



Unification of Context Modeling Methods for Large Transform Blocks for Coding Significant Coefficient Flags

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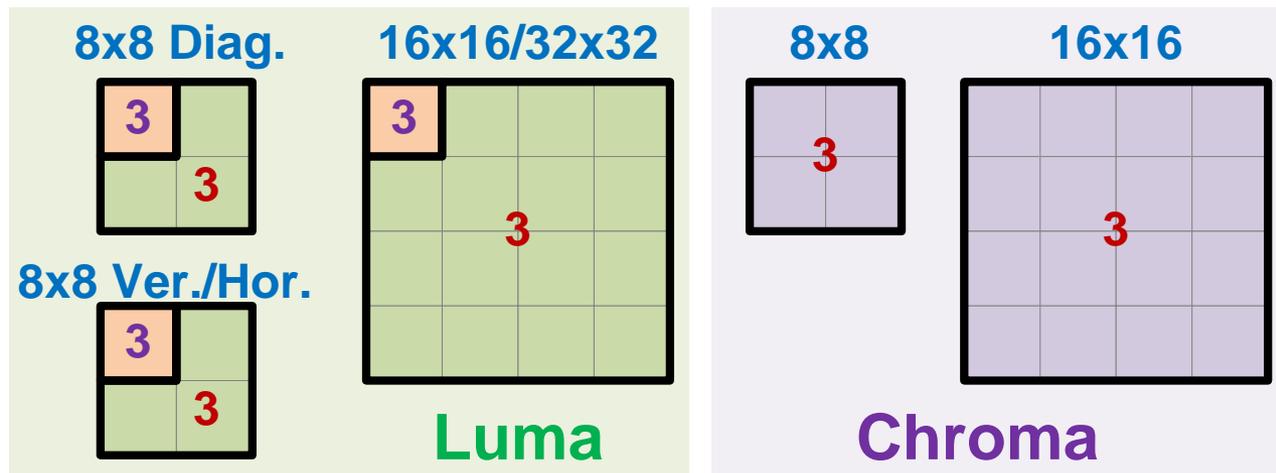
Presented by Tzu-Der Chuang
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Overall Summary

- In HM-8.0 significant coefficient flags coding, 8x8 transform blocks (TBs) and 16x16/32x32 TBs use different context sets
 - In 8x8 TBs, diag. scan and non-diag. scan uses different contexts
- Propose to further unify the context modeling for 8x8 TBs and 16x16/32x32 TBs
- Method 1: Share the contexts for 8x8 diag. scan and 8x8 non-diag. scan
 - Remove the scan index derivation for context selection
 - 6 contexts are reduced with Y BD rate loss less than 0.03% loss in normal QPs, or less than 0.02% loss in low QPs
- Method 2: Share the Luma high-freq. sub-set contexts and Share the Chroma 8x8 and 16x16 TBs contexts
 - 12 contexts are reduced with Y BD rate loss less than 0.06% loss in normal QPs, or less than 0.01% loss in low QPs

Contexts of Significant Coefficient Flag for 8x8/16x16/32x32 TBs in HM-8.0

- Separate contexts are used for the 8x8 TBs and 16x16/32x32 TBs
- Separate contexts are used for 8x8 diagonal scan and 8x8 non-diagonal scan
 - Need to derive the scan index for context set selection
 - Diag./Ver./Hor. scans share the same contexts in 4x4 TBs



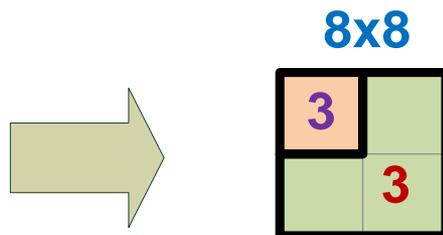
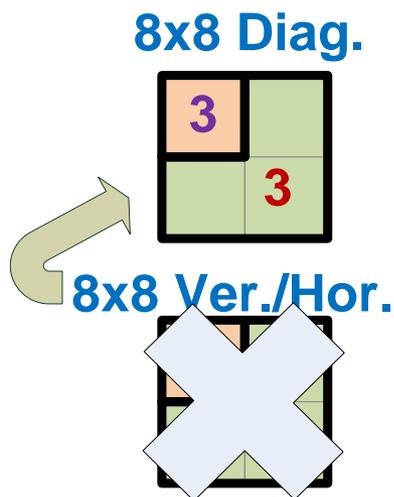
Contexts of Significant Coefficient Flag for 8x8/16x16/32x32 TBs in HM-8.0

- Separate contexts are used for the 8x8 TBs and 16x16/32x32 TBs
- Separate contexts are used for 8x8 diagonal scan and 8x8 non-diagonal scan
- DC coefficient still uses the current DC context shared by all Luma TBs

Comp.	TB and scan	Sub-set	Ctx.
Luma	8x8 Diag.	Low-freq. sub-set	3
		High-freq. sub-set	3
	8x8 Non-diag.	Low-freq. sub-set	3
		High-freq. sub-set	3
	16x16/32x32	Low-freq. sub-set	3
		High-freq. sub-set	3
Chroma	8x8	All sub-set	3
	16x16	All sub-set	3

Proposed Method I

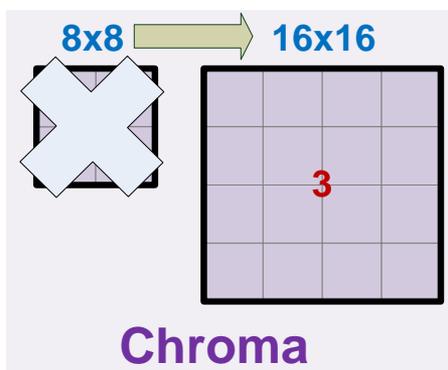
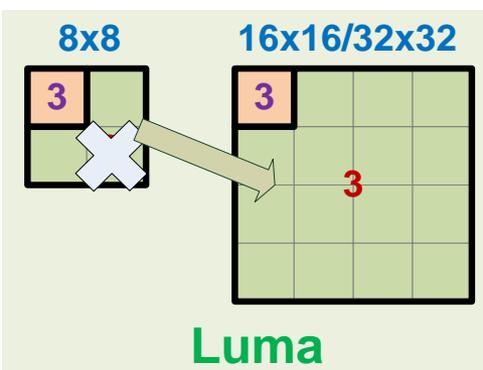
- Same set of contexts shared by the 8x8 Luma TBs in diagonal and non-diagonal scans
- Benefits
 - Further unify the context selection methods for large TBs
 - Don't have to derive scan index for context set selection
 - Reduce the number of CABAC modeling contexts by 6



TB	Sub-set	Ctx.
8x8	Low-freq. sub-set	3
	High-freq. sub-set	3

Proposed Method II

- Same set of contexts shared by Luma 8x8/16x16/32x32 high-freq. sub-set
- Same set of contexts shared by Chroma 8x8 TBs and 16x16/32x32 TBs
- Further reduce the number of CABAC modeling contexts by 12



Comp.	TB	Sub-set	Ctx.
Luma	8x8	Low-freq.	3
	16x16/32x32	Low-freq.	3
	8x8/16x16/32x32	High-freq.	3
Chroma	8x8 /16x16	All sub-set	3

Results: Method I under the CTCs

	All Intra Main			Random Access Main			Low delay B Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.02%	-0.01%	-0.05%	0.04%	-0.04%	-0.06%			
Class B	0.02%	-0.02%	-0.02%	0.01%	0.00%	-0.02%	0.03%	0.19%	0.05%
Class C	0.03%	0.03%	0.02%	0.00%	0.05%	0.03%	0.04%	0.05%	-0.10%
Class D	0.02%	0.03%	0.00%	0.03%	0.06%	-0.12%	-0.05%	0.67%	-0.25%
Class E	0.09%	-0.03%	-0.06%				0.06%	-0.72%	1.01%
Overall	0.03%	0.00%	-0.02%	0.02%	0.02%	-0.04%	0.02%	0.11%	0.12%

	All Intra HE10			Random Access HE10			Low delay B HE10		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.02%	-0.01%	0.01%	-0.02%	-0.11%	-0.27%			
Class B	0.02%	-0.03%	-0.01%	0.01%	0.10%	0.04%	-0.01%	-0.16%	0.23%
Class C	0.03%	0.04%	-0.04%	0.03%	0.00%	-0.13%	-0.01%	0.01%	0.45%
Class D	0.02%	0.00%	0.01%	-0.03%	-0.05%	-0.37%	0.03%	-0.31%	-0.55%
Class E	0.10%	-0.07%	-0.05%				-0.12%	0.72%	-0.49%
Overall	0.03%	-0.01%	-0.01%	0.00%	-0.01%	-0.17%	-0.02%	0.01%	-0.05%

Results: Method I over low QPs (QP = 12, 17, 22, 27)

	All Intra Main			Random Access Main			Low delay B Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.00%	0.00%	0.00%	0.04%	-0.05%	-0.04%			
Class B	-0.01%	0.04%	0.03%	0.02%	0.03%	0.00%	0.00%	0.01%	-0.05%
Class C	0.00%	0.02%	0.01%	0.01%	0.05%	0.02%	0.00%	-0.01%	0.06%
Class D	-0.01%	0.00%	0.00%	0.01%	-0.02%	0.09%	0.00%	0.11%	-0.06%
Class E	0.01%	0.02%	0.00%				0.08%	0.13%	0.11%
Overall	0.00%	0.02%	0.01%	0.02%	0.01%	0.02%	0.01%	0.05%	0.00%

	All Intra HE10			Random Access HE10			Low delay B HE10		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.00%	0.00%	0.00%	0.02%	0.04%	-0.08%			
Class B	0.00%	0.04%	0.03%	0.00%	0.00%	0.04%	0.00%	-0.01%	-0.06%
Class C	0.00%	0.00%	0.00%	0.02%	0.02%	-0.02%	0.01%	-0.01%	-0.01%
Class D	-0.01%	0.01%	0.00%	-0.01%	0.05%	-0.03%	0.01%	-0.18%	-0.08%
Class E	0.02%	-0.01%	0.01%				-0.04%	0.07%	-0.24%
Overall	0.00%	0.01%	0.01%	0.00%	0.03%	-0.02%	0.00%	-0.04%	-0.09%

Results: Method II under the CTCs

	All Intra Main			Random Access Main			Low delay B Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.05%	0.01%	-0.01%	0.04%	-0.06%	-0.11%			
Class B	0.05%	-0.09%	-0.06%	0.01%	-0.13%	0.14%	0.04%	-0.11%	-0.17%
Class C	0.05%	0.05%	0.03%	0.01%	0.01%	0.13%	0.09%	-0.07%	-0.02%
Class D	0.03%	0.04%	-0.01%	0.04%	0.09%	0.10%	-0.03%	0.73%	-0.21%
Class E	0.11%	-0.05%	-0.08%				0.02%	-0.06%	0.93%
Overall	0.06%	-0.01%	-0.03%	0.02%	-0.03%	0.07%	0.03%	0.12%	0.06%

	All Intra HE10			Random Access HE10			Low delay B HE10		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.05%	0.01%	0.01%	-0.02%	0.12%	0.07%			
Class B	0.05%	-0.06%	-0.04%	0.01%	-0.05%	0.05%	0.04%	-0.16%	0.04%
Class C	0.05%	0.02%	-0.02%	0.02%	0.14%	-0.07%	-0.01%	-0.04%	0.10%
Class D	0.04%	0.04%	0.01%	-0.04%	0.08%	-0.28%	0.04%	0.01%	-0.35%
Class E	0.11%	-0.05%	-0.07%				-0.16%	0.67%	-0.43%
Overall	0.06%	-0.01%	-0.02%	-0.01%	0.06%	-0.05%	-0.01%	0.07%	-0.13%

Results: Method II over low QPs (QP = 12, 17, 22, 27)

	All Intra Main			Random Access Main			Low delay B Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.02%	0.00%	0.00%	0.01%	-0.02%	-0.04%			
Class B	-0.05%	-0.15%	-0.06%	0.02%	-0.08%	-0.10%	-0.02%	-0.09%	-0.02%
Class C	0.00%	0.02%	0.02%	0.00%	0.01%	-0.02%	0.01%	-0.02%	-0.05%
Class D	0.00%	-0.01%	0.02%	0.02%	0.01%	0.09%	0.01%	-0.01%	-0.03%
Class E	0.02%	-0.01%	-0.01%				0.03%	-0.45%	-0.20%
Overall	-0.01%	-0.04%	-0.01%	0.01%	-0.02%	-0.02%	0.01%	-0.12%	-0.06%

	All Intra HE10			Random Access HE10			Low delay B HE10		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.02%	0.00%	0.00%	0.03%	0.06%	-0.04%			
Class B	-0.06%	-0.15%	-0.06%	-0.04%	-0.16%	0.04%	-0.01%	-0.10%	-0.06%
Class C	0.00%	0.00%	0.00%	0.01%	0.01%	-0.06%	0.01%	-0.07%	0.00%
Class D	0.00%	0.00%	0.01%	0.01%	0.01%	-0.09%	0.03%	-0.11%	-0.18%
Class E	0.03%	-0.03%	0.00%				-0.07%	0.15%	-0.73%
Overall	-0.01%	-0.04%	-0.01%	0.00%	-0.03%	-0.03%	-0.01%	-0.05%	-0.20%

Conclusion

- Propose to further unify the context modeling for 8x8 TBs and 16x16/32x32 TBs
- **Method 1:** Share the contexts for 8x8 diag. scan and 8x8 non-diag. scan
 - Remove the need to derive the scan index for context selection
 - Context reduction by 6

	AI Main	RA Main	LB Main	AI HE10	RA HE10	LB HE10
Y-BD Rate	0.03%	0.02%	0.02%	0.03%	0.00%	-0.02%

- **Method 2:** Share the Luma high-freq. sub-set contexts and Share the Chroma 8x8 and 16x16 TBs contexts
 - Context reduction by 12

	AI Main	RA Main	LB Main	AI HE10	RA HE10	LB HE10
Y-BD Rate	0.06%	0.02%	0.03%	0.06%	-0.01%	-0.01%