

JVET-L0468: Fixed sub-block size and restriction for ATMVP

Hahyun Lee

hanilee@etri.re.kr



❑ ATMVP (Alternative Temporal Motion Vector Prediction)

- ❖ At the 11th JVET meeting, ATMVP was adopted into VVC WD2 with an adaptive sub-block size.
- ❖ A sub-block size can be either 4x4 or 8x8, which is decided by slice level signaling.
- ❖ When coding unit size is less than or equal to the sub-block size, ATMVP becomes a non-sub-block ATMVP.
- ❖ ATMVP is relatively more complex than TMVP
 - Find an initial temporal vector according to the spatial merge candidates
 - Check the availability of the center MV of the corresponding block
 - Find MVs of all collocated sub-blocks in CU
- ❖ The worst case of MC memory bandwidth occurs with the bi-directional MC of a 4x4 sub-block
- ❖ This contribution propose to use a fixed sub-block size (8x8) and restrict CU size to reduce complexity and memory bandwidth of ATMVP.

□ Method 1

- ❖ Disallow ATMVP when width and height of CU size is less than equal to a adaptive sub-block size (4x4 or 8x8)
 - When a sub-block size is 4x4, 4x4 CU does not support ATMVP
 - When a sub-block size is 8x8, 4x4, 4x8/8x4, 8x8 CU does not support ATMVP
 - Worst case memory bandwidth for ATMVP: 4x4 bi-directional prediction, due to 4x4 sub-block

<Method1>

	Random Access Main 10				
	Over BMS-2.1 (VTM cfg)				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.01%	-0.01%	100%	100%
Class A2	0.01%	-0.01%	-0.02%	100%	100%
Class B	-0.02%	-0.03%	-0.04%	100%	100%
Class C	0.01%	-0.07%	-0.02%	100%	100%
Class E					
Overall	0.00%	-0.03%	-0.03%	100%	100%
Class D	0.02%	0.01%	-0.03%	100%	100%

	Low delay B Main10				
	Over BMS-2.1 (VTM cfg)				
	Y	U	V	EncT	DecT
Class B	-0.01%	-0.21%	-0.41%	100%	100%
Class C	-0.02%	-0.11%	0.09%	100%	100%
Class E	0.05%	0.17%	0.11%	100%	100%
Overall	0.00%	-0.08%	-0.11%	100%	100%
Class D	-0.07%	0.02%	-0.42%	100%	100%

❑ Method 2

- ❖ Disallow ATMVP when width and height of CU size is less than or equal to a fixed sub-block size (8x8)
 - 4x4/4x8/8x4/8x8 CU do not support ATMVP
 - 4xN/Nx4 CU ($N > 8$) support ATMVP with 4x8/8x4 sub-blocks
 - Worst case memory bandwidth for ATMVP: 4x8/8x4 bi-directional prediction

<Method2>		Random Access Main 10				
		Over BMS-2.1 (VTM cfg)				
		Y	U	V	EncT	DecT
Class A1		-0.01%	-0.11%	-0.03%	100%	100%
Class A2		-0.01%	0.09%	-0.02%	100%	99%
Class B		-0.03%	0.00%	-0.04%	100%	99%
Class C		0.01%	-0.11%	-0.02%	100%	98%
Class E						
Overall		-0.01%	-0.03%	-0.03%	100%	99%
Class D		-0.03%	0.10%	-0.01%	100%	98%

		Low delay B Main10				
		Over BMS-2.1 (VTM cfg)				
		Y	U	V	EncT	DecT
Class B		0.01%	-0.21%	-0.41%	99%	97%
Class C		-0.01%	-0.06%	0.12%	99%	97%
Class E		0.03%	0.25%	0.27%	99%	96%
Overall		0.01%	-0.05%	-0.06%	99%	97%
Class D		-0.02%	-0.15%	-0.34%	99%	97%

❑ Method 3

- ❖ Disallow ATMVP when width or height of CU size is less than a fixed sub-block size (8x8)
 - 4x4/4x8/8x4 does not support ATMVP but 8x8 CU supports ATMVP with non sub-block
 - 4xN/Nx4 CU (N > 8) does not support ATMVP
 - Worst case memory bandwidth for ATMVP: 8x8 bi-directional prediction

		Random Access Main 10				
		Over BMS-2.1 (VTM cfg)				
<Method3>		Y	U	V	EncT	DecT
Class A1		0.00%	-0.06%	-0.03%	100%	100%
Class A2		-0.02%	-0.01%	-0.04%	100%	100%
Class B		-0.03%	-0.02%	-0.04%	100%	99%
Class C		0.01%	-0.06%	0.09%	100%	99%
Class E						
Overall		-0.01%	-0.03%	0.00%	100%	99%
Class D		0.00%	0.14%	0.05%	100%	98%

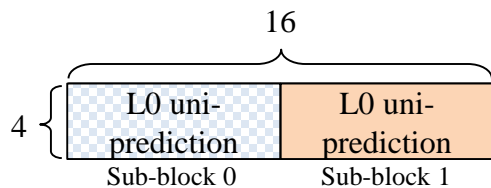
		Low delay B Main10				
		Over BMS-2.1 (VTM cfg)				
		Y	U	V	EncT	DecT
Class B		0.00%	-0.17%	-0.31%	99%	97%
Class C		-0.03%	-0.13%	0.20%	100%	97%
Class E		0.08%	0.13%	0.15%	99%	96%
Overall		0.01%	-0.08%	-0.02%	99%	97%
Class D		-0.02%	0.02%	-0.41%	99%	98%

Proposed Methods

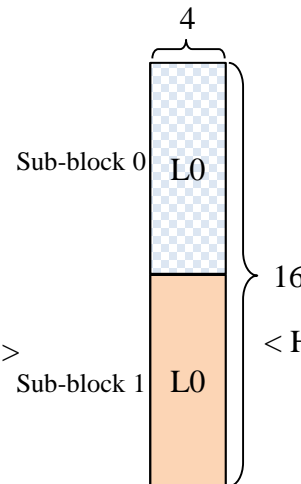
< JVET-L0468 >

❑ Method 4

- ❖ Disallow ATMVP when width and height of CU size is less than or equal to a fixed sub-block size (8x8)
- ❖ Only allow ATMVP with uni-directional prediction when width or height of CU size is equal to 4
 - 4x4/4x8/8x4/8x8 CU does not support ATMVP
 - 4xN/Nx4 CU (N > 8) supports ATMVP with uni-directional prediction and 4x8/8x4 sub-blocks
 - Worst case memory bandwidth for ATMVP: 8x8 bi-directional prediction



< width of CU is greater than a fixed sub-block size(8) >



< Height is greater than a fixed sub-block size (8) >

<Method4>	Random Access Main 10				
	Over BMS-2.1 (VTM cfg)				
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.20%	-0.01%	100%	100%
Class A2	-0.01%	-0.04%	0.06%	100%	99%
Class B	-0.03%	-0.02%	-0.03%	100%	99%
Class C	0.00%	-0.04%	0.01%	99%	99%
Class E					
Overall	-0.01%	-0.07%	0.00%	100%	99%
Class D	-0.01%	0.01%	0.04%	99%	98%

	Low delay B Main10				
	Over BMS-2.1 (VTM cfg)				
	Y	U	V	EncT	DecT
Class B	0.00%	-0.06%	-0.34%	100%	97%
Class C	-0.02%	-0.13%	0.16%	99%	97%
Class E	0.04%	0.05%	0.07%	100%	96%
Overall	0.01%	-0.05%	-0.07%	100%	97%
Class D	-0.08%	-0.05%	0.06%	99%	97%

Conclusions

< JVET-L0468>

- ❑ **Proposed methods show no coding performance changes and slight software runtime reduction is observed by fixing sub-block size to 8x8**

Condition that disallows ATMVP			Y	U	V	EncT	DecT	Worst-case memory BW (ATMVP)
1	W and H <= adaptive sub-block size (4x4, 8x8)	RA	0.00%	-0.03%	-0.03%	100%	100%	4x4 bi-prediction
		LDB	0.00%	-0.08%	-0.11%	100%	100%	
2	W and H <= fixed sub-block size (8x8)	RA	-0.01%	-0.03%	-0.03%	100%	99%	4x8/8x4 bi-prediction
		LDB	0.01%	-0.05%	-0.06%	99%	97%	
3	W or H < fixed sub-block size (8x8)	RA	-0.01%	-0.03%	0.00%	100%	99%	8x8 bi-prediction
		LDB	0.01%	-0.08%	-0.02%	99%	97%	
4	W and H <= fixed sub-block size (8x8) * only allow ATMVP with uni-directional prediction (4xN/Nx4, N > 8)	RA	-0.01%	-0.07%	0.00%	100%	99%	8x8 bi-prediction
		LDB	0.01%	-0.05%	-0.07%	100%	97%	

- ❑ **Suggest to be adopted in VTM**

- ❖ Use a fixed sub-block size (8x8) instead of an adaptive sub-block size
- ❖ Restrict CU size to reduce the worst-case memory bandwidth for ATMVP

- ❑ **Thanks to Qualcomm for cross-check (JVET-L0588)**