

JCTVC-L0174: Non-TE2: Inter-layer reference picture placement

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Introduction:

- REF_IDX is under evaluation in TE A2 with SMuC 0.1.1.
 - For AI coding, encoder run-time almost doubles that of simulcast encoding.
- Proposal:
 - Propose some simple non-normative encoder changes to significantly reduce the encoder run-time in the AI case
 - Changes are also applicable to the other test cases in TE A2.

Proposal:

- Non-normative encoder changes in SMuC 0.1.1 :
 - Add a mode decision module for 2Nx2N ILR (Inter-layer reference prediction) with uni-prediction and motion vectors forced to be zero.
 - When BL is I_SLICE, two test methods are configured for EL.
 - Test Method 1: only intra mode and 2Nx2N ILR mode are tested
 - Test Method 2: only 2Nx2N merge mode, intra mode and 2Nx2N ILR mode are tested
 - Otherwise, apply two changes.
 - First, in 2Nx2N inter mode, ME excludes testing of ILR picture.
 - Second, the 2Nx2N ILR mode is tested after intra mode.

Rationale:

- In AI cases, when EL is configured as P slice, proposed change removes redundancy in testing all inter-partition modes.
 - Test Method 1 and 2 differs in testing of $2N \times 2N$ merge mode: tradeoff in complexity and coding efficiency
- Gain in chroma coding efficiency: current software does not consider chroma cost in ME but does that in MD.

Simulation Results: Test Method 1

- Implemented in TE A2 3.2.1 software
- Refldx setting 2 zeroMV is used as an anchor
- AI case:

	AI HEVC 2x			AI HEVC 1.5x		
	Y	U	V	Y	U	V
Class A	0.1%	-0.1%	-0.1%			
Class B	0.1%	-0.1%	-0.1%	0.2%	-0.3%	-0.3%
Overall (EL+BL)	0.1%	-0.1%	-0.1%	0.2%	-0.3%	-0.3%
Overall (EL)	0.3%	-0.2%	-0.3%	0.8%	-1.2%	-1.1%
Enc Time[%]	53.0%			57.2%		
Dec Time[%]	103.2%			89.0%		
Enc Mem[%]	100.0%			100.0%		
BL Match	Matched			Matched		

Simulation Results: Test Method 1

Other cases:

	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.0%	-0.4%	-0.5%				0.0%	-0.3%	-0.5%
Class B	-0.1%	-0.7%	-0.9%	0.0%	-0.6%	-0.8%	0.0%	-0.8%	-1.1%
Overall (EL+BL)	-0.1%	-0.6%	-0.8%	0.0%	-0.6%	-0.8%	0.0%	-0.7%	-0.9%
Overall (EL)	-0.1%	-1.0%	-1.3%	0.1%	-1.2%	-1.6%	0.0%	-1.2%	-1.6%
Enc Time[%]		97.0%			100.3%			99.0%	
Dec Time[%]		99.7%			99.7%			97.8%	
Enc Mem[%]		100.0%			100.0%			100.0%	
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%	-0.3%	-0.3%				0.0%	-0.2%	-0.2%
Class B	-0.1%	-0.3%	-0.4%	-0.1%	-0.3%	-0.2%	-0.1%	-0.3%	-0.3%
Overall (EL+BL)	-0.1%	-0.3%	-0.4%	-0.1%	-0.3%	-0.2%	-0.1%	-0.3%	-0.3%
Overall (EL)	-0.1%	-0.5%	-0.6%	-0.1%	-0.7%	-0.5%	-0.1%	-0.5%	-0.5%
Enc Time[%]		94.2%			108.7%			98.8%	
Dec Time[%]		96.2%			109.6%			99.0%	
Enc Mem[%]		100.0%			100.0%			100.0%	
BL Match		Matched			Matched			Matched	

Simulation Results: Test Method 2

- AI case:

	AI HEVC 2x			AI HEVC 1.5x		
	Y	U	V	Y	U	V
Class A	0.0%	-0.1%	-0.1%			
Class B	-0.1%	0.0%	-0.1%	0.0%	0.0%	-0.1%
Overall (EL+BL)	-0.1%	-0.1%	-0.1%	0.0%	0.0%	-0.1%
Overall (EL)	-0.1%	-0.1%	-0.2%	0.0%	-0.1%	-0.3%
Enc Time[%]	75.3%			78.5%		
Dec Time[%]	93.8%			85.4%		
Enc Mem[%]	100.0%			100.0%		
BL Match	Matched			Matched		

Simulation Results: Test Method 2

Other cases:

	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.0%	-0.4%	-0.5%				0.0%	-0.3%	-0.4%
Class B	-0.1%	-0.6%	-0.8%	0.0%	-0.5%	-0.7%	-0.1%	-0.9%	-1.1%
Overall (EL+BL)	-0.1%	-0.5%	-0.8%	0.0%	-0.5%	-0.7%	0.0%	-0.7%	-0.9%
Overall (EL)	-0.2%	-0.9%	-1.2%	-0.1%	-1.0%	-1.5%	-0.1%	-1.2%	-1.4%
Enc Time[%]		98.4%			99.1%			100.6%	
Dec Time[%]		98.5%			95.9%			97.9%	
Enc Mem[%]		100.0%			100.0%			100.0%	
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%	-0.2%	-0.3%				0.0%	-0.1%	-0.2%
Class B	-0.1%	-0.2%	-0.4%	0.0%	-0.2%	-0.3%	0.0%	-0.3%	-0.2%
Overall (EL+BL)	-0.1%	-0.2%	-0.4%	0.0%	-0.2%	-0.3%	0.0%	-0.3%	-0.2%
Overall (EL)	-0.1%	-0.4%	-0.6%	-0.1%	-0.6%	-0.7%	-0.1%	-0.4%	-0.4%
Enc Time[%]		103.6%			102.3%			102.9%	
Dec Time[%]		100.4%			101.2%			100.9%	
Enc Mem[%]		100.0%			100.0%			100.0%	
BL Match		Matched			Matched			Matched	

Crosscheck: JCTVC-L0261

- We would like to thank Liwei Guo from Qualcomm for crosschecking our proposal.

Conclusion

- Proposal significantly reduces the encoder run-time of REF_IDX framework in SMuC 0.1.1 in the AI case.
 - Test Method 1: about 50% reduction, but with {0.3%, 0.8%} loss in EL or {0.1%, 0.2%} in BL+EL for {AI2x, AI1.5x}.
 - Test Method 2: about 25% reduction with no loss.
- Changes are also applicable to the other cases, and shown to improve chroma coding performance under the REF_IDX framework.

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