

JCTVC-M0179

APS FOR INTER-LAYER PROCESSING SIGNALING

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Carriage of High Level Signaling

- VPS
 - Information shared by multiple layers, capability exchange/session negotiation
- SPS
 - Common information for a coded video sequence
- PPS
 - Picture level information, not frequently changed
- Slice Header
 - Slice level information, every overhead bit counts

Adaptation Parameter Set (APS)

- Inter-layer filtering tools (SCE4)
 - Parameters signaled in PPS or slice header
- APS was used to carry picture level adaptive data (ALF/SAO)
- APS is a good match to convey inter-layer processing parameters
 - Frequently changed picture level parameters
 - Keep slice header syntax intact
 - Enable parallelism of BL codec, inter-layer processing and EL codec operation

APS Syntax Structure

| 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) |
| rbp_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.

APS for SCE4.2.4 Chroma Enhancement Filter

| | |
|--|-------------------|
| 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_coefficients; 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_coefficients; i++) { | |
| chroma_cr_filter_coefficients[i] | u (4) |
| } | |
| } | |
| } | |
| } | |

Simulation results (refidx, 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 | |

| | 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% |

Simulation results (refidx, anchor SCE4.2.4)

| | 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% |

| | 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% |

| | 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% |

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% |

Simulation results (IntraBL, 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 | |

| | 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 | |

Simulation results (IntraBL, anchor SCE4.2.4)

| | 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% |

| | 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% |

| | 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% |

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% |

- We thank Huawei to cross-check the results

Conclusion

- Adaptation Parameter Set (APS) is a good carriage to convey inter-layer processing parameters
 - Keep existing PPS and slice header intact
 - Achieve additional parallelism for inter-layer processing
 - No additional cost for single slice per picture, may save more for multiple slices per picture
- Suggest to adopt APS into SHVC