in SDC (JCT3V-E0165) | Cross Check |
| MediaTek | [JCT3V-E0167](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1181) | 3D-CE6.h related: Simplified SDC prediction | Proposal |
| Sharp | [JCT3V-E0255](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1271) | 3D-CE6.h related: cross-check of Simplified SDC prediction (JCT3V-E0167) | Cross Check |
| LG Electronics | [JCT3V-E0157](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1171) | CE 6.h related: Applying Depth Look-up Table to Intra Modes of Depth Map | Proposal |
| Qualcomm | [JCT3V-E0234](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1250) | 3D-CE6.h related: Cross check on applying depth look-up table to Intra modes of depth map (JCT3V-E0157) | Cross Check |
| GIST | [JCT3V-E0243](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=1259) | CE6.h related: SDC coding for 64x64 blocks | Proposal |
|  |  |  | Cross Check |

# Summary of Proposals

## Simplification of DC Predictor Generation

In this test subcategory, three approaches for reducing the number of operations and memory accesses for the generation of the DC predictors for SDC are to be compared. This comparison should include the number of required operations and memory accesses per SDC coding unit, which are required to generate the final DC predictor(s). Ideally, all three proposals do not have a negative impact on coding efficiency, but this is also to be investigated.

**Summary of the Test Results**

JCT3V-E0031, JCT3V-E0221 and JCT3V-E0222 show no difference in coding performance compared to the anchor configuration. While E0221 and E0222 propose simplification by subsampling and by replacing the division by a shift operation, E0031 simplifies the same process by taking only very few samples depending on the prediction mode. The latter approach seems like being the simplest among the tested methods and also makes the other two proposals obsolete.

## Modifications to Simplified Depth Coding Scheme

In the second category, three modifications to the current SDC coding scheme are to be compared. The resulting BD-Rate savings should be reported together with the amount of complexity reduction in terms of number of operations, memory requirements and accesses.

**Summary of the Test Results**

JCT3V-E0158 proposes to remove DC prediction from the available modes in SDC. The simulation results show no difference (**0.0%**) for random access (CTC) and all intra (AI) coding configurations while simplifying the specification text for SDC.

JCT3V-E0032 and JCT3V-E0181 propose to derive the prediction signal for SDC-coded blocks from the neighboring pixels instead of the two-step process that is currently used in the anchor. E0032 shows the same performance compared to the anchor (**0.0%** gain) for CTC and AI while E0181 shows **0.1%** coding gain for AI and **0.0%** for CTC.

## Simplified Depth Coding for INTER

In this sub-category, a proposal on using the SDC approach in INTER coding units is to be tested.

**Summary of the Test Results**

JCT3V-E0156 proposes to use an SDC-like approach for INTER-predicted blocks. Simulation results show a coding **gain of 0.7%** for synthesized views over total bitrate while there is a slight **loss of 0.2%** for video PSNR over total bitrate.