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| *Title:* | **Core Experiment 6: Intra Prediction Improvement** | |
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| *Purpose:* | CE Description | |
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# Abstract

This output document provides a list of key Core Experiment 6 (CE6) contributions on Intra Prediction Improvements.

# Introduction

Intra prediction improvement core experiments are divided into 4 categories

1. CE6.a: Block based Intra Prediction
2. CE6.b: Short Distance Intra Prediction (SDIP) Harmonization
3. CE6.c: Differential Coding of Intra Mode (DCIM)
4. CE6.d: Parallel Intra Coding
5. CE6.e: Intra Smoothing
6. CE6.f: Intra Coding and MDIS Interaction

# Experimental Conditions

## Software

CE will be implemented into the HM3.0 software that is recommended by the TM software group at the end of Geneva meeting.

## Test Sequences, Bit Rates and Coding Conditions

In this CE, the recommended Test conditions of Intra-only configuration and Test sequences as defined in the document JCTVC-E700 and provided in the reference config files by the TM software group will be used for all sub-CE tests. The participants could consider either Intra High Efficiency or Intra Low Complexity or both. In addition, the AIS flag needs to be set to “ON”. AIS related CEs can be done independently.

## Evaluation of CE Results

Results of the CE will be evaluated on the basis of BD-measures. In addition subjective evaluation to support the advantage of the proposed tools is highly desirable.

## Evaluation of Complexity

For the complexity measurement, the anchor, the reference software and the reference software with the tool implemented will be executed on the same machine and the computational time will be measured for each software. Then, a time factor is calculated which compares the reference software including the sub-CE test tool and the reference software without the tool.

# Timelines

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| --- | --- |
| **April 15, 2011** | **HM3.0** software available |
| **Geneva + 2Wks** | Deadline for sending email to coordinator expressing interest to participate in core experiment. |
| **June 27, 2011** | Distribution of SW for Cross Check |
| **July xxx, 2011** | Cross-verification completed CE. |
| **July yyy, 2011** | Report the verification results uploading |

# 

# Description of Tool Experiment

## CE6.a: Block Based Intra Prediction

### Bi-predictive Uni-Directional Intra (BUDI) Mode

JCTVC-E286 & JCTVC-D300 proposed Bi-predictive UDI Intra mode (BUDI) by using linear interpolation between two corresponding reference samples from main and side reference arrays, respectively. The purpose of this CE subset is to study the trade-off between coding performance and complexity. In addition, combination of BUDI with the adopted planar prediction will be considered.

The followings items will be investigated in this CE: (1) to study the performance of LUT-based and LUT-free implementations of BUDI. (2) To investigate signal method of BUDI modes as additional intra mode, instead of replacing the existing Intra mode 6. (3) To investigate on the interaction between BUDI and the planar prediction adopted in this meeting.

#### Participants

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## CE6.b: Short Distance Intra Prediction (SDIP) Harmonization (JCTVC-E278)

This CE subset is to complete and provide the harmonization solution that unifies the adopted SDIP features together with the remaining and existing HM tools from the conclusion of the 5th JCTVC meeting; test and confirm the SDIP performance in the harmonized software; revise and verify and confirm the WD document matches the resulting new HM software.

### Tests to be performed

1. Interaction between SDIP and RQT  
   Details tbd.
2. Interaction between SDIP and Mode-Dependent DCT/DST

Details tbd.

1. Interaction between SDIP and MDCS

Details tbd.

1. Consistency verification between WD and HM software

### Software

CE will be implemented into the HM-SDIP branch (HM3.x).

### Timelines

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| --- | --- |
| **Geneva +6 Wks (May 4)** | HM-SDIP software as well as WD with SDIP available |
| **Geneva + 8Wks (May 18)** | Final CE-description, deadline for expressing interests in joining CE |
| **TBD, follow the CE group**  **(June 27, 2011)** | Start cross verification tests |
| **TBD, follow the CE group**  **(July 4, 2011??)** | Complete the tasks of cross-check, and report the results to CE coordinators |
| **TBD, follow the CE group (July 11, 2011??)** | Report the verification results and upload input document |

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## CE6.c: Differential Coding of Intra Modes (DCIM) JCTVC-E318

DCIM (Differential Coding of Intra Modes) is a method categorized as Edge based Intra Prediction, which has been evaluated in the past CE [1]. The latest DCIM results are summarized in JCTVC-E318 [2]. In this experiment, the performance of DCIM on the latest reference software i.e., HM3.0 is evaluated. In addition, as listed in the following section, some variations of the component of DCIM and combination with other intra coding tools will be tested.

### List of configuration and combinations to be evaluated

The following configurations of the DCIM combination might be evaluated to find the best configuration.

a) Interpolation filter for prediction (bilinear vs. 4-tap):

- DCIM with bilinear compared to UI with bilinear

- DCIM with 4-tap compared to UI with 4-tap

- DCIM with 4-tap compared to UI with bilinear

- DCIM with bilinear compared to UI with 4-tap

b) Number of intra modes (both UI modes and DCIM modes)

The interaction with the following intra coding tools might be evaluated:

1. SDIP: Short Distance Intra Prediction [JCTVC-E278]
2. MDDT: Mode-dependent DCT/DST [JCTVC-E125, HM 3.x]
3. MDCS: Mode Dependent Coefficient Scan [HM 3.0]
4. BIP: Bidirectional Intra Prediction [JCTVC-D108]
5. Chroma Intra Prediction by Reconstructed Luma Samples [JCTVC-E266]

The harmonization could be done if necessary, and the details of such harmonization shall be reported.

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### Reference

[1] “Description of Core Experiment 6 (CE6): Intra Prediction Improvement”, JCTVC-D606, Daegu, January 2011.

[2] “Differential Coding of Intra Modes”, JCTVC-E318, Geneva, March 2011.

## CE6.d: Parallel Intra Coding

In contribution (JCTVC-E315), the concept of parallel intra-prediction unit (PPU) is introduced. The PPU defines the size of a block that can be coded using parallelization. The motivation is to increase the degree of parallelism for small blocks sizes. The blocks within the PPU are divided into two sets, and blocks within each set are predicted in parallel. The second set of blocks depend on the first set of blocks. For more information, see JCTVC-E315.

In this sub-CE, we will test the coding efficiency degradation of the JCTVC-E315 with different definitions for the first and second set blocks. (Including, a checker board assignment and a vertical assignment.) Additionally, we will consider the case of disabling 4x4 predictions completely as a second point of reference.

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## CE6.e: Intra Smoothing

### JCTVC-D282:”Adaptive intra smoothing”, Qualcomm

In this proposal, an adaptive intra smoothing method is proposed. Multiple filters are introduced and investigated in order to improve the performance of the current intra smoothing method in HM3.0. Filter modes are explicitly and implicitly signaled.

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## CE6.f: ”On intra coding and MDIS”, Sharp JCTVC-E437

This proposal seeks to improve the mode dependent intra smoothing (MDIS) technique that was adopted in the previous meeting. MDIS filters the source pixels used for intra prediction with different degrees of smoothing, with the degree determined by the intra prediction direction. The document reports that using edge directed smoothing in the construction of the neighborhood mitigates these issues. For a detailed description of the method see JCTVC-E437.

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