

# CE2 subtest C.1: Non-square quadtree (NSQT) with 2x8 and 8x2 transform

JCTVC-G518

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# Motivation

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- Evaluate coding performance and complexity of 2x8 and 8x2 transform under NSQT structure

# NSQT with 2x8 and 8x2 transform

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- Transform design
  - ◆ Share 8-pt and 2-pt core transform
  - ◆ a 2-pt hadamard-like core transform is added to HEVC framework
- Quantization and entropy coding method are same as non-square block's implementation at current HM

# NSQT with 2x8 and 8x2 transform (continue)

Relationship between trafoDepth and transform block size when partition mode is SIZE\_2NxN, or SIZE2NxN<sub>U</sub>, or Size\_2NxN<sub>D</sub>

	64x64 CU		32x32 CU		16x16 CU		8x8 CU	
	HM4.0	G518	HM4.0	G518	HM4.0	G518	HM4.0	G518
trafoDepth=0	N/A	N/A	32x32	32x32	16x16	16x16	8x8	8x8
trafoDepth=1	32x32	32x32	32x8	32x8	16x4	16x4	4x4	8x2
trafoDepth=2	32x8	32x8	16x4	16x4	4x4	8x2	N/A	N/A

Relationship between trafoDepth and transform block size when partition mode is SIZE\_Nx2N, or SIZE\_nLx2U, or Size\_nRx2N

	64x64 CU		32x32 CU		16x16 CU		8x8 CU	
	HM4.0	G518	HM4.0	G518	HM4.0	G518	HM4.0	G518
trafoDepth=0	N/A	N/A	32x32	32x32	16x16	16x16	8x8	8x8
trafoDepth=1	32x32	32x32	8x32	8x32	4x16	4x16	4x4	2x8
trafoDepth=2	8x32	8x32	4x16	4x16	4x4	2x8	N/A	N/A

# Test results

- Reference: HM4.0
- Tested: HM4.0 + G518
- Results w/o classF

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.6%	-0.5%	0.1%	-0.2%	-0.3%
Class B	0.1%	-0.8%	-0.7%	0.0%	-0.6%	-0.4%
Class C	0.1%	-0.6%	-0.5%	0.0%	-0.6%	-0.5%
Class D	0.0%	-0.7%	-1.0%	0.0%	-0.6%	-0.8%
Class E						
Class F	-0.1%	-0.5%	-0.5%	-0.2%	-0.5%	-0.5%
<b>Overall</b>	0.0%	-0.7%	-0.7%	0.0%	-0.5%	-0.5%
	0.0%	-0.7%	-0.7%	0.0%	-0.5%	-0.5%
Enc Time[%]	101%			100%		
Dec Time[%]	99%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-1.8%	-1.9%	0.0%	-0.9%	-1.1%
Class C	-0.2%	-1.5%	-1.5%	-0.3%	-1.2%	-1.1%
Class D	-0.3%	-1.8%	-1.8%	-0.4%	-1.0%	-1.5%
Class E	-0.1%	-0.6%	-0.8%	-0.1%	-0.5%	-0.3%
Class F	-1.0%	-1.3%	-1.9%	-0.8%	-1.4%	-1.5%
<b>Overall</b>	-0.1%	-1.5%	-1.6%	-0.2%	-0.9%	-1.1%
	-0.1%	-1.5%	-1.6%	-0.2%	-0.9%	-1.1%
Enc Time[%]	100%			101%		
Dec Time[%]	99%			100%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-1.6%	-1.7%	0.0%	-0.8%	-0.8%
Class C	-0.1%	-1.2%	-1.2%	-0.2%	-0.9%	-1.2%
Class D	-0.2%	-1.5%	-2.0%	-0.3%	-1.3%	-1.3%
Class E	0.0%	-0.4%	0.3%	-0.1%	0.6%	0.2%
Class F	-0.9%	-1.5%	-1.4%	-0.7%	-1.4%	-1.6%
<b>Overall</b>	-0.1%	-1.2%	-1.3%	-0.1%	-0.7%	-0.8%
	-0.1%	-1.2%	-1.2%	-0.1%	-0.7%	-0.8%
Enc Time[%]	100%			100%		
Dec Time[%]	98%			99%		

# Test results (continue)

- Reference: HM4.0
- Tested: HM4.0 + G518
- Results with classF

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.6%	-0.5%	0.1%	-0.2%	-0.3%
Class B	0.1%	-0.8%	-0.7%	0.0%	-0.6%	-0.4%
Class C	0.1%	-0.6%	-0.5%	0.0%	-0.6%	-0.5%
Class D	0.0%	-0.7%	-1.0%	0.0%	-0.6%	-0.8%
Class E						
Class F	-0.1%	-0.5%	-0.5%	-0.2%	-0.5%	-0.5%
<b>Overall</b>	0.0%	-0.6%	-0.7%	0.0%	-0.5%	-0.5%
	0.0%	-0.6%	-0.7%	0.0%	-0.5%	-0.5%
Enc Time[%]	100%			101%		
Dec Time[%]	99%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-1.8%	-1.9%	0.0%	-0.9%	-1.1%
Class C	-0.2%	-1.5%	-1.5%	-0.3%	-1.2%	-1.1%
Class D	-0.3%	-1.8%	-1.8%	-0.4%	-1.0%	-1.5%
Class E	-0.1%	-0.6%	-0.8%	-0.1%	-0.5%	-0.3%
Class F	-1.0%	-1.3%	-1.9%	-0.8%	-1.4%	-1.5%
<b>Overall</b>	-0.3%	-1.5%	-1.6%	-0.3%	-1.0%	-1.1%
	-0.3%	-1.5%	-1.6%	-0.3%	-1.0%	-1.2%
Enc Time[%]	100%			101%		
Dec Time[%]	100%			100%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-1.6%	-1.7%	0.0%	-0.8%	-0.8%
Class C	-0.1%	-1.2%	-1.2%	-0.2%	-0.9%	-1.2%
Class D	-0.2%	-1.5%	-2.0%	-0.3%	-1.3%	-1.3%
Class E	0.0%	-0.4%	0.3%	-0.1%	0.6%	0.2%
Class F	-0.9%	-1.5%	-1.4%	-0.7%	-1.4%	-1.6%
<b>Overall</b>	-0.2%	-1.3%	-1.3%	-0.3%	-0.8%	-1.0%
	-0.2%	-1.3%	-1.3%	-0.2%	-0.9%	-1.0%
Enc Time[%]	101%			100%		
Dec Time[%]	99%			99%		

# Test results (continue)

- Reference: HM4.0
- Tested: HM4.0 + G518 + encoder optimization (non-square hadamard transform)
- Results w/o classF

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.6%	-0.6%	0.0%	-0.3%	-0.3%
Class B	0.0%	-0.8%	-0.8%	-0.1%	-0.6%	-0.5%
Class C	-0.2%	-0.8%	-0.6%	-0.2%	-0.6%	-0.6%
Class D	-0.2%	-0.8%	-1.0%	-0.4%	-0.6%	-0.8%
Class E						
Class F	-0.3%	-0.5%	-0.5%	-0.4%	-0.5%	-0.6%
<b>Overall</b>	-0.1%	-0.7%	-0.8%	-0.2%	-0.5%	-0.5%
	-0.1%	-0.7%	-0.7%	-0.2%	-0.5%	-0.5%
Enc Time[%]	102%			101%		
Dec Time[%]	100%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-2.0%	-2.2%	-0.2%	-0.9%	-0.9%
Class C	-0.4%	-1.6%	-1.8%	-0.5%	-1.3%	-1.4%
Class D	-0.6%	-2.4%	-2.2%	-0.8%	-1.5%	-1.5%
Class E	-0.2%	-0.6%	-1.0%	-0.3%	-0.1%	-0.3%
Class F	-1.3%	-1.5%	-1.7%	-1.3%	-1.7%	-1.6%
<b>Overall</b>	-0.3%	-1.7%	-1.9%	-0.4%	-1.0%	-1.0%
	-0.3%	-1.7%	-1.9%	-0.4%	-1.0%	-1.0%
Enc Time[%]	101%			102%		
Dec Time[%]	100%			101%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-1.7%	-1.7%	-0.2%	-0.7%	-0.9%
Class C	-0.4%	-1.4%	-1.5%	-0.4%	-1.0%	-1.4%
Class D	-0.5%	-1.9%	-2.3%	-0.7%	-0.8%	-1.5%
Class E	-0.2%	-0.7%	0.0%	-0.3%	0.4%	0.0%
Class F	-1.2%	-1.8%	-1.8%	-1.1%	-1.7%	-2.0%
<b>Overall</b>	-0.3%	-1.5%	-1.5%	-0.4%	-0.6%	-1.0%
	-0.3%	-1.5%	-1.5%	-0.4%	-0.7%	-1.0%
Enc Time[%]	101%			102%		
Dec Time[%]	99%			100%		

# Test results (continue)

- Reference: HM4.0
- Tested: HM4.0 + G518 + encoder optimization (non-square hadamard transform)
- Results with classF

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.6%	-0.6%	0.0%	-0.3%	-0.3%
Class B	0.0%	-0.8%	-0.8%	-0.1%	-0.6%	-0.5%
Class C	-0.2%	-0.8%	-0.6%	-0.2%	-0.6%	-0.6%
Class D	-0.2%	-0.8%	-1.0%	-0.4%	-0.6%	-0.8%
Class E						
Class F	-0.3%	-0.5%	-0.5%	-0.4%	-0.5%	-0.6%
<b>Overall</b>	-0.1%	-0.7%	-0.8%	-0.2%	-0.5%	-0.5%
	-0.1%	-0.7%	-0.7%	-0.2%	-0.5%	-0.5%
Enc Time[%]	102%			101%		
Dec Time[%]	100%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-2.0%	-2.2%	-0.2%	-0.9%	-0.9%
Class C	-0.4%	-1.6%	-1.8%	-0.5%	-1.3%	-1.4%
Class D	-0.6%	-2.4%	-2.2%	-0.8%	-1.5%	-1.5%
Class E	-0.2%	-0.6%	-1.0%	-0.3%	-0.1%	-0.3%
Class F	-1.3%	-1.5%	-1.7%	-1.3%	-1.7%	-1.6%
<b>Overall</b>	-0.5%	-1.7%	-1.8%	-0.6%	-1.1%	-1.1%
	-0.5%	-1.7%	-1.9%	-0.6%	-1.1%	-1.2%
Enc Time[%]	102%			102%		
Dec Time[%]	102%			101%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-1.7%	-1.7%	-0.2%	-0.7%	-0.9%
Class C	-0.4%	-1.4%	-1.5%	-0.4%	-1.0%	-1.4%
Class D	-0.5%	-1.9%	-2.3%	-0.7%	-0.8%	-1.5%
Class E	-0.2%	-0.7%	0.0%	-0.3%	0.4%	0.0%
Class F	-1.2%	-1.8%	-1.8%	-1.1%	-1.7%	-2.0%
<b>Overall</b>	-0.5%	-1.5%	-1.6%	-0.5%	-0.8%	-1.2%
	-0.5%	-1.6%	-1.5%	-0.5%	-0.9%	-1.2%
Enc Time[%]	102%			102%		
Dec Time[%]	100%			101%		

# Conclusion

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- Average BD-rate reduction is from 0.1% ~ 0.5%
- About 1% encoding time increase compared to HM4.0
- Recommend to adopt NSQT with 2x8 and 8x2 transform

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*Thanks HHI's help on cross-checking!*



# Thank you!

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