

# JVET-N0084

## CE4-related: Motion compression for HMVP buffers and MV line buffer

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# Overall Summary

- Reduce the number of bits for MV storage
  - Utilize the same mantissa-exponent representation for temporal motion vector predictors (TMVPs)
    - 10 bits instead of 18 bits for one MV in JVET-M0512
  - Compress history motion vector predictor (HMVP) buffers
  - Compress motion vector (MV) line buffer

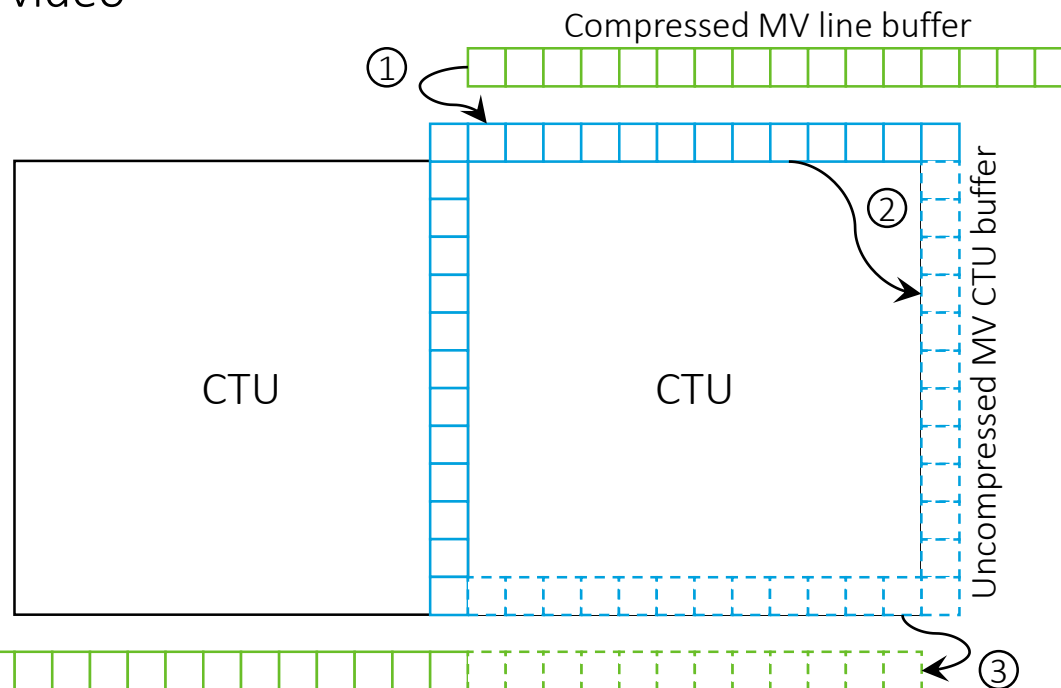
| Over VTM-4.0 (%) |                                       | Y  | U     | V     | EncT | DecT |      |
|------------------|---------------------------------------|----|-------|-------|------|------|------|
| 1                | Motion compression for HMVP buffers   | AI | 0.00  | 0.00  | 0.00 | 100% | 100% |
|                  |                                       | RA | -0.03 | -0.02 | 100% | 100% |      |
|                  |                                       | LB | 0.05  | 0.04  | 100% | 99%  |      |
| 2                | Motion compression for MV line buffer | AI | 0.00  | 0.00  | 0.00 | 100% | 100% |
|                  |                                       | RA | -0.01 | 0.00  | 100% | 100% |      |
|                  |                                       | LB | -0.07 | -0.13 | 100% | 100% |      |

# Proposed Methods (1/2)

- Motion compression for HMVP buffers
  - Apply mantissa-exponent representation to the MVs in the two HMVP buffers, including regular merge HMVP buffer and IBC HMVP buffer
  - 320 bits for HMVP buffers are reduced
  - $(2 \text{ lists} \times 2 \text{ comps} \times (18-10) \times 5 \text{ entries} \times 2 \text{ buffers})$

## Proposed Methods (2/2)

- Motion compression for MV line buffer
  - Apply mantissa-exponent representation to MV line buffer
  - Fetch compressed MVs when fetching crossing CTU row boundary
  - 32 bits are reduced per 4x4 luma block, and 30720 bits are reduced in case of 4K video



# Simulation Results (1/3)

## Motion compression for HMVP buffers

|                | All Intra Main10 |       |        |      |      |
|----------------|------------------|-------|--------|------|------|
|                | Over VTM-4.0     |       |        |      |      |
|                | Y                | U     | V      | EncT | DecT |
| Class A1       | 0.00%            | 0.00% | 0.00%  | 99%  | 97%  |
| Class A2       | 0.00%            | 0.00% | 0.00%  | 100% | 97%  |
| Class B        | 0.00%            | 0.00% | 0.00%  | 100% | 102% |
| Class C        | 0.00%            | 0.00% | 0.00%  | 100% | 101% |
| Class E        | 0.00%            | 0.00% | 0.00%  | 100% | 101% |
| <b>Overall</b> | 0.00%            | 0.00% | 0.00%  | 100% | 100% |
| Class D        | 0.00%            | 0.00% | 0.00%  | 100% | 102% |
| Class F        | 0.00%            | 0.12% | -0.01% | 101% | 100% |

|                | Random access Main10 |        |        |      |      |
|----------------|----------------------|--------|--------|------|------|
|                | Over VTM-4.0         |        |        |      |      |
|                | Y                    | U      | V      | EncT | DecT |
| Class A1       | 0.01%                | -0.07% | -0.02% | 100% | 99%  |
| Class A2       | -0.01%               | 0.05%  | 0.03%  | 100% | 101% |
| Class B        | 0.03%                | -0.10% | 0.05%  | 100% | 100% |
| Class C        | 0.02%                | 0.02%  | -0.14% | 99%  | 100% |
| Class E        |                      |        |        |      |      |
| <b>Overall</b> | 0.02%                | -0.03% | -0.02% | 100% | 100% |
| Class D        | 0.00%                | -0.04% | -0.02% | 100% | 99%  |
| Class F        | -0.02%               | 0.11%  | -0.15% | 100% | 99%  |

|                | Low delay B Main10 |        |        |      |      |
|----------------|--------------------|--------|--------|------|------|
|                | Over VTM-4.0       |        |        |      |      |
|                | Y                  | U      | V      | EncT | DecT |
| Class A1       |                    |        |        |      |      |
| Class A2       |                    |        |        |      |      |
| Class B        | 0.02%              | 0.03%  | 0.16%  | 100% | 99%  |
| Class C        | 0.01%              | 0.07%  | -0.01% | 100% | 100% |
| Class E        | -0.01%             | 0.06%  | -0.11% | 100% | 96%  |
| <b>Overall</b> | 0.01%              | 0.05%  | 0.04%  | 100% | 99%  |
| Class D        | -0.01%             | -0.08% | -0.81% | 100% | 100% |
| Class F        | -0.02%             | 0.02%  | -0.08% | 101% | 100% |

# Simulation Results (2/3)

## Motion compression for MV line buffer

|                | All Intra Main10 |        |        |      |      |
|----------------|------------------|--------|--------|------|------|
|                | Over VTM-4.0     |        |        |      |      |
|                | Y                | U      | V      | EncT | DecT |
| Class A1       | 0.00%            | 0.00%  | 0.00%  | 99%  | 99%  |
| Class A2       | 0.00%            | 0.00%  | 0.00%  | 99%  | 97%  |
| Class B        | 0.00%            | 0.00%  | 0.00%  | 100% | 100% |
| Class C        | 0.00%            | 0.00%  | 0.00%  | 100% | 101% |
| Class E        | 0.00%            | 0.00%  | 0.00%  | 100% | 101% |
| <b>Overall</b> | 0.00%            | 0.00%  | 0.00%  | 100% | 100% |
| Class D        | 0.00%            | 0.00%  | 0.00%  | 100% | 102% |
| Class F        | 0.00%            | -0.02% | -0.02% | 100% | 102% |

|                | Random access Main10 |        |        |      |      |
|----------------|----------------------|--------|--------|------|------|
|                | Over VTM-4.0         |        |        |      |      |
|                | Y                    | U      | V      | EncT | DecT |
| Class A1       | 0.14%                | 0.05%  | 0.16%  | 100% | 101% |
| Class A2       | 0.06%                | -0.04% | 0.00%  | 100% | 100% |
| Class B        | 0.10%                | -0.01% | 0.04%  | 100% | 100% |
| Class C        | 0.05%                | 0.03%  | -0.15% | 100% | 100% |
| Class E        |                      |        |        |      |      |
| <b>Overall</b> | 0.09%                | 0.01%  | 0.00%  | 100% | 100% |
| Class D        | -0.01%               | 0.02%  | -0.14% | 100% | 100% |
| Class F        | 0.03%                | 0.02%  | -0.04% | 100% | 99%  |

|                | Low delay B Main10 |        |        |      |      |
|----------------|--------------------|--------|--------|------|------|
|                | Over VTM-4.0       |        |        |      |      |
|                | Y                  | U      | V      | EncT | DecT |
| Class A1       |                    |        |        |      |      |
| Class A2       |                    |        |        |      |      |
| Class B        | 0.03%              | -0.17% | 0.00%  | 100% | 102% |
| Class C        | -0.01%             | 0.13%  | -0.16% | 100% | 100% |
| Class E        | 0.04%              | -0.16% | -0.32% | 100% | 96%  |
| <b>Overall</b> | 0.02%              | -0.07% | -0.13% | 100% | 100% |
| Class D        | -0.04%             | 0.06%  | -0.42% | 101% | 101% |
| Class F        | -0.17%             | -0.26% | 0.05%  | 100% | 101% |

## Simulation Results (3/3)

### Motion compression for MV line buffer with 7-bit mantissa and 4-bit exponent

|                | All Intra Main10 |       |       |      |      |
|----------------|------------------|-------|-------|------|------|
|                | Over VTM-4.0     |       |       |      |      |
|                | Y                | U     | V     | EncT | DecT |
| Class A1       | 0.00%            | 0.00% | 0.00% | 102% | 98%  |
| Class A2       | 0.00%            | 0.00% | 0.00% | 100% | 107% |
| Class B        | 0.00%            | 0.00% | 0.00% | 100% | 101% |
| Class C        | 0.00%            | 0.00% | 0.00% | 100% | 102% |
| Class E        | 0.00%            | 0.00% | 0.00% | 100% | 101% |
| <b>Overall</b> | 0.00%            | 0.00% | 0.00% | 100% | 102% |
| Class D        | 0.00%            | 0.00% | 0.00% | 100% | 101% |
| Class F        | 0.00%            | 0.00% | 0.00% | 101% | 104% |

|                | Random access Main10 |        |        |      |      |
|----------------|----------------------|--------|--------|------|------|
|                | Over VTM-4.0         |        |        |      |      |
|                | Y                    | U      | V      | EncT | DecT |
| Class A1       | 0.05%                | 0.00%  | 0.03%  | 100% | 102% |
| Class A2       | 0.00%                | -0.07% | -0.05% | 100% | 100% |
| Class B        | 0.03%                | 0.04%  | 0.01%  | 100% | 101% |
| Class C        | 0.01%                | -0.04% | -0.12% | 100% | 104% |
| Class E        |                      |        |        |      |      |
| <b>Overall</b> | 0.02%                | -0.01% | -0.03% | 100% | 102% |
| Class D        | 0.02%                | -0.19% | -0.18% | 100% | 102% |
| Class F        | 0.00%                | 0.02%  | -0.01% | 100% | 100% |

|                | Low delay B Main10 |        |       |      |      |
|----------------|--------------------|--------|-------|------|------|
|                | Over VTM-4.0       |        |       |      |      |
|                | Y                  | U      | V     | EncT | DecT |
| Class A1       |                    |        |       |      |      |
| Class A2       |                    |        |       |      |      |
| Class B        | -0.01%             | -0.23% | 0.06% | 100% | 105% |
| Class C        | -0.01%             | 0.28%  | 0.08% | 100% | 101% |
| Class E        | 0.02%              | 0.00%  | 0.15% | 99%  | 98%  |
| <b>Overall</b> | 0.00%              | 0.00%  | 0.09% | 100% | 102% |
| Class D        | -0.03%             | 0.20%  | 0.13% | 101% | 102% |
| Class F        | -0.06%             | 0.43%  | 0.27% | 100% | 100% |

# Conclusions

- Proposed to compress motion for HMVP buffers and MV line buffer
- Coding efficiency impact is minor
- MV storage can be reduced to 56% (10/18)
- Thanks Sharp for cross-checking