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| --- | --- | --- | --- |
| *Title:* | **APS for inter-layer processing signaling** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes to use Adaptation Parameter Set (APS) to carry parameter information required for inter-layer processing. The filtering parameters of chroma enhancement filter (SCE4.2.4) for inter-layer prediction is proposed to be signaled in APS instead of slice header to save bits and keep existing slice header syntax intact. The APS syntax, semantic and simulation results are provided in this contribution.

# Introduction

At the 12th JCTVC Geneva meeting, SCE4 was established to evaluate inter-layer filtering tools for SHVC. Currently, the parameters of these tools are designed to be signaled in PPS or slice header depending on individual implementation. Additional syntax elements need to be added to the PPS or slice header to support these tools.

In general, VPS is used to hold the syntax elements shared by multiple layers and/or essential information for the purpose of capability exchange and session negotiation. The SPS carries the information common to all pictures/slices in a coded video sequence. The PPS carries the picture level information which does not need frequent updates and remains unchanged through a relative long duration of pictures. Slice header usually carries the parameters that change on the slice level, while the overhead bit cost is higher, especially when multiple slices are used to code a picture.

Adaptation parameter set (APS) was adopted in early versions of HEVC to carry picture level adaptive data, such as ALF and SAO parameters, that usually change more frequently than those carried in PPS. The characteristic of APS could be a good match to signal the inter-layer processing parameters. In addition, APS is defined as an individual NAL unit with unique NAL unit type assigned. The benefits of carrying the inter-layer processing information and parameters in a separate APS NAL unit are:

1. This allows parsing of the slice header syntax elements and decoding of the slice header to remain substantially similar to those of the single layer codec
2. This allows the BL codec, the ILP unit, and the EL codec to operate in a multi-threaded and parallelized manner.

# Proposed APS Format

Table 1 is the proposed general APS syntax structure. The 4 bits LSB of the picture order count for the picture associated with the current APS is used as the identification of the APS. Such identification is able to detect APS packet loss to improve the error resilience. In addition, it also helps to synchronize the APS with corresponding pictures to which the inter layer processing parameters are applied.

1. Adaptation parameter set RBSP syntax

|  |  |
| --- | --- |
| aps\_rbsp( ) { | Descriptor |
| **aps\_pic\_order\_cnt\_lsb** | u (4) |
| inter\_layer\_information() |  |
| **aps\_extension\_flag** | u (1) |
| if( aps\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **aps\_extension\_data\_flag** | u (1) |
| rbsp\_trailing\_bits( ) |  |
| } |  |

**aps\_pic\_order\_cnt\_lsb** identifies the picture to which the inter layer processing information in the current adaptation parameter set is associated.

**aps\_extension\_flag** equal to 0 specifies that no aps\_extension\_data\_flag syntax elements are present in the adaptation parameter set RBSP syntax structure. aps\_extension\_flag shall be equal to 0 in bitstreams conforming to this Recommendation | International Standard. The value of 1 for aps\_extension\_flag is reserved for future use by ITU‑T | ISO/IEC. Decoders shall ignore all data that follow the value 1 for aps\_extension\_flag in an aps\_extension\_flag parameter set NAL unit.

**aps\_extension\_data\_flag** may have any value. Its value does not affect decoder conformance to profiles specified in this Recommendation | International Standard.

The NAL unit type of proposed APS NAL unit type is 41 (currently reserved as RSV\_NVCL41).

# APS Signaling for Chroma Enhancement Filter

Chroma enhancement filter is an inter-layer filtering tool to improve the quality of chroma planes by using the information from the luma plane. Currently chroma enhancement filter is being evaluated in SCE4. The chroma enhancement filter is performed on a picture basis and the filter coefficients can change for every picture.

1. Chroma enhancement filter parameters syntax

|  |  |
| --- | --- |
| inter\_layer\_information ( ) { | Descriptor |
| **chroma\_cb\_filtering\_flag** | u (1) |
| if (chroma\_cb\_filtering\_flag) { |  |
| **chroma\_cb \_scaling** | u (11) |
| **chroma\_cb \_shifting** | u (5) |
| for (i = 0; i < number\_of\_coefficents; i++) { |  |
| **chroma\_cb \_filter\_coefficients[i]** | u (4) |
| } |  |
| } |  |
| **chroma\_cr\_filtering\_flag** | u (1) |
| if (chroma\_cr\_filtering\_flag) { |  |
| **chroma\_filter\_identical\_flag** | u (1) |
| if (chroma\_filter\_identical\_flag == 0) { |  |
| **chroma\_cr\_scaling** | u (11) |
| **chroma\_cr\_shifting** | u (5) |
| for (i = 0; i < number\_of\_coefficents; i++) { |  |
| **chroma\_cr\_filter\_coefficients[i]** | u (4) |
| } |  |
| } |  |
| } |  |
| } |  |

Table 2 is the syntax of chroma enhancement filter parameters included in the inter\_layer\_information() section of proposed APS. The semantics associated with the syntax elements in Table 2 are specified below.

**chroma\_cb\_filtering\_flag** specifies if the chroma enhancement filter for Cb is presented or not. When chroma\_cb\_filtering\_flag is set to 1, the corresponding chroma enhancement filter for Cb plane is presented.

**chroma\_cb\_scaling** is 11-bit scaling factor, where the first bit is the sign bit and the rest 10 bits represent the absolute value of the scaling factor.

**chroma\_cb\_shifting** is 5-bit right shifting factor used by chroma enhancement filter for Cb.

**chroma\_cb\_filter\_coefficients** are the chroma enhancement filter coefficients used for Cb.

**chroma\_cr\_filtering\_flag** specifies if the chroma enhancement filter for Cr is presented or not. When chroma\_cr\_filtering\_flag is set to 1, the corresponding chroma enhancement filter for Cr plane is presented.

**chroma\_filter\_identical\_flag** equal to 1 indicates the same chroma enhancement filter as for Cb is used forCr, and no additional parameters will be presented for Cr in the following bitstream

**chroma\_cr\_scaling** is 11-bit scaling factor, where the first bit is the sign bit and the rest 10 bits represent the absolute value of the scaling factor.

**chroma\_cr\_shifting** is 5-bit right shifting factor used by chroma enhancement filter for Cr.

**chroma\_cr\_filter\_coefficients** are the chroma enhancement filter coefficients used for Cr.

The number\_of\_coefficents of current chroma enhancement filter is 12.

# Simulation results

The APS signaling to support chroma enhancement filters is implemented based on SCE4.2.4 chroma enhancement filter code. The results of chroma enhancement filtering performance using APS signaling for refidx and intraBL framework are shown in Table 3 and Table 4, respectively. The anchor in Table 3 and Table 4 are the corresponding refidx and intraBL anchor data from SHM1.0.

1. APS signaled SCE4.2.4 performance (refidx framework, anchor: SHM1.0)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | -0.9% | -7.8% | -6.2% |  |  |  |  |  |  |
| Class B | -0.8% | -6.4% | -8.4% | -0.7% | -8.2% | -10.4% |  |  |  |
| **Overall (Test vs Ref)** | -0.8% | -6.8% | -7.8% | -0.7% | -8.2% | -10.4% |  |  |  |
| **Overall (Test vs single layer)** | 11.9% | 7.4% | 6.2% | 9.8% | 1.1% | -1.0% |  |  |  |
| **EL only (Test vs Ref)** | -1.6% | -7.9% | -8.9% | -2.2% | -11.3% | -13.7% |  |  |  |
| Enc Time[%] | 128.1% | | | 125.3% | | |  |  |  |
| Dec Time[%] | 127.2% | | | 124.6% | | |  |  |  |
| 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 | -0.5% | -11.2% | -7.7% |  |  |  | -0.4% | -9.0% | -5.4% |
| Class B | -0.3% | -8.1% | -9.8% | -0.2% | -10.5% | -12.1% | -0.3% | -7.6% | -8.6% |
| **Overall (Test vs Ref)** | -0.3% | -9.0% | -9.2% | -0.2% | -10.5% | -12.1% | -0.3% | -8.0% | -7.7% |
| **Overall (Test vs single layer)** | 19.7% | 20.9% | 22.3% | 17.1% | 14.9% | 15.6% | 15.5% | 19.5% | 24.6% |
| **EL only (Test vs Ref)** | -0.6% | -9.6% | -9.7% | -0.6% | -11.9% | -13.4% | -0.6% | -8.9% | -8.4% |
| Enc Time[%] | 136.2% | | | 139.6% | | | 129.4% | | |
| Dec Time[%] | 131.6% | | | 128.5% | | | 124.2% | | |
| 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 | -0.2% | -9.3% | -5.2% |  |  |  | -0.3% | -7.3% | -4.4% |
| Class B | -0.2% | -4.5% | -6.0% | -0.2% | -7.5% | -10.1% | -0.2% | -5.2% | -6.1% |
| **Overall (Test vs Ref)** | -0.2% | -5.9% | -5.7% | -0.2% | -7.5% | -10.1% | -0.2% | -5.8% | -5.6% |
| **Overall (Test vs single layer)** | 26.4% | 29.2% | 31.2% | 22.7% | 23.0% | 22.4% | 23.2% | 26.6% | 31.6% |
| **EL only (Test vs Ref)** | -0.3% | -6.2% | -5.9% | -0.5% | -8.3% | -10.8% | -0.4% | -6.3% | -6.0% |
| Enc Time[%] | 109.4% | | | 123.9% | | | 122.8% | | |
| Dec Time[%] | 114.2% | | | 125.0% | | | 124.3% | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
| **Optional Tests** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-B HEVC 2x** | | | **LD-B HEVC 1.5x** | | | **LD-B HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -0.2% | -9.7% | -5.8% |  |  |  | -0.3% | -8.0% | -5.0% |
| Class B | -0.2% | -5.0% | -6.8% | -0.1% | -8.1% | -10.8% | -0.2% | -5.6% | -6.8% |
| **Overall (Test vs Ref)** | -0.2% | -6.4% | -6.5% | -0.1% | -8.1% | -10.8% | -0.2% | -6.2% | -6.3% |
| **Overall (Test vs single layer)** | 28.3% | 29.3% | 31.2% | 24.6% | 22.5% | 21.5% | 24.0% | 26.0% | 30.7% |
| **EL only (Test vs Ref)** | -0.3% | -6.6% | -6.7% | -0.4% | -8.8% | -11.4% | -0.4% | -6.8% | -6.7% |
| Enc Time[%] | 121.2% | | | 119.2% | | | 113.4% | | |
| Dec Time[%] | 137.1% | | | 137.6% | | | 136.3% | | |
| BL Match | Matched | | | Matched | | | Matched | | |

1. APS signaled SCE4.2.4 performance (intraBL framework, anchor: SHM1.0)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | -0.9% | -7.3% | -5.7% |  |  |  |  |  |  |
| Class B | -0.8% | -6.1% | -7.9% | -0.7% | -7.4% | -9.3% |  |  |  |
| **Overall (Test vs Ref)** | -0.8% | -6.4% | -7.3% | -0.7% | -7.4% | -9.3% |  |  |  |
| **Overall (Test vs single layer)** | 11.5% | 6.6% | 5.6% | 9.5% | 2.4% | 0.4% |  |  |  |
| **EL only (Test vs Ref)** | -1.5% | -7.6% | -8.4% | -2.2% | -10.3% | -12.3% |  |  |  |
| Enc Time[%] | 102.7% | | | 102.2% | | |  |  |  |
| Dec Time[%] | 105.8% | | | 104.9% | | |  |  |  |
| 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 | -0.4% | -10.6% | -7.1% |  |  |  | -0.4% | -8.4% | -4.9% |
| Class B | -0.3% | -7.7% | -9.1% | -0.2% | -9.5% | -10.9% | -0.3% | -6.6% | -7.4% |
| **Overall (Test vs Ref)** | -0.3% | -8.5% | -8.5% | -0.2% | -9.5% | -10.9% | -0.3% | -7.1% | -6.7% |
| **Overall (Test vs single layer)** | 18.9% | 20.6% | 22.3% | 16.3% | 16.7% | 17.6% | 14.5% | 19.7% | 24.1% |
| **EL only (Test vs Ref)** | -0.6% | -9.2% | -9.1% | -0.6% | -10.8% | -12.1% | -0.6% | -8.0% | -7.4% |
| Enc Time[%] | 91.9% | | | 80.4% | | | 81.5% | | |
| Dec Time[%] | 102.7% | | | 89.9% | | | 90.9% | | |
| 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 | -0.2% | -9.1% | -5.2% |  |  |  | -0.2% | -7.1% | -4.2% |
| Class B | -0.2% | -4.8% | -6.1% | -0.1% | -7.4% | -9.7% | -0.2% | -4.8% | -6.0% |
| **Overall (Test vs Ref)** | -0.2% | -6.0% | -5.8% | -0.1% | -7.4% | -9.7% | -0.2% | -5.5% | -5.5% |
| **Overall (Test vs single layer)** | 25.8% | 27.9% | 30.3% | 22.4% | 23.6% | 23.4% | 22.1% | 26.9% | 31.5% |
| **EL only (Test vs Ref)** | -0.3% | -6.4% | -6.0% | -0.4% | -8.1% | -10.3% | -0.3% | -6.0% | -5.9% |
| Enc Time[%] | 100.3% | | | 94.3% | | | 96.0% | | |
| Dec Time[%] | 104.5% | | | 99.8% | | | 104.6% | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
| **Optional Tests** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-B HEVC 2x** | | | **LD-B HEVC 1.5x** | | | **LD-B HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | -0.2% | -8.9% | -4.9% |  |  |  | -0.3% | -7.2% | -4.3% |
| Class B | -0.1% | -4.6% | -6.0% | -0.1% | -6.9% | -9.2% | -0.2% | -4.5% | -5.5% |
| **Overall (Test vs Ref)** | -0.2% | -5.8% | -5.7% | -0.1% | -6.9% | -9.2% | -0.2% | -5.3% | -5.1% |
| **Overall (Test vs single layer)** | 28.0% | 28.9% | 30.8% | 24.5% | 24.0% | 23.2% | 23.5% | 26.4% | 30.1% |
| **EL only (Test vs Ref)** | -0.3% | -6.1% | -5.8% | -0.4% | -7.5% | -9.8% | -0.3% | -5.7% | -5.5% |
| Enc Time[%] | 93.1% | | | 93.6% | | | 94.9% | | |
| Dec Time[%] | 106.9% | | | 109.2% | | | 115.8% | | |
| BL Match | Matched | | | Matched | | | Matched | | |

Table 5 and Table 6 are the comparison of SCE4.2.4 performance between APS signaling method and slice header signaling method for refidx and intraBL framework, respectively. The anchor in the table is SCE4.2.4 chroma enhancement filtering using slice header to signal the parameters. The results show APS signaling method is able to provide the same performance as slice header signaling method for single slice per picture case. The overhead saving would be more for multiple slices per picture cases.

1. APS signaled SCE4.2.4 performance (RefIdx, anchor: SCE4.2.4 w/ slice header signaling)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | 0.0% | 0.0% | 0.0% |  |  |  |  |  |  |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| **Overall (Test vs single layer)** | 11.9% | 7.4% | 6.2% | 9.8% | 1.1% | -1.0% |  |  |  |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| Enc Time[%] | 99.3% | | | 97.8% | | |  |  |  |
| Dec Time[%] | 97.7% | | | 98.4% | | |  |  |  |
| 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 | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 19.7% | 20.9% | 22.3% | 17.1% | 14.9% | 15.6% | 15.5% | 19.5% | 24.6% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 100.9% | | | 103.0% | | | 103.0% | | |
| Dec Time[%] | 95.7% | | | 96.8% | | | 98.7% | | |
| 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 | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 26.4% | 29.2% | 31.2% | 22.7% | 23.0% | 22.4% | 23.2% | 26.6% | 31.6% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 102.0% | | | 107.8% | | | 113.5% | | |
| Dec Time[%] | 97.3% | | | 98.9% | | | 98.2% | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
| **Optional Tests** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-B HEVC 2x** | | | **LD-B HEVC 1.5x** | | | **LD-B HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 28.3% | 29.3% | 31.2% | 24.6% | 22.5% | 21.5% | 24.0% | 26.0% | 30.7% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 97.9% | | | 96.0% | | | 90.1% | | |
| Dec Time[%] | 97.4% | | | 91.2% | | | 88.9% | | |
| BL Match | Matched | | | Matched | | | Matched | | |

1. APS signaled SCE4.2.4 performance (IntraBL, anchor: SCE 4.2.4 w/ slice header signaling)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x** | | | **AI HEVC 1.5x** | | |  |  |  |
|  | Y | U | V | Y | U | V |  |  |  |
| Class A | 0.0% | 0.0% | 0.0% |  |  |  |  |  |  |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| **Overall (Test vs single layer)** | 11.5% | 6.6% | 5.6% | 9.5% | 2.4% | 0.4% |  |  |  |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |  |  |  |
| Enc Time[%] | 106.6% | | | 107.3% | | |  |  |  |
| Dec Time[%] | 106.0% | | | 105.2% | | |  |  |  |
| 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 | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 18.9% | 20.6% | 22.3% | 16.3% | 16.7% | 17.6% | 14.5% | 19.7% | 24.1% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 79.1% | | | 69.3% | | | 73.9% | | |
| Dec Time[%] | 85.9% | | | 78.7% | | | 82.6% | | |
| 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 | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 25.8% | 27.9% | 30.3% | 22.4% | 23.6% | 23.4% | 22.1% | 26.9% | 31.5% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 100.0% | | | 93.5% | | | 94.0% | | |
| Dec Time[%] | 91.5% | | | 85.5% | | | 88.5% | | |
| BL Match | Matched | | | Matched | | | Matched | | |
|  |  |  |  |  |  |  |  |  |  |
| **Optional Tests** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | **LD-B HEVC 2x** | | | **LD-B HEVC 1.5x** | | | **LD-B HEVC SNR** | | |
|  | Y | U | V | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.0% | 0.0% |  |  |  | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **Overall (Test vs single layer)** | 28.0% | 28.9% | 30.8% | 24.5% | 24.0% | 23.2% | 23.5% | 26.4% | 30.1% |
| **EL only (Test vs Ref)** | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 79.6% | | | 79.0% | | | 83.9% | | |
| Dec Time[%] | 79.3% | | | 83.1% | | | 86.6% | | |
| BL Match | Matched | | | Matched | | | Matched | | |

# Conclusion

This contribution proposes to use adaptation parameter set (APS) to carry SHVC inter-layer processing parameters. An example of using APS to signal chroma enhancement filter is provided and implemented based on the SCE4.2.4 software. By using APS to signal the necessary parameter information of inter-layer processing module, the existing PPS and slice header would be kept intact and additional parallelism can be achieved for inter-layer processing. Considering the unique characteristic of APS is a good match for inter-layer processing, we suggest adopting this parameter set into the test model for further SHVC development.

# Patent rights declaration(s)

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