



Non-CE11: Unification of Transform Coefficient Coding

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Presented by Tzu-Der (Peter) Chuang
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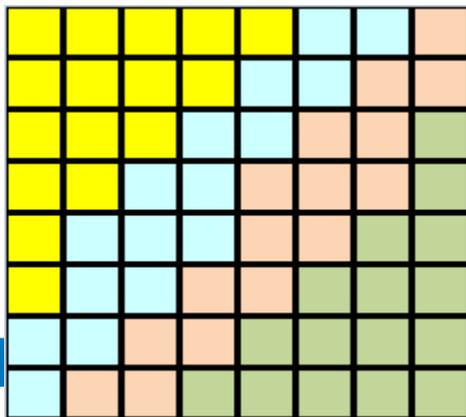
Overall Summary

- In HM-5.0, one TU is divided into subsets for coefficient coding, and subset partitioning of 8x8 TU is different from other TUs.
- In HM-5.0, 4x4 and 8x8 TUs both use position-based context selection but their context selection look-up tables are different.
- In this contribution, two unifications are proposed
 - Unify the subset partitioning of 8x8 TU with other TUs
 - Unify the position-based context selection look-up tables between 4x4 and 8x8 TUs
- No change in BD-rates and run times

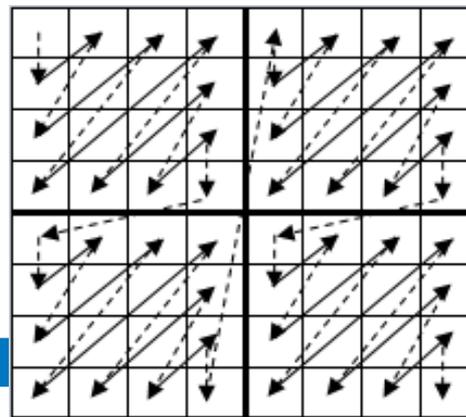
Different Subset Partitioning Methods

- In HM-5.0, TU is divided into several subsets when TU size is larger than 4x4
 - For one 8x8 TU, the 64 coefficients are divided into 4 subsets
 - Each subset contains 16 continuous coefficients
 - For TU sizes larger than 8x8 (e.g. 16x16, 32x32) and non-square TUs (e.g. 16x4, 4x16, 32x8, 8x32),
 - TU is divided into 4x4 sub-blocks
 - Each sub-block is a coefficient subset

8x8 TU subsets



4x4 sub-blocks



Different Context Selection Tables

- Different context selection methods are adopted for different TU sizes as proposed in JCTVC-G1015
 - Three different look-up tables are used for position-based context selection of 4x4 and 8x8 TUs

0	1	4	5
2	3	4	5
6	6	8	8
7	7	8	

4x4 Luma SigMap
Context Grouping

0	1	2	4
1	1	2	4
3	3	5	5
4	4	5	

4x4 Chroma SigMap
Context Grouping

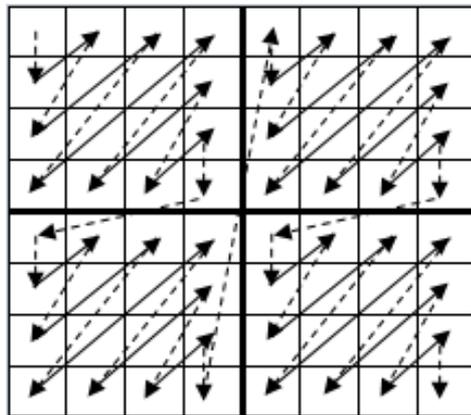
15*	0	1	1	2	2	3	3
0	0	1	1	2	2	3	3
4	4	5	5	10	10	3	3
4	4	5	5	10	10	3	3
8	8	10	10	10	10	11	11
8	8	10	10	10	10	11	11
12	12	12	12	11	11	11	11
12	12	12	12	11	11	11	

8x8 Luma and Chroma
SigMap Context Grouping

Proposed Subset Partitioning for 8x8 TU

- Unifications of subset partitioning for 8x8 TU
 - Instead of using diagonal scan through an entire 8x8 TU, the 8x8 TU is partitioned into 4x4 sub-blocks.
 - The 2-level diagonal scan will be used.
 - 4x4 sub-blocks will be coefficient subsets as in other TUs.

2-level diagonal scan for 8x8 TU



Simulation Results

- Anchor: HM-5.0
- No impact on BD-rate and run time

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.1%	-0.2%	0.1%	0.2%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	-0.2%
Class D	0.0%	-0.2%	-0.1%	0.0%	0.2%	0.0%
Class E						
Overall	0.0%	0.0%	-0.1%	0.0%	0.1%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Class F	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low Delay B HE			Low Delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	0.1%	0.0%	-0.1%	0.4%
Class C	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
Class D	0.0%	-0.2%	-0.1%	-0.1%	0.9%	-0.5%
Class E	0.0%	0.9%	-0.2%	0.0%	-0.3%	-0.8%
Overall	0.0%	0.1%	0.0%	0.0%	0.2%	-0.2%
	0.0%	0.1%	0.0%	0.0%	0.1%	-0.2%
Class F	-0.2%	-0.2%	-0.3%	0.0%	0.1%	-0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

	Low Delay P HE			Low Delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.2%	-0.1%	0.1%	0.1%	-0.1%
Class C	0.0%	0.0%	-0.2%	0.0%	0.1%	0.3%
Class D	0.0%	-0.2%	-0.2%	0.0%	0.0%	0.3%
Class E	0.0%	0.7%	0.1%	0.0%	-1.5%	-1.2%
Overall	0.0%	0.2%	-0.1%	0.0%	-0.2%	-0.1%
	0.0%	0.1%	-0.1%	0.0%	-0.3%	-0.1%
Class F	0.0%	0.3%	0.4%	0.2%	-0.1%	0.7%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

Proposed Context Selection Method 1

- Unifications of significance map context selection for 4x4 and 8x8 TUs
 - Reuse the context selection look-up table of 4x4 luma for both 8x8 luma and chroma

(pos_X, pos_Y)

0	1	4	5
2	3	4	5
6	6	8	8
7	7	8	8

4x4 Luma SigMap
Context Grouping

(pos_X>>1, pos_Y>>1)

15*	0	1	1	4	4	5	5
0	0	1	1	4	4	5	5
2	2	3	3	4	4	5	5
2	2	3	3	4	4	5	5
6	6	6	6	8	8	8	8
6	6	6	6	8	8	8	8
7	7	7	7	8	8	8	8
7	7	7	7	8	8	8	8

8x8 Luma and Chroma
SigMap Context Grouping

0	1	2	4
1	1	2	4
3	3	5	5
4	4	5	5

4x4 Chroma SigMap
Context Grouping

Simulation Results

- Anchor: HM-5.0
- No impact on BD-rate and run time

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%
Class B	0.0%	0.4%	0.3%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Class E	0.0%	0.4%	0.3%	0.0%	0.0%	0.0%
Overall	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%
	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.2%	0.0%	0.0%	0.1%	-0.1%
Class B	0.0%	0.3%	0.4%	0.0%	0.1%	-0.1%
Class C	-0.1%	0.2%	0.2%	0.0%	0.1%	0.0%
Class D	0.0%	0.0%	0.2%	0.0%	0.3%	0.1%
Class E						
Overall	0.0%	0.1%	0.2%	0.0%	0.2%	0.0%
	0.0%	0.1%	0.2%	0.0%	0.2%	0.0%
Class F	-0.1%	0.0%	0.1%	0.0%	-0.1%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low Delay B HE			Low Delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.4%	1.0%	0.0%	0.0%	-0.2%
Class C	0.0%	0.1%	0.4%	0.0%	0.2%	0.2%
Class D	0.0%	-0.1%	-0.1%	0.0%	0.2%	-0.8%
Class E	0.0%	0.2%	-0.4%	-0.1%	0.4%	0.3%
Overall	0.0%	0.2%	0.3%	0.0%	0.1%	-0.2%
	0.0%	0.2%	0.4%	0.0%	0.1%	-0.1%
Class F	-0.1%	0.0%	-0.1%	0.2%	-0.4%	-0.3%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

	Low Delay P HE			Low Delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.6%	0.6%	0.0%	0.2%	-0.4%
Class C	0.0%	0.2%	0.1%	0.0%	0.2%	0.1%
Class D	0.0%	0.2%	-0.7%	0.0%	-0.1%	-0.1%
Class E	0.0%	0.5%	0.1%	0.0%	-0.1%	-0.7%
Overall	0.0%	0.4%	0.1%	0.0%	0.1%	-0.3%
	0.0%	0.4%	0.1%	0.0%	-0.1%	-0.2%
Class F	0.0%	0.2%	-0.1%	0.2%	0.2%	0.5%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

Proposed Context Selection Method 2

- Unification of significance map context selections for 4x4 and 8x8 TUs
 - Reuse the context selection look-up table of 4x4 luma for 4x4 chroma
 - Reuse the context selection look-up table of 4x4 luma for both 8x8 luma and chroma

(pos_X, pos_Y)

0	1	4	5
2	3	4	5
6	6	8	8
7	7	8	8

4x4 Luma and Chroma
SigMap Context Grouping

(pos_X>>1, pos_Y>>1)

15*	0	1	1	4	4	5	5
0	0	1	1	4	4	5	5
2	2	3	3	4	4	5	5
2	2	3	3	4	4	5	5
6	6	6	6	8	8	8	8
6	6	6	6	8	8	8	8
7	7	7	7	8	8	8	8
7	7	7	7	8	8	8	8

8x8 Luma and Chroma SigMap
Context Grouping

Simulation Results

- Anchor: HM-5.0
- No impact on BD-rate and run time

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Class B	-0.1%	0.5%	0.6%	0.0%	0.0%	0.0%
Class C	0.0%	0.4%	0.3%	0.0%	0.0%	0.0%
Class D	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%
	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%
Class F	-0.1%	0.4%	0.4%	0.0%	0.2%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			99%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A (8bit)	0.0%	0.1%	-0.1%	0.0%	0.0%	-0.2%
Class B	0.0%	0.4%	0.6%	0.0%	0.1%	0.0%
Class C	0.0%	0.2%	0.4%	0.0%	0.1%	0.1%
Class D	0.0%	0.1%	0.4%	0.0%	0.2%	-0.4%
Class E						
Overall	0.0%	0.3%	0.4%	0.0%	0.1%	-0.1%
	0.0%	0.2%	0.4%	0.0%	0.1%	-0.1%
Class F	-0.1%	0.5%	0.5%	0.0%	-0.1%	-0.2%
Enc Time[%]	101%			100%		
Dec Time[%]	100%			100%		

	Low Delay B HE			Low Delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.5%	0.3%	0.0%	-0.1%	0.1%
Class C	0.0%	0.0%	0.4%	0.0%	0.2%	0.2%
Class D	0.0%	-0.4%	-0.2%	0.0%	0.8%	-0.7%
Class E	0.0%	-0.3%	-1.4%	-0.1%	-0.9%	0.0%
Overall	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.1%
	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%
Class F	-0.2%	0.3%	0.2%	-0.2%	-0.7%	-0.7%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

	Low Delay P HE			Low Delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.4%	0.3%	0.0%	0.1%	-0.4%
Class C	0.0%	0.1%	0.0%	0.0%	0.3%	0.3%
Class D	0.0%	0.2%	-0.3%	-0.1%	-0.2%	-0.1%
Class E	0.0%	-0.7%	-1.1%	0.0%	-0.5%	-0.4%
Overall	0.0%	0.1%	-0.2%	0.0%	0.0%	-0.1%
	0.0%	0.1%	-0.2%	0.0%	-0.1%	-0.1%
Class F	-0.1%	0.7%	0.7%	0.0%	-0.5%	0.4%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

Conclusions

- In this contribution, two unifications are proposed for the coefficient coding in HM-5.0
- One is to unify the subset partitioning of 8x8 TU with other TUs
- The other is to unify the position-based context selection look-up tables between 4x4 and 8x8 TUs
- Simulation results reportedly show no meaningful differences in BD-rates and run times in comparison with HM-5.0