

# CE2: Summary of Core Experiment 2 on Motion Partitioning and OBMC

**X. Zheng, I. S. Chong, I.-K. Kim**

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# Sub Experiments in CE2

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- Block partitioning
  - ◆ Subtest A.1: NRMP (Non-Rectangular Motion Partitioning)
- OBMC (Overlapped Block Motion Partitioning)
  - ◆ Subtest B.1: OBMC for  $2N \times N$  and  $N \times 2N$  partitions
  - ◆ Subtest B.2: OBMC with Motion Merging
- Non-Square TU
  - ◆ Subtest C.1: NSQT (Non-Square Quadtree Transform)
  - ◆ Subtest C.2: Non-Square Transform for  $2N \times N$  and  $N \times 2N$  Motion Partitions
  - ◆ Subtest C.3: RQT with rectangular transform unit

# Summary of CE2 proposals

Subtest	Status	Document	Proponents	Cross-checker
A.1	Withdraw	x	x	x
B.1	Software released on 13th Sep. Software updated after 13th Sep.	G749	Qualcomm	ETRI MediaTek
B.2	Withdraw	x	x	x
C.1	Software released on 13th Sep.	G517 G518	HiSilicon	HHI
C.2	Withdraw	X	x	x
C.3	Withdraw	x	x	x

# Summary of subtest B.1 OBMC for 2NxN and Nx2N partitions

- Brief of implementation
  - ◆ Overlapped region: two rows (columns) of each partition for luma, or one rows (columns) of each partition for chroma
  - ◆ Used at 2NxN, Nx2N, 2NxN<sub>U</sub>, 2NxN<sub>D</sub>, nLx2N and nRx2N partitions
  - ◆ Limited
    - Not applied to PUs with size 32x64 and/or 64x32
    - Disabled for bi-prediction PU in a 8x8 CU
      - to ensure no increase in the worst case memory BW
- Average gain and increase of encoding and decoding time
  - ◆ 0.6% ~ 2.1% BD-rate reduction
  - ◆ Around 2% encoding time increase
  - ◆ Around 1% decoding time increase

# Summary of subtest B.1 OBMC for 2NxN, Nx2N, and AMP partitions (continue)

- Reference: HM4.0
- Tested: HM4.0 + G749

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.4%	-1.2%	-1.1%	-0.5%	-0.5%	-0.5%
Class B	-0.5%	-0.8%	-0.8%	-0.5%	-0.6%	-0.6%
Class C	-0.9%	-1.2%	-1.0%	-0.7%	-1.0%	-1.2%
Class D	-0.8%	-0.9%	-1.0%	-0.6%	-0.9%	-0.7%
Class E						
<b>Overall</b>	-0.6%	-1.0%	-1.0%	-0.6%	-0.7%	-0.7%
	-0.6%	-1.0%	-1.0%	-0.6%	-0.7%	-0.7%
Enc Time[%]	99%			100%		
Dec Time[%]	99%			101%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-1.4%	-1.6%	-1.4%	-1.7%	-1.2%	-1.3%
Class C	-2.0%	-2.0%	-2.2%	-1.9%	-1.5%	-1.9%
Class D	-2.7%	-2.3%	-2.2%	-2.5%	-1.7%	-2.2%
Class E	-2.2%	-1.7%	-1.5%	-2.3%	-1.7%	-1.6%
<b>Overall</b>	-2.0%	-1.9%	-1.8%	-2.0%	-1.5%	-1.7%
	-2.1%	-1.9%	-2.0%	-2.1%	-1.5%	-1.7%
Enc Time[%]	101%			102%		
Dec Time[%]	101%			100%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.7%	-1.0%	-1.0%	-0.6%	-0.6%	-0.4%
Class C	-1.0%	-1.1%	-1.1%	-0.8%	-0.8%	-1.1%
Class D	-1.1%	-0.9%	-1.1%	-0.8%	-0.7%	-0.7%
Class E	-1.2%	-0.9%	0.0%	-1.0%	-0.8%	-1.1%
<b>Overall</b>	-1.0%	-1.0%	-0.9%	-0.8%	-0.7%	-0.8%
	-1.0%	-1.0%	-0.9%	-0.8%	-0.8%	-0.8%
Enc Time[%]	96%			99%		
Dec Time[%]	99%			101%		

# Summary of subtest B.1 OBMC for 2NxN, Nx2N, and AMP partitions (continue)

- Further improvement: software updated after CE deadline
- Reference: HM4.0
- Tested: HM4.0 + G749

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.4%	-1.5%	-1.0%	-0.5%	-0.6%	-0.7%
Class B	-0.5%	-0.9%	-0.8%	-0.5%	-0.8%	-0.7%
Class C	-0.9%	-1.3%	-1.2%	-0.8%	-1.1%	-1.3%
Class D	-0.7%	-1.0%	-1.0%	-0.6%	-0.9%	-0.8%
Class E						
<b>Overall</b>	-0.6%	-1.2%	-1.0%	-0.6%	-0.8%	-0.8%
	-0.6%	-1.2%	-1.0%	-0.6%	-0.8%	-0.8%
Enc Time[%]	98%			103%		
Dec Time[%]	101%			102%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-1.4%	-1.6%	-1.4%	-1.7%	-1.2%	-1.3%
Class C	-2.0%	-2.0%	-2.2%	-1.9%	-1.5%	-1.9%
Class D	-2.7%	-2.3%	-2.2%	-2.5%	-1.7%	-2.2%
Class E	-2.2%	-1.7%	-1.5%	-2.3%	-1.7%	-1.6%
<b>Overall</b>	-2.0%	-1.9%	-1.8%	-2.0%	-1.5%	-1.7%
	-2.1%	-1.9%	-2.0%	-2.1%	-1.5%	-1.7%
Enc Time[%]	101%			100%		
Dec Time[%]	100%			101%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.7%	-1.1%	-0.9%	-0.6%	-0.6%	-0.5%
Class C	-1.0%	-1.4%	-1.4%	-0.9%	-0.8%	-1.3%
Class D	-1.1%	-1.1%	-0.7%	-0.8%	-0.6%	-0.9%
Class E	-1.1%	-0.7%	-0.8%	-1.0%	-0.7%	-0.7%
<b>Overall</b>	-0.9%	-1.1%	-0.9%	-0.8%	-0.7%	-0.8%
	-0.9%	-1.1%	-1.0%	-0.8%	-0.7%	-0.8%
Enc Time[%]	96%			100%		
Dec Time[%]	98%			101%		

# Summary of subtest C.1 Harmonization of unified scan and NSQT - G517

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- Brief of implementation
  - ◆ Remove  $2N \times 0.5N$  /  $0.5N \times 2N$  to  $N \times N$  coefficient data reordering process
  - ◆ Use  $2N \times 0.5N$  /  $0.5N \times 2N$  diagonal scan to derive coefficient position
  - ◆ Modify ctx derivation process of `significant_coeff_flag`, `last_significant_coeff_x` and `last_significant_coeff_y` at non-square transform
- Average gain and increase of encoding and decoding time
  - ◆ 0% BD-rate reduction for luma,  $\pm 0.1\%$  BD-rate reduction for chroma
  - ◆ Both encoding and decoding time are almost same as HM4.0

# Summary of subtest C.1 Harmonization of unified scan and NSQT - G517 (continue)

- Reference: HM4.0
- Tested: HM4.0 + G517
- Result without classF

	Random Access HE		
	Y	U	V
Class A	0.0%	-0.1%	-0.2%
Class B	0.0%	0.1%	0.0%
Class C	0.0%	-0.1%	0.0%
Class D	0.0%	0.0%	0.1%
Class E			
<b>Overall</b>	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%
Enc Time[%]	101%		
Dec Time[%]	99%		

	Low delay P HE		
	Y	U	V
Class A			
Class B	0.0%	0.2%	0.4%
Class C	0.0%	0.0%	0.0%
Class D	0.1%	-0.1%	-0.6%
Class E	0.0%	-0.5%	-0.2%
<b>Overall</b>	0.0%	-0.1%	-0.1%
	0.0%	0.0%	-0.1%
Enc Time[%]	101%		
Dec Time[%]	98%		

	Low delay B HE		
	Y	U	V
Class A			
Class B	0.0%	0.2%	0.2%
Class C	0.0%	0.0%	0.1%
Class D	0.0%	0.1%	-0.3%
Class E	0.1%	-0.3%	0.6%
<b>Overall</b>	0.0%	0.0%	0.1%
	0.0%	0.0%	0.1%
Enc Time[%]	101%		
Dec Time[%]	98%		



# Summary of subtest C.1 Harmonization of unified scan and NSQT - G517 (continue)

- Reference: HM4.0
- Tested: HM4.0 + G517
- Result with classF

	Random Access HE		
	Y	U	V
Class A	0.0%	-0.1%	-0.2%
Class B	0.0%	0.1%	0.0%
Class C	0.0%	-0.1%	0.0%
Class D	0.0%	0.0%	0.1%
Class E			
<b>Overall</b>	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%
Enc Time[%]	100%		
Dec Time[%]	99%		

	Low delay P HE		
	Y	U	V
Class A			
Class B	0.0%	0.2%	0.4%
Class C	0.0%	0.0%	0.0%
Class D	0.1%	-0.1%	-0.6%
Class E	0.0%	-0.5%	-0.2%
<b>Overall</b>	0.0%	-0.1%	-0.1%
	0.0%	-0.1%	-0.2%
Enc Time[%]	101%		
Dec Time[%]	99%		

	Low delay B HE		
	Y	U	V
Class A			
Class B	0.0%	0.2%	0.2%
Class C	0.0%	0.0%	0.1%
Class D	0.0%	0.1%	-0.3%
Class E	0.1%	-0.3%	0.6%
<b>Overall</b>	0.0%	0.0%	0.1%
	0.0%	0.0%	0.1%
Enc Time[%]	101%		
Dec Time[%]	98%		

# Summary of subtest C.1 Harmonization of unified scan and NSQT - G518

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- Brief of implementation
  - ◆ Add 2x8 and 8x2 transform to NSQT structure
  - ◆ Quantization and coefficient coding are same as NSQT implementation at HM4
- Average gain and increase of encoding and decoding time
  - ◆ 0~0.2% BD-rate reduction for sequences w/o classF, 0.0% ~ 0.3% BD-rate reduction for sequences with classF
  - ◆ Both encoding and decoding time are almost same as HM4.0

# Summary of subtest C.1 Harmonization of unified scan and NSQT - G518 (continue)

- 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						
<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%
<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%
<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%		

# Summary of subtest C.1 Harmonization of unified scan and NSQT - G518 (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						
<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%
<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%
<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%		

# Comments from cross-checkers

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- G517
  - ◆ Unclear description at CE document (F902)
  - ◆ Hard to confirm the relationship between CE description and software implementation
  - ◆ Code style problem
- G518
  - ◆ Code style problem

# Proposals related to CE2

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- Related to NSQT coefficient coding
  - ◆ JCTVC-G322 CE6.c: Harmonization of HE residual coding with non-square block transform
  - ◆ JCTVC-G202 Non-CE2: Modified NSQT coefficient scan for CAVLC
  - ◆ JCTVC-G750 [Qualcomm, LGE] Non-CE2: Harmonization of HE residual coding and NSQT
- Related to NSQT encoder optimization
  - ◆ JCTVC-G521 Non-CE2: Non-square hadamard transform for motion estimation and merge estimation
- Others
  - ◆ JCTVC-G519 Non-CE2: Harmonization of implicit TU, AMP and NSQT



# Thank you!

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