



CREATING THE LIVING NETWORK™

JVET-00706

CE8-related: 4x4 sub-block based dual-tree chroma IBC block-vector derivation

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Introduction

- Dual-tree chroma IBC block-vector (BV) derivation
 - Chroma 2x2 sub-blocks → collocated luma 4x4 sub-blocks
 - Encoder conformance check: only if all the collocated luma 4x4 sub-blocks are IBC coded and the according BVs are all valid, can allow/check chroma IBC mode.
- JVET-O0117
 - CE8-1.4: default IBC mode in case of invalid BVs
 - CE8-1.5 a: CE8-1.4 + CU based chroma BV:
 - Use collocated luma CU center BV (if exists) as the BV for the whole CU → one chroma CU BV
 - CE8-1.5 b: CE8-1.4 + subblock based chroma BV with default BV:
 - Still use chroma 2x2 subblocks. Additionally, if collocated luma 4x4 sub-block is not IBC coded or the BV is not valid, will use CU center BV (if exists) as the default BV for the sub-block. → chroma 2x2 sub-block BVs.

Proposal

- Chroma sub-block: $2 \times 2 \rightarrow 4 \times 4$
 - Better hardware (HW) efficiency and throughput: 2 samples in width $\rightarrow$ 4 samples in width, 4 samples/cycle $\rightarrow$ 16 samples/cycle
 - Chroma $4 \times 4 \rightarrow$ collocated luma 8×8 : contains 4 luma 4×4 subblocks, use center BV (if exists) as the luma 8×8 BV.
- Other details
 - For chroma $2 \times N$, $N \times 2$ ($N \geq 8$) CUs, still use chroma 2×2 sub-blocks.
 - Test with VTM5 + CE8-1.4, for fair comparison with CE8-1.5.

Test 1: Chroma 4x4 change only

All Intra Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1	-0.05%	-0.05%	0.02%	142%	100%
Class A2	-0.78%	-1.08%	-1.00%	147%	102%
Class B	-0.80%	-0.69%	-0.86%	157%	100%
Class C	-0.35%	-0.38%	-0.34%	157%	99%
Class E	-1.32%	-1.27%	-1.37%	161%	99%
Overall	-0.66%	-0.68%	-0.71%	153%	100%
Class D	-0.66%	-0.51%	-0.69%	149%	97%
Class F	-0.02%	0.00%	0.04%	102%	100%
Class TGM	-0.07%	-0.08%	-0.12%	101%	100%

Low Delay B Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.04%	0.10%	0.06%	118%	101%
Class C	0.11%	0.17%	0.03%	124%	101%
Class E	0.08%	-0.84%	0.33%	112%	102%
Overall	0.08%	-0.11%	0.12%	118%	101%
Class D	0.06%	-0.04%	0.05%	125%	102%
Class F	-0.03%	-0.07%	0.22%	100%	101%
Class TGM	0.02%	-0.12%	0.03%	100%	100%

Random Access Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1	0.11%	-0.11%	0.24%	105%	102%
Class A2	-0.06%	-0.32%	-0.21%	106%	103%
Class B	-0.13%	-0.35%	-0.72%	108%	99%
Class C	0.15%	-0.27%	-0.18%	113%	98%
Class E					
Overall	0.01%	-0.27%	-0.28%	108%	100%
Class D	0.10%	-0.31%	0.23%	112%	97%
Class F	-0.01%	0.08%	-0.04%	101%	100%
Class TGM	-0.04%	-0.02%	-0.10%	100%	99%

Test 2: Chroma 4x4 change + CU center based BV as default BV (CE8-1.5.b)

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.05%	-0.05%	0.04%	142%	101%
Class A2	-0.82%	-1.08%	-0.98%	148%	101%
Class B	-0.82%	-0.78%	-1.00%	157%	101%
Class C	-0.37%	-0.44%	-0.34%	157%	99%
Class E	-1.32%	-1.34%	-1.41%	161%	99%
Overall	-0.67%	-0.73%	-0.75%	154%	100%
Class D	-0.67%	-0.54%	-0.71%	149%	97%
Class F	-0.05%	-0.10%	-0.11%	102%	100%
Class TGM	-0.30%	-0.37%	-0.45%	101%	100%

	Low Delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.02%	-0.02%	-0.25%	118%	102%
Class C	0.11%	0.04%	-0.25%	124%	101%
Class E	0.06%	-0.65%	0.24%	113%	102%
Overall	0.06%	-0.16%	-0.13%	119%	102%
Class D	0.05%	-0.29%	0.22%	125%	102%
Class F	0.02%	0.13%	-0.05%	101%	102%
Class TGM	-0.05%	-0.17%	-0.07%	101%	101%

	Random Access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.11%	-0.15%	0.29%	106%	101%
Class A2	-0.08%	-0.32%	-0.07%	106%	102%
Class B	-0.16%	-0.50%	-0.81%	108%	100%
Class C	0.15%	-0.34%	-0.16%	112%	99%
Class E					
Overall	-0.01%	-0.35%	-0.27%	108%	100%
Class D	0.08%	-0.18%	0.06%	111%	97%
Class F	-0.03%	-0.14%	-0.08%	101%	101%
Class TGM	-0.12%	-0.12%	-0.23%	101%	100%

Ref: CE8-1.5.b (JVET-O0117): CU center based BV as default BV

All Intra Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1	-0.04%	-0.01%	0.05%	141%	100%
Class A2	-0.82%	-1.04%	-0.97%	146%	101%
Class B	-0.80%	-0.78%	-0.87%	154%	99%
Class C	-0.30%	-0.32%	-0.31%	152%	96%
Class E	-1.23%	-1.25%	-1.43%	156%	98%
Overall	-0.64%	-0.67%	-0.70%	150%	99%
Class D	-0.53%	-0.55%	-0.68%	145%	99%
Class F	-0.06%	-0.13%	-0.14%	101%	98%
Class TGM	-0.33%	-0.43%	-0.47%	99%	98%

Low Delay B Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.03%	0.26%	-0.23%	116%	96%
Class C	0.12%	0.30%	-0.05%	124%	100%
Class E	0.02%	-0.19%	0.45%	110%	97%
Overall	0.06%	0.16%	0.00%	117%	97%
Class D	0.06%	0.08%	0.71%	126%	102%
Class F	0.04%	-0.57%	-0.34%	99%	97%
Class TGM	-0.06%	-0.11%	-0.10%	97%	95%

Random Access Main10					
Over VTM-5.0					
	Y	U	V	EncT	DecT
Class A1	0.10%	-0.17%	0.19%	103%	99%
Class A2	-0.07%	-0.28%	-0.10%	105%	98%
Class B	-0.13%	-0.44%	-0.70%	106%	99%
Class C	0.15%	-0.27%	-0.25%	111%	98%
Class E					
Overall	0.00%	-0.31%	-0.28%	106%	99%
Class D	0.09%	-0.37%	-0.05%	112%	101%
Class F	-0.08%	-0.09%	-0.07%	98%	97%
Class TGM	-0.14%	-0.20%	-0.27%	98%	97%

Test 2 vs CE8-1.5.b (JVET-00117)

	All Intra Main10				
	Over CE8-1.5.b			EncT	DecT
	Y	U	V		
Class A1	-0.02%	-0.04%	-0.02%		
Class A2	-0.01%	-0.04%	0.00%		
Class B	-0.02%	0.00%	-0.13%		
Class C	-0.07%	-0.13%	-0.03%		
Class E	-0.09%	-0.09%	0.03%		
Overall	-0.04%	-0.06%	-0.04%		
Class D	-0.13%	0.01%	-0.03%		
Class F	0.01%	0.02%	0.03%		
Class TGM	0.03%	0.07%	0.02%		

	Low Delay B Main10				
	Over CE8-1.5.b			EncT	DecT
	Y	U	V		
Class A1					
Class A2					
Class B	-0.01%	-0.27%	-0.02%		
Class C	-0.01%	-0.26%	-0.21%		
Class E	0.04%	-0.46%	-0.19%		
Overall	0.00%	-0.32%	-0.12%		
Class D	-0.01%	-0.37%	-0.49%		
Class F	-0.02%	0.71%	0.30%		
Class TGM	0.01%	-0.07%	0.03%		

	Random Access Main10				
	Over CE8-1.5.b			EncT	DecT
	Y	U	V		
Class A1	0.01%	0.03%	0.10%		
Class A2	-0.01%	-0.04%	0.03%		
Class B	-0.03%	-0.05%	-0.11%		
Class C	0.00%	-0.08%	0.09%		
Class E					
Overall	-0.01%	-0.04%	0.01%		
Class D	0.00%	0.20%	0.11%		
Class F	0.05%	-0.04%	-0.01%		
Class TGM	0.02%	0.08%	0.03%		

Test 3 a: chroma 4x4 + No encoder conformance check

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.06%	-0.16%	-0.07%	144%	102%
Class A2	-0.79%	-1.06%	-1.16%	149%	102%
Class B	-0.81%	-0.86%	-1.05%	158%	101%
Class C	-0.36%	-0.41%	-0.36%	158%	99%
Class E	-1.33%	-1.36%	-1.44%	162%	99%
Overall	-0.67%	-0.76%	-0.82%	155%	100%
Class D	-0.66%	-0.73%	-0.91%	150%	98%
Class F	-0.04%	-0.47%	-0.59%	103%	99%
Class TGM	-0.48%	-1.14%	-1.20%	102%	99%

	Low Delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.02%	0.30%	-0.28%	118%	102%
Class C	0.10%	-0.24%	0.01%	124%	101%
Class E	-0.08%	-0.94%	0.51%	112%	102%
Overall	0.02%	-0.19%	0.02%	118%	102%
Class D	0.08%	-0.19%	0.00%	125%	102%
Class F	-0.04%	-0.70%	-0.26%	101%	102%
Class TGM	0.03%	-0.25%	-0.17%	101%	100%

	Random Access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.11%	-0.11%	0.23%	106%	102%
Class A2	-0.05%	-0.35%	-0.16%	106%	103%
Class B	-0.12%	-0.36%	-0.83%	108%	101%
Class C	0.14%	-0.32%	-0.30%	113%	98%
Class E					
Overall	0.01%	-0.30%	-0.34%	108%	101%
Class D	0.08%	-0.21%	-0.04%	112%	98%
Class F	-0.06%	-0.42%	-0.39%	101%	100%
Class TGM	-0.17%	-0.61%	-0.61%	101%	101%

- No encoder conformance check: encoder always check chroma IBC mode.
- CE8-1.4 default IBC compensation will be used in case of invalid BV.
- Better coding efficiency.

Test 3 b: chroma 4x4 + CU center BV as default BV + No encoder conformance check

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.06%	-0.12%	-0.06%	143%	102%
Class A2	-0.83%	-1.12%	-1.14%	148%	100%
Class B	-0.82%	-1.00%	-1.13%	157%	101%
Class C	-0.37%	-0.46%	-0.37%	158%	99%
Class E	-1.32%	-1.45%	-1.51%	161%	99%
Overall	-0.68%	-0.83%	-0.85%	154%	100%
Class D	-0.66%	-0.72%	-0.93%	150%	96%
Class F	-0.08%	-0.49%	-0.59%	103%	99%
Class TGM	-0.61%	-1.26%	-1.37%	102%	99%

	Low Delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.02%	0.15%	-0.26%	118%	101%
Class C	0.10%	0.02%	-0.17%	124%	100%
Class E	0.10%	-0.57%	0.08%	112%	102%
Overall	0.07%	-0.07%	-0.14%	118%	101%
Class D	0.07%	0.18%	0.13%	125%	102%
Class F	-0.12%	-0.42%	-0.40%	100%	100%
Class TGM	-0.07%	-0.25%	-0.24%	100%	100%

	Random Access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.10%	-0.11%	0.22%	106%	102%
Class A2	-0.07%	-0.43%	-0.28%	106%	102%
Class B	-0.15%	-0.69%	-0.99%	108%	100%
Class C	0.14%	-0.39%	-0.31%	112%	99%
Class E					
Overall	-0.01%	-0.44%	-0.42%	108%	100%
Class D	0.10%	-0.15%	0.05%	112%	98%
Class F	-0.08%	-0.44%	-0.40%	101%	100%
Class TGM	-0.25%	-0.64%	-0.68%	100%	100%

Test 4 a: chroma 4x4 only

without CE8-1.4 default IBC compensation mode

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.05%	-0.05%	0.02%	140%	102%
Class A2	-0.79%	-1.06%	-0.99%	145%	101%
Class B	-0.80%	-0.71%	-0.87%	154%	102%
Class C	-0.35%	-0.38%	-0.35%	155%	99%
Class E	-1.32%	-1.27%	-1.36%	158%	100%
Overall	-0.66%	-0.68%	-0.71%	151%	101%
Class D	-0.66%	-0.51%	-0.69%	147%	100%
Class F	-0.03%	0.02%	0.07%	100%	100%
Class TGM	-0.09%	-0.09%	-0.15%	100%	100%

	Low Delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.05%	0.08%	-0.16%	117%	101%
Class C	0.11%	0.17%	0.03%	123%	99%
Class E	0.08%	-0.84%	0.33%	112%	101%
Overall	0.08%	-0.12%	0.03%	118%	100%
Class D	0.06%	-0.04%	0.05%	123%	99%
Class F	-0.07%	-0.11%	0.13%	100%	100%
Class TGM	-0.05%	-0.10%	-0.11%	100%	99%

	Random Access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.11%	-0.11%	0.24%	105%	102%
Class A2	-0.06%	-0.34%	-0.18%	105%	103%
Class B	-0.13%	-0.42%	-0.76%	107%	101%
Class C	0.15%	-0.27%	-0.17%	112%	99%
Class E					
Overall	0.01%	-0.30%	-0.29%	108%	101%
Class D	0.10%	-0.35%	0.29%	111%	99%
Class F	-0.03%	0.06%	0.00%	100%	101%
Class TGM	-0.03%	-0.04%	-0.07%	100%	102%

Test 4 b: chroma 4x4 only + CU center BV as default BV
without CE8-1.4 default IBC compensation mode

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.05%	-0.05%	0.04%	142%	102%
Class A2	-0.82%	-1.08%	-0.98%	147%	103%
Class B	-0.82%	-0.78%	-1.00%	157%	102%
Class C	-0.37%	-0.44%	-0.34%	157%	100%
Class E	-1.32%	-1.34%	-1.41%	161%	100%
Overall	-0.67%	-0.73%	-0.75%	154%	101%
Class D	-0.67%	-0.54%	-0.71%	149%	100%
Class F	-0.05%	-0.10%	-0.11%	102%	100%
Class TGM	-0.30%	-0.37%	-0.45%	101%	101%

	Low Delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.02%	-0.02%	-0.25%	118%	101%
Class C	0.11%	0.04%	-0.25%	124%	100%
Class E	0.06%	-0.65%	0.24%	113%	102%
Overall	0.06%	-0.16%	-0.13%	119%	101%
Class D	0.05%	-0.29%	0.22%	125%	100%
Class F	0.02%	0.13%	-0.05%	101%	101%
Class TGM	-0.05%	-0.17%	-0.07%	101%	101%

	Random Access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.11%	-0.15%	0.29%	106%	102%
Class A2	-0.08%	-0.32%	-0.07%	106%	103%
Class B	-0.16%	-0.50%	-0.81%	108%	101%
Class C	0.15%	-0.34%	-0.16%	113%	100%
Class E					
Overall	-0.01%	-0.35%	-0.27%	108%	101%
Class D	0.08%	-0.18%	0.06%	112%	100%
Class F	-0.03%	-0.14%	-0.08%	101%	101%
Class TGM	-0.12%	-0.12%	-0.23%	101%	101%

Summary

- Propose to adopt “chroma 4x4 sub-block based dual-tree chroma IBC BV derivation”
 - Better throughput and HW efficiency
 - Class TGM Y-BD-rate change: (vs VTM-5.0)
Chroma 4x4 only: AI/RA/LDB: -0.07%/-0.04%/0.02%
+ CU center BV as default BV (CE8-1.5.b):
AI/RA/LDB: -0.30%/-0.12%/-0.05%
(ref: CE3-1.5.b: -0.33%/-0.14%/-0.06%)
- If CE8-1.4 default IBC compensation → No need for encoder conformance check and constraint (Encoder change)
 - Better coding efficiency
 - Class TGM Y-BD-rate change: (vs VTM-5.0)
Chroma 4x4 only: AI/RA/LDB: -0.48%/-0.17%/0.03%
+ CU center BV as default BV (CE8-1.5.b):
AI/RA/LDB: -0.61%/-0.25%/-0.07%

Thank Bytedance for cross-checking !
(JVET-O0740)