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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**  8th Meeting: Valencia, ES, 29 March – 4 April 2014 | Document: JCT3V-I0104 |  |  |

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| *Title:* | **CE1: Results of ARP simplification** | | |
| *Status:* | Input Document to JCT-3V | | |
| *Purpose:* | Proposal | | |
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# Abstract

This proposal reports a CE result of omitting residual prediction for 4x4 chroma block to reduce the worst case memory bandwidth complexity. The experiment result shows that the BD-rate gain is 0.1 %, 0.1 % and 0.1 % in video, total video and synthesis respectively.

# Introduction

At San Jose meeting, JCT3V-G0033 proposed to omit residual prediction for 4x4 chroma block and included in CE2. At Valencia meeting, JCT3V-H0063 provided the CE2 results and it was suggested that memory pattern consideration was also needed in memory bandwidth complexity.

# Proposal

The text of the proposal of omiting chroma residual prediction for 4x4 chroma block was highlighted in yellow.

* If nPbW is greater than 8, the modified prediction samples predSamplesLXCb[ x ][ y ] with x = 0..( nPbW /2 ) − 1 and y = 0..( nPbH /2 )−1 are derived as specified in the following:
  1. predSamplesLXCb[ x ][ y ] = predSamplesLXCb[ x ][ y ] +   
      ( ( rpSamplesLXCb[ x ][ y ] − rpRefSamplesLXCb[ x ][ y ] )  >>  shiftVal ) (I‑228)
* If nPbW is greater than 8, the modified prediction samples predSamplesLXCr[ x ][ y ] with x = 0..( nPbW /2 ) − 1 and y = 0..( nPbH /2 ) − 1 are derived as specified in the following:
  1. predSamplesLXCr[ x ][ y ] = predSamplesLXCr[ x ][ y ] +   
      ( ( rpSamplesLXCr[ x ][ y ] − rpRefamplesLXCr[ x ][ y ] )  >>  shiftVal ) (I‑229)
* Simulation results

Experimental result based on HTM10 is shown in Table 1.

Table 1 Experimental result (anchor: HTM11)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video PSNR / video bitrate | video PSNR / total bitrate | synth PSNR / total bitrate | enc time | dec time | ren time |
| Balloons | 0.0% | 1.2% | 1.3% | 0.38% | 0.35% | 0.36% | 100.3% | 103.3% | 101.6% |
| Kendo | 0.0% | 0.6% | 0.7% | 0.20% | 0.13% | 0.19% | 100.4% | 101.7% | 101.3% |
| Newspaper\_CC | 0.0% | 0.5% | 0.4% | 0.14% | 0.15% | 0.15% | 100.7% | 100.1% | 100.8% |
| GT\_Fly | 0.0% | 0.2% | 0.0% | 0.01% | -0.01% | -0.03% | 101.2% | 100.6% | 100.0% |
| Poznan\_Hall2 | 0.0% | 0.2% | 0.1% | 0.02% | 0.05% | 0.10% | 100.2% | 100.8% | 99.8% |
| Poznan\_Street | 0.0% | 0.3% | 0.1% | 0.03% | 0.04% | 0.06% | 100.4% | 101.3% | 100.1% |
| Undo\_Dancer | 0.0% | 0.1% | 0.1% | 0.02% | 0.02% | 0.03% | 100.3% | 100.7% | 99.9% |
| Shark | 0.0% | 0.4% | 0.5% | 0.05% | 0.02% | 0.05% | 100.1% | 100.6% | 100.0% |
| 1024x768 | 0.0% | 0.7% | 0.8% | 0.24% | 0.21% | 0.23% | 100.5% | 101.7% | 101.2% |
| 1920x1088 | 0.0% | 0.2% | 0.2% | 0.03% | 0.02% | 0.04% | 100.4% | 100.8% | 100.0% |
| **average** | **0.0%** | **0.4%** | **0.4%** | **0.11%** | **0.09%** | **0.11%** | **100.4%** | **101.1%** | **100.4%** |

# Complexity comparison

Table 2 shows that worst case memory bandwidth in terms of memory pattern. The template was provided by AHG7.

Table 2: Worst case memory bandwidth with memory patterns (without depth access)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | memory pattern | | | |
|  | 1x1 | 4x2 | 4x4 | 8x2 |
| HTM11 (current) | 122% | 135% | 128% | 158% |
| proposal | 105% | 95% | 88% | 108% |

Table 3: Worst case memory bandwidth with memory patterns (with depth access)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Number of operation [%] | | Data transfer rate [%] | | | | | | | |
| 3D-HEVC |  | Mult [%] | Add [%] | Partial depth access in DoNBDV | | | | Full depth access in DoNBDV | | | |
|  |  |  | 1x1 | 4x2 | 4x4 | 8x2 | 1x1 | 4x2 | 4x4 | 8x2 |
| MC | 100% | 100% | 101% | 103% | 105% | 106% | 110% | 113% | 111% | 114% |
| ARP (current) | 46% | 38% | 122% | 138% | 133% | 164% | 132% | 148% | 139% | 172% |
| I0104 (proposed) | 44% | 37% | 105% | 98% | 93% | 114% | 115% | 108% | 99% | 122% |

# Conclusion

This proposal omits residual prediction for 4x4 chroma block. Because the proposal addresses the worst case concerns with small coding loss, it is recommended to adopt this method in 3D-HEVC.

# Patent rights declaration

**Sharp Corporation may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**

# References

[1] T. Ikai, “CE4-related: ARP simplification”, JCT3V-G0033, JCT-3V 7th Meeting: San Jose, USA, 11 Jan. – 17 Jan. 2013

[2] T. Ikai, “CE2: Results of ARP simplification”, JCT3V-H0063, JCT-3V 8th Meeting: Valencia, ES, 29 March – 4 April 2014