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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  12th Meeting: Geneva, CH, 14–23 Jan. 2013 | Document: JCTVC-L0376 |

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| *Title:* | **TE5: Results of test 5.2.8 on inter-layer motion-vector prediction by the base-layer MV up-scaling and refinement using HEVC base layer** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes the inter-layer motion-vector prediction for HEVC scalable extensions. The proposed method generates the motion vector candidate by using similar manner of SVC. In other word, the motion vector is up-scaled and then refined. A generated motion-vector is inserted as the third candidate for both merge mode and AMVP mode in the HEVC architecture. The number of motion vector candidates also increases to 7 and 3 for merge mode and AMVP mode, respectively. The proposed method is independent to the base layer codec like HEVC and AVC. This contribution provides the result of the HEVC base-layer case. The experimental condition follows TE-C5. In the case of merge mode, the Y BD-rate gains of RA HEVC 2x / 1.5x and LD-P HEVC 2x / 1.5 are 1.4% / 1.7% and 0.8% / 1.0%, respectively. In the case of AMVP mode, the Y BD-rate gains of RA HEVC 2x / 1.5x and LD-P HEVC 2x / 1.5 are 0.7% / 1.0% and 0.3% / 0.5%, respectively.

# Introduction

This contribution proposes the inter-layer motion-vector prediction for HEVC scalable extensions. The proposed method is a part of KDDI response [1] to the call for proposal of the scalable video coding technology. In this contribution, target syntax is motion vector. The motion vector candidate is generated by using similar manner of SVC. For instance, a motion vector in the base layer becomes that in the enhancement layer. Generated motion vector is inserted to motion vector candidates in the HEVC architecture.

# Proposed method

A procedure for generating motion vector candidate is similar manner of SVC. The collocated base layer is specified for each 4x4 pixels’ block of an enhancement layer. When the collocated base layer is coded by an inter mode, RefIdx and up-sampled MV of the collocated base layer is assigned to the 4x4 block of the enhancement layer. When the collocated base layer is coded by intra mode, RefIdx and up-scaled MV in the neighboring blocks of the base layer is assigned to the 4x4 block. If the all neighboring block is coded by an intra mode, zero MV is assigned to the 4x4 block.

Following is the MV refinement process. Four MVs in the 8x8 pixels’ block of the enhancement layer are replaced by the MV which is associated with the smallest RefIdx. This operation is applied for each L0 and L1 list. If two or four 4x4 blocks in the 8x8 block have similar L0 MV and L1 MV, such 4x4 blocks are merged and get new L0 MV and L1 MV based on the average of MVs.

Resulting MV and RefIdx is inserted to as the third candidate for both merge mode and AMVP mode. Consequently, the number of MV candidates in the merge mode increase from five to six. The number of that in the AMVP mode increase from two to three.

The advantage of the proposed methods is that this prediction can apply both HEVC and AVC base layers.

# Experimental results

The proposed method is implemented to the SMuC 0.1.1. A test condition follows the TE-C5 description [2]. AI condition has no impact because the proposed method is applied to the inter frame. Following tables show the summary of BD-rate gain and codec runtime.

Table 1 Merge mode results of the Random Access HE conditions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 2x** | | | **RA HEVC 1.5x** | | |
|  | Y | U | V | Y | U | V |
| Class A | -1.2% | -2.1% | -2.1% |  |  |  |
| Class B | -1.5% | -2.3% | -2.4% | -1.7% | -2.6% | -2.8% |
| **Overall (EL+BL)** | -1.4% | -2.3% | -2.3% | -1.7% | -2.6% | -2.8% |
| **Overall (EL)** | -2.6% | -4.2% | -4.2% | -4.5% | -6.4% | -6.9% |
| Enc Time[%] | 98.1% | | | 96.1% | | |
| Dec Time[%] | 104.5% | | | 104.9% | | |
| Enc Mem[%] | #DIV/0! | | | #DIV/0! | | |
| BL Match | Matched | | | Matched | | |

Table 2 Merge mode results of the Low delay B HE conditions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **LD-P HEVC 2x** | | | **LD-P HEVC 1.5x** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.6% | -1.0% | -0.9% |  |  |  |
| Class B | -0.9% | -1.3% | -1.3% | -1.0% | -1.4% | -1.5% |
| **Overall (EL+BL)** | -0.8% | -1.2% | -1.2% | -1.0% | -1.4% | -1.5% |
| **Overall (EL)** | -1.3% | -2.0% | -2.0% | -2.3% | -3.0% | -3.0% |
| Enc Time[%] | 99.2% | | | 96.8% | | |
| Dec Time[%] | 103.9% | | | 104.0% | | |
| Enc Mem[%] | #DIV/0! | | | #DIV/0! | | |
| BL Match | Matched | | | Matched | | |

Table 3 AMVP mode results of the Random Access HE conditions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 2x** | | | **RA HEVC 1.5x** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.6% | -1.1% | -1.1% |  |  |  |
| Class B | -0.8% | -1.2% | -1.2% | -1.0% | -1.2% | -1.4% |
| **Overall (EL+BL)** | -0.7% | -1.1% | -1.2% | -1.0% | -1.2% | -1.4% |
| **Overall (EL)** | -1.4% | -2.0% | -2.2% | -2.6% | -2.9% | -3.5% |
| Enc Time[%] | 98.3% | | | 97.7% | | |
| Dec Time[%] | 105.4% | | | 105.4% | | |
| Enc Mem[%] | #DIV/0! | | | #DIV/0! | | |
| BL Match | Matched | | | Matched | | |

Table 4 AMVP mode results of the Low delay B HE conditions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **LD-P HEVC 2x** | | | **LD-P HEVC 1.5x** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.3% | -0.3% | -0.4% |  |  |  |
| Class B | -0.4% | -0.6% | -0.6% | -0.5% | -0.6% | -0.7% |
| **Overall (EL+BL)** | -0.3% | -0.5% | -0.6% | -0.5% | -0.6% | -0.7% |
| **Overall (EL)** | -0.5% | -0.9% | -0.9% | -1.0% | -1.2% | -1.4% |
| Enc Time[%] | 98.0% | | | 97.4% | | |
| Dec Time[%] | 104.3% | | | 104.3% | | |
| Enc Mem[%] | #DIV/0! | | | #DIV/0! | | |
| BL Match | Matched | | | Matched | | |

# Conclusion

This contribution proposed inter-layer syntax prediction for HEVC scalable extensions. The proposed method predicted motion vector of the enhancement layer from that of the collocated base layer. Resulting motion vector was inserted to both the merge mode and the AMVP mode.

Experimental results showed that the proposed method in the merge mode case achieved 1.4% / 1.7% and 0.8% / 1.0% Y BD-rate reduction for RA HEVC 2x / 1.5x and LD-P HEVC 2x / 1.5, respectively. Other experimental results showed that the proposed method in the AMVP mode case achieved 0.7% / 1.0% and 0.3% / 0.5% Y BD-rate reduction in the merge mode case for RA HEVC 2x / 1.5x and LD-P HEVC 2x / 1.5, respectively.

# References

1. K. Kawamura, et al. “Description of scalable video coding technology proposal by KDDI”, JCTVC-K0052, Shanghai, Oct. 2012.
2. V. Seregin, et al. “Description of Tool Experiment C5: Inter-layer syntax prediction using HEVC base layer”, JCTVC-K1106, Shanghai, Oct. 2012.

# Patent rights declaration(s)

**KDDI 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).**