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| *Title:* | **TE2: Results of Test 3.3.1 On Enhancement Layer Skipped Slice** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

In this contribution, the skipped slice mode is proposed for SHVC Tool Experiment A2 (TE-A2), Inter-layer Texture Prediction Signaling in SHVC. The skipped slice mode uses up-sampled base layer reconstructed picture directly as the enhancement layer reconstruction to achieve better rate distortion performance.

# Enhancement layer skipped slice (ELSkip)

Enhancement layer skipped slice mode uses up-sampled base layer reconstructed picture directly as the enhancement layer reconstruction. The skip slice mode can sometimes offer better rate distortion performance. When such is the case, only inter layer processing parameters, used to generate the inter layer reference, need to be sent at picture (or slice) level, and no additional coding of the blocks in the enhancement layer picture is performed, which significantly reduces decoding complexity as well. EL skipped slice mode was proposed in InterDigital SHVC CFP response [1] and was assigned to TE-A2 [2] in JCTVC 11th meeting.

In the proposed tool, the encoder uses R-D cost to determine whether to choose the EL Skip mode for the enhancement layer picture. The percentage of EL skipped slices depends on the video content, the correlation between the layers, as well as on the relatively rate allocation between the base and the enhancement layers.

In the proposed tool, the EL Skip slice is signaled using a new NAL unit type as show in Table 1. Currently the slice header of an ELSkip slice is still signaled in the proposed system, mostly to ensure correct DPB operation using RPS.

1. NAL unit type codes and NAL unit type classes

|  |  |  |  |
| --- | --- | --- | --- |
| **nal\_unit\_type** | **Name of nal\_unit\_type** | **Content of NAL unit and RBSP syntax structure** | **NAL unit type class** |
| 0 | UNSPEC0 | Unspecified | non-VCL |
|  | … |  |  |
| 15 | SKIP\_SLICE | Coded slice of a skipped slice | VCL |
| 16..20 | RSV\_VCL16.. RSV\_VCL20 | Reserved | VCL |
|  | … |  |  |

# Simulation results

The proposed scheme is implemented on Smuc0.1.1 for both intraBL and ref\_idx framework.

Table 2 is the skip slice simulation results on IntraBL framework, the reference is the HM8.1 simulcast results.

Table 3 is the skip slice simulation results on refidx framework, the reference is the HM8.1 simulcast results.

Full simulation results are provided in the attached Excel sheets. The reference encoding and decoding time are from original Excel template.

1. Skip Slice simulation results on IntraBL framework

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | -27.0% | -27.2% | -28.0% |  |  |  |  |  |  |
| Class B | -21.1% | -21.2% | -21.0% | -32.6% | -33.0% | -33.0% |  |  |  |
| **Overall (EL+BL)** | -22.8% | -22.9% | -23.0% | -32.6% | -33.0% | -33.0% |  |  |  |
| **Overall (EL)** | -34.8% | -35.2% | -35.3% | -58.3% | -58.4% | -58.5% |  |  |  |
| Enc Time[%] | 105.1% | | | 105.2% | | |  |  |  |
| Dec Time[%] | 89.3% | | | 90.5% | | |  |  |  |
| Enc Mem[%] | #NUM! | | | #NUM! | | |  |  |  |
| BL Match | Matched | | | Matched | | |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | **RA HEVC 2x** | | | **RA HEVC 1.5x** | | | **RA HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -18.5% | -7.8% | -9.3% |  |  |  | -21.5% | -12.0% | -11.7% |
| Class B | -15.5% | -9.2% | -7.8% | -26.1% | -20.3% | -18.8% | -19.4% | -11.2% | -8.2% |
| **Overall (EL+BL)** | -16.4% | -8.8% | -8.3% | -26.1% | -20.3% | -18.8% | -20.0% | -11.4% | -9.2% |
| **Overall (EL)** | -25.2% | -13.6% | -12.9% | -47.4% | -38.2% | -35.5% | -31.7% | -19.1% | -15.9% |
| Enc Time[%] | 84.6% | | | 78.5% | | | 95.3% | | |
| Dec Time[%] | 105.0% | | | 95.5% | | | 88.9% | | |
| Enc Mem[%] | #NUM! | | | #NUM! | | | #NUM! | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-P HEVC 2x** | | | **LD-P HEVC 1.5x** | | | **LD-P HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -13.6% | -1.9% | -3.0% |  |  |  | -14.0% | -7.2% | -6.4% |
| Class B | -11.7% | -6.9% | -5.1% | -22.0% | -17.1% | -15.2% | -12.8% | -5.7% | -2.2% |
| **Overall (EL+BL)** | -12.3% | -5.5% | -4.5% | -22.0% | -17.1% | -15.2% | -13.1% | -6.2% | -3.4% |
| **Overall (EL)** | -19.6% | -8.6% | -7.2% | -41.3% | -32.7% | -29.1% | -21.1% | -11.6% | -7.6% |
| Enc Time[%] | 96.5% | | | 100.9% | | | 86.7% | | |
| Dec Time[%] | 119.8% | | | 122.9% | | | 84.7% | | |
| Enc Mem[%] | #NUM! | | | #NUM! | | | #NUM! | | |
| BL Match | Matched | | | Matched | | | Matched | | |

1. Skip Slice simulation results on refidx framework

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | -26.9% | -26.2% | -27.1% |  |  |  |  |  |  |
| Class B | -21.2% | -20.1% | -20.0% | -32.8% | -32.9% | -33.1% |  |  |  |
| **Overall (EL+BL)** | -22.8% | -21.9% | -22.0% | -32.8% | -32.9% | -33.1% |  |  |  |
| **Overall (EL)** | -34.8% | -33.7% | -33.9% | -58.5% | -58.2% | -58.7% |  |  |  |
| Enc Time[%] | 231.2% | | | 177.1% | | |  |  |  |
| Dec Time[%] | 82.5% | | | 76.4% | | |  |  |  |
| Enc Mem[%] | #NUM! | | | #NUM! | | |  |  |  |
| BL Match | Matched | | | Matched | | |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | **RA HEVC 2x** | | | **RA HEVC 1.5x** | | | **RA HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -17.3% | -4.6% | -6.1% |  |  |  | -20.3% | -8.3% | -7.3% |
| Class B | -14.2% | -5.2% | -3.3% | -25.4% | -18.8% | -16.9% | -17.7% | -5.8% | -1.2% |
| **Overall (EL+BL)** | -15.1% | -5.1% | -4.1% | -25.4% | -18.8% | -16.9% | -18.5% | -6.5% | -2.9% |
| **Overall (EL)** | -23.4% | -8.0% | -6.9% | -46.5% | -36.0% | -32.8% | -29.2% | -11.7% | -6.5% |
| Enc Time[%] | 81.6% | | | 80.0% | | | 83.4% | | |
| Dec Time[%] | 93.2% | | | 91.3% | | | 71.8% | | |
| Enc Mem[%] | #NUM! | | | #NUM! | | | #NUM! | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-P HEVC 2x** | | | **LD-P HEVC 1.5x** | | | **LD-P HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -13.3% | -1.1% | -2.3% |  |  |  | -13.7% | -6.4% | -5.4% |
| Class B | -11.6% | -5.6% | -3.9% | -22.1% | -16.9% | -15.2% | -12.7% | -5.7% | -1.8% |
| **Overall (EL+BL)** | -12.1% | -4.3% | -3.5% | -22.1% | -16.9% | -15.2% | -13.0% | -5.9% | -2.9% |
| **Overall (EL)** | -19.4% | -6.8% | -5.7% | -41.4% | -32.2% | -29.1% | -20.9% | -11.2% | -6.9% |
| Enc Time[%] | 92.6% | | | 87.2% | | | 85.4% | | |
| Dec Time[%] | 109.5% | | | 101.1% | | | 77.4% | | |
| Enc Mem[%] | #NUM! | | | #NUM! | | | #NUM! | | |
| BL Match | Matched | | | Matched | | | Matched | | |

Table 4 shows the decoding time reduced for the sequences with skipped slice. The decoding time is measured on a standalone 64-bit machine with Intel i7 CPU, [Q740@1.73GHz](mailto:Q740@1.73GHz), 6GB RAM. For lowerDelay\_P Kimono 1.5X with QP 30/34, the decoding time with EL-skip is approximately half of the decoding time without EL-skip.

1. Decoding time measurement for EL-Skip

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LowDelay\_P | intraBL decoding time (sec.) | Number of EL slice skipped | EL-Skip decoding time (sec.) | EL-Skip decoding time percentage (vs. w/o EL-Skip) |
| BasketballDrive 1.5X QP30/34 | 113.823 | 19 | 110.88 | 97.4144% |
| Kimono 1.5X QP26/28 | 55.923 | 13 | 54.26 | 97.0263% |
| Kimono 1.5x QP26/30 | 57.552 | 85 | 47.666 | 82.8225% |
| Kimono 1.5x QP30/32 | 52.812 | 38 | 48.877 | 92.549% |
| Kimono 1.5x QP30/34 | 56.647 | 236 | 30.684 | 54.167% |

# Patent rights declaration(s)

**InterDigital Communications, LLC may have IPR 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. J. Dong, Y. He, Y. He, G. McClellan, E. Ryu, X. Xiu, Y. Ye, Description of scalable video coding technology proposal by InterDigital Communications. Document no JCTVC-K0034. Oct. 2012.
2. L. Wei, Y. He, D. Kwon, J. Zan, H. Lakshman, J. Kang, Description of Tool Experiment A2: Inter-layer Texture Prediction Signaling in SHVC, Document no JCTVC-K1102. Oct 2012.