

CE7-related: Further Context Reduction for sig_coeff_flag (JVET-P0169)

Shih-Ta Hsiang, Tzu-Der Chuang, Yu-Wen Huang, and Shawmin Lei

Presented by Tzu-Der Chuang

Overall Summary

- Propose two methods to further apply the context reduction scheme in CE7-3.1 to more context subsets for coding the syntax element *sig_coeff_flag*
 - More organized context subsets for context selection
 - Further reduction in the number of the context variables
- Summary of overall BD bitrate results

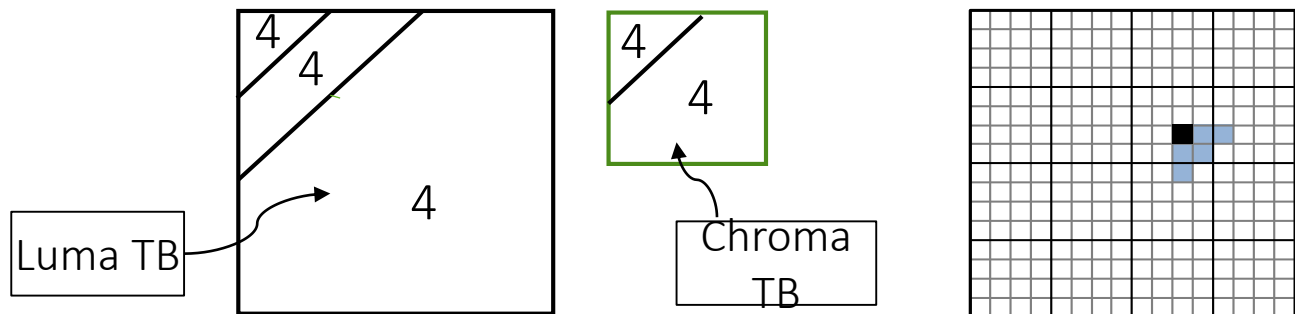
CTC	All Intra (AI)			Random Access (RA)			Low Delay B (LB)		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
Method 1	0.03%	-0.04%	0.00%	0.01%	0.04%	0.04%	-0.02%	0.05%	0.07%
Method 2	0.02%	0.07%	0.11%	0.01%	0.16%	-0.01%	-0.03%	0.05%	0.15%

Context Modeling for sig_coeff_flag in VVC WD

- Each transform block divided into 3 zones for luma or 2 zones for chroma
- Each context subset contains 4 context variables with context selection determined by

$$\text{ctxInc} = \text{Min}(\text{locSumAbsPass1} + 1) \gg 1, 3) \quad (1)$$

- Context modeling for dependent quantization states 0 and 1 share the same set of 20 context variables
- 2 additional context sets allocated for quantization states 2 and 3, respectively. The 60 total context variables allocated for entropy coding sig_coeff_flag



Proposed Methods - I

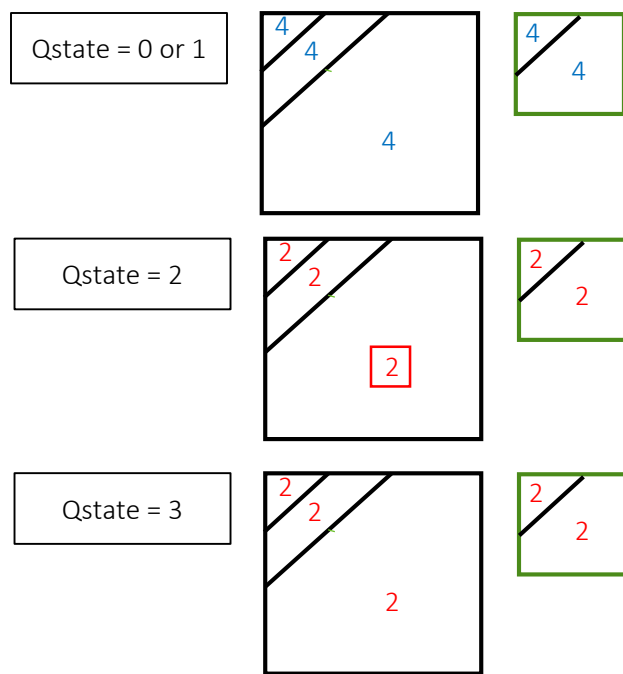
- Motivation: The transform coefficients corresponding to the dependent quantization state $QState = 2$ or 3 (associated with half dead-zone size) have significantly higher probability of being significant
- The number of the context variables is reduced to 2 in some context subsets with context selection in a subset determined by

$$ctxInc = (locSumAbsPass1 == 0) ? 0 : 1 \quad (2)$$

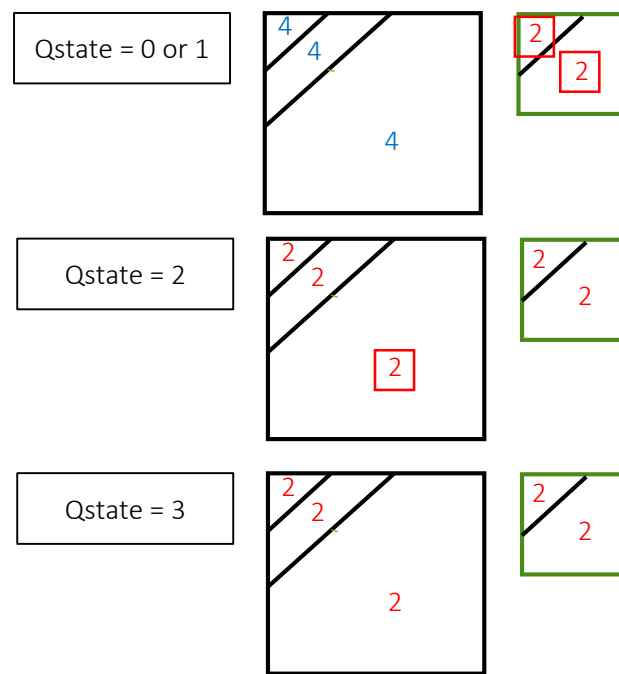
- The complexity for deriving selected index in a context subset is further reduced
 - One comparison for 2-context subsets in EQ (2) versus one comparison + one addition + one bit-wise shift for 4-context subsets in EQ (1)

Proposed Methods - II

- Method 1: context reduction applied to all subsets associated with $Q_{state} > 1$ (*context reduction by 20*)
- Method 2: context reduction applied to all subsets associated with $Q_{state} > 1$ or associated with chroma components (*context reduction by 24*)



Method 1



Method 2

Results over Standard QPs 22, 27, 32, 37 (no re-training of context initialization variables)

- Test 1 (left): Method 1 with context reduction by 20
- Test 2 (right): Method 2 with context reduction by 24

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.03%	-0.03%	0.06%	101%	102%
Class A2	0.04%	-0.06%	-0.07%	102%	103%
Class B	0.02%	-0.02%	-0.05%	101%	102%
Class C	0.02%	-0.10%	0.01%	100%	99%
Class E	0.01%	0.04%	0.10%	97%	99%
Overall	0.03%	-0.04%	0.00%	100%	101%
Class D	-0.01%	0.04%	0.06%	98%	96%
Class F	0.01%	-0.03%	0.01%	96%	96%
	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.03%	-0.07%	0.00%	104%	102%
Class A2	0.01%	0.19%	0.06%	105%	101%
Class B	0.00%	0.04%	0.09%	102%	98%
Class C	0.01%	0.01%	0.00%	99%	98%
Overall	0.01%	0.04%	0.04%	102%	99%
Class D	-0.06%	-0.31%	0.21%	99%	103%
Class F	-0.03%	0.02%	0.09%	100%	102%
	Low delay B Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class B	0.00%	0.10%	-0.15%	101%	96%
Class C	-0.01%	-0.15%	-0.05%	106%	105%
Class E	-0.07%	0.22%	0.59%	104%	104%
Overall	-0.02%	0.05%	0.07%	103%	101%
Class D	0.05%	0.00%	0.63%	105%	108%
Class F	0.10%	0.12%	0.35%	100%	100%

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.01%	0.06%	0.14%	101%	102%
Class A2	0.03%	0.08%	0.07%	102%	104%
Class B	0.02%	0.07%	0.00%	102%	104%
Class C	0.01%	0.05%	0.24%	101%	100%
Class E	0.02%	0.10%	0.13%	98%	99%
Overall	0.02%	0.07%	0.11%	101%	102%
Class D	0.00%	0.10%	0.13%	98%	96%
Class F	0.01%	0.00%	0.06%	98%	97%
	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.22%	0.06%	105%	105%
Class A2	0.03%	0.12%	0.01%	104%	102%
Class B	-0.02%	0.12%	-0.03%	102%	99%
Class C	0.03%	0.20%	-0.05%	100%	100%
Overall	0.01%	0.16%	-0.01%	102%	101%
Class D	-0.06%	-0.31%	-0.05%	99%	105%
Class F	-0.04%	0.10%	0.15%	99%	108%
	Low delay B Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class B	0.02%	0.12%	-0.24%	103%	101%
Class C	-0.01%	-0.03%	0.08%	101%	101%
Class E	-0.13%	0.02%	0.90%	101%	100%
Overall	-0.03%	0.05%	0.15%	102%	101%
Class D	-0.02%	-0.25%	0.48%	98%	102%
Class F	-0.05%	-0.22%	0.40%	97%	100%

Results over Low QPs 2, 7, 12, 17

(no re-training of context initialization variables)

- Test 1 (left): Method 1 with context reduction by 20
- Test 2 (right): Method 2 with context reduction by 24

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	-0.01%	0.08%	0.07%	95%	91%
Class A2	-0.02%	0.07%	0.08%	97%	95%
Class B	0.02%	0.02%	0.07%	100%	100%
Class C	0.01%	0.04%	0.08%	100%	100%
Class E	0.02%	0.01%	0.06%	100%	101%
Overall	0.01%	0.04%	0.07%	99%	98%
Class D	0.02%	0.00%	0.05%	100%	100%
Class F	0.03%	0.02%	0.01%	100%	100%
	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.01%	0.02%	99%	100%
Class A2	-0.01%	0.02%	0.04%	101%	100%
Class B	0.02%	-0.02%	0.02%	99%	102%
Class C	0.01%	0.00%	0.06%	99%	101%
Overall	0.01%	0.00%	0.03%	100%	101%
Class D	0.02%	-0.04%	0.02%	100%	91%
Class F	0.03%	-0.17%	-0.11%	100%	99%
	Low delay B Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class B	0.01%	-0.01%	0.02%	101%	100%
Class C	0.00%	0.03%	0.03%	98%	97%
Class E	0.01%	0.04%	0.04%	98%	99%
Overall	0.01%	0.02%	0.03%	99%	99%
Class D	0.00%	0.02%	-0.01%	101%	101%
Class F	-0.01%	-0.14%	-0.02%	98%	97%

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	-0.04%	0.37%	0.36%	97%	93%
Class A2	0.00%	0.31%	0.31%	100%	100%
Class B	0.00%	0.16%	0.28%	102%	104%
Class C	0.01%	0.14%	0.20%	101%	102%
Class E	-0.02%	0.26%	0.33%	100%	101%
Overall	-0.01%	0.23%	0.29%	100%	101%
Class D	0.01%	0.12%	0.18%	100%	100%
Class F	0.02%	0.12%	0.16%	100%	102%
	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	-0.01%	0.12%	0.14%	101%	101%
Class A2	0.01%	0.17%	0.17%	101%	99%
Class B	0.01%	0.09%	0.15%	100%	100%
Class C	-0.01%	0.10%	0.14%	101%	96%
Overall	0.00%	0.11%	0.15%	101%	99%
Class D	0.00%	0.07%	0.07%	101%	96%
Class F	-0.13%	-0.09%	0.00%	100%	92%
	Low delay B Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class B	0.00%	0.09%	0.15%	99%	96%
Class C	-0.01%	0.06%	0.10%	99%	97%
Class E	0.01%	0.14%	0.16%	99%	101%
Overall	0.00%	0.09%	0.14%	99%	98%
Class D	0.01%	0.04%	0.03%	101%	102%
Class F	-0.02%	-0.09%	0.07%	99%	98%

Conclusion

- Improving CE7-3.1 by simplifying the organization of context subsets with further context reduction
 - Method 1 uses 4-context subsets for Qstate < 2, 2-context subsets, otherwise
 - Method 2 uses 4-context subsets for luma with Qstate < 2, 2-context subsets, otherwise
- Asserted the proposed 2-context subset reduces the complexity for deriving the selected index in a subset
- Method 1 achieves context reduction by 20, or 33% of the total context variables for sig_coeff_flag and has no BD bitrate impact when DQ is disabled

Method 1	All Intra (AI)			Random Access (RA)			Low Delay B (LB)		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
CTC QPs	0.03%	-0.04%	0.00%	0.01%	0.04%	0.04%	-0.02%	0.05%	0.07%
low QPs	0.01%	0.04%	0.07%	0.01%	0.00%	0.03%	0.01%	0.02%	0.03%

- Method 2 achieves context reduction by 24, or 40% of the total context variables for sig_coeff_flag

Method 2	All Intra (AI)			Random Access (RA)			Low Delay B (LB)		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
CTC QPs	0.02%	0.07%	0.11%	0.01%	0.16%	-0.01%	-0.03%	0.05%	0.15%
low QPs	-0.01%	0.23%	0.29%	0.00%	0.11%	0.15%	0.00%	0.09%	0.14%

- Thank Tencent for cross checking this contribution