

JCTVC-S0136

Non-CE4: On CABAC Throughput of Intra Line Copy

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- * In CE4 Test A, 9% increase (484->528) in context-coded bins due to ILC is observed
- * To reduce context-coded bins, this contribution proposes
 - Coding **row_split_flag** in bypass mode
 - Modifying BVP candidate list
 - Inferring **explicit_rdp_pcm_flag** to be equal to RDPCM_OFF
- * Results
 - 4 extra context-coded bins in the worst case
 - 0.1-0.3% BD-rate savings relative to Test A

* Test A vs. this contribution

1x4 ILC (CU Size: 8x8)	CE4 Test A	Proposed	Reduction per CU
row_split_flag	Context coded	Bypass coded	-4 bins
BVP candidate list construction	Same as IBC	<ul style="list-style-type: none">1st line: same as IBC2~4th: previously decoded BV	-12 bins
RDPCM	Same as IBC	explicit_rdpdm_flag inferred to be RDPCM_OFF	-24 bins

* Results: worst-case number of context-coded bins

4x8, Uni-pred.	4x4, IBC	1x4, ILC (CE4 Test A)	1x4, ILC (Proposed)
488	484	528	488

Worst-case Number of Context-coded Bins

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Prediction Mode (Note: CU Size = 8x8)	4x4, IntraBC		1x4, IntraLC		1x4, IntraLC	
	Syntax Elements	#	Syntax Elements	#	Syntax Elements	#
Mode Flag	cu_transquant_bypass_flag	1	cu_transquant_bypass_flag	1	cu_transquant_bypass_flag	1
	cu_skip_flag	1	cu_skip_flag	1	cu_skip_flag	1
	intra_bc_flag	1	intra_bc_flag	1	intra_bc_flag	1
	pred_mode_flag	1	intra_lc_flag	4	intra_lc_flag	4
	palette_mode_flag	1	row_splitting_flag	4	row_splitting_flag	0
			pred_mode_flag	1	pred_mode_flag	1
			palette_mode_flag	1	palette_mode_flag	1
Partition	part_mode	3	part_mode	3	part_mode	3
MV or BV	abs_bvd_greater0_flag	8	abs_bvd_greater0_flag	32	abs_bvd_greater0_flag	32
	bvp_flag	4	bvp_flag	16	bvp_flag	4
Others	...	440	...	440	...	440
	explicit_rdpcom_flag	12	explicit_rdpcom_flag	12	explicit_rdpcom_flag	0
	explicit_rdpcom_dir_flag	12	explicit_rdpcom_dir_flag	12	explicit_rdpcom_dir_flag	0
# of Context-coded Bins		484		528		488
Bins per Pixel		7.56		8.25		7.62

CE4 Test A.1: 4-CTU Configuration

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* SCM-2.0

CU Size	8x8				16x16			Others
PU Type	-	4x4	4x8/8x4	8x8	-	8x16/16x8	16x16	
Search Range	-	4-CTU	4-CTU	4-CTU	-	X	4-CTU	X

* CE4 Test A.1

CU Size	8x8				16x16			Others
PU Type	Line	4x4	4x8/8x4	8x8	Line	8x16/16x8	16x16	
Search Range	4-CTU	4-CTU	4-CTU	4-CTU	X	X	4-CTU	X

4-CTU Configuration

Lossy (G/Y BD-rate)	All Intra		Random Access		Low Delay B	
	Proposed	CE4 Test A1	Proposed	CE4 Test A1	Proposed	CE4 Test A1
RGB, text & graphics with motion, 1080p	-6.7	-6.4	-3.8	-3.7	-2.4	-2.4
RGB, text & graphics with motion, 720p	-3.3	-3.3	-2.6	-2.6	-1.1	-0.9
RGB, mixed content, 1440p	-2.6	-2.5	-1.8	-1.7	-1.0	-1.0
RGB, mixed content, 1080p	-3.9	-3.7	-3.0	-3.0	-1.4	-1.5
YUV, text & graphics with motion, 1080p	-6.7	-6.2	-3.4	-3.3	-2.1	-2.0
YUV, text & graphics with motion, 720p	-3.2	-3.0	-2.5	-2.5	-0.9	-0.9
YUV, mixed content, 1440p	-2.7	-2.4	-1.9	-1.8	-0.9	-0.9
YUV, mixed content, 1080p	-4.0	-3.7	-2.9	-2.9	-1.6	-1.6
Enc Time[%]	120%	119%	104%	103%	102%	102%
Dec Time[%]	103%	106%	102%	102%	103%	102%

Lossless (G/Y BD-rate)	All Intra		Random Access		Low Delay B	
	Proposed	CE4 Test A1	Proposed	CE4 Test A1	Proposed	CE4 Test A1
RGB, text & graphics with motion, 1080p	7.2	7.1	5.3	5.3	4.5	4.4
RGB, text & graphics with motion, 720p	2.1	2.1	1.2	1.2	0.6	0.6
RGB, mixed content, 1440p	1.0	1.1	0.2	0.2	0.1	0.1
RGB, mixed content, 1080p	1.5	1.5	0.3	0.3	0.1	0.1
YUV, text & graphics with motion, 1080p	7.8	7.4	5.8	5.6	5.0	4.9
YUV, text & graphics with motion, 720p	2.6	2.5	1.5	1.5	0.8	0.8
YUV, mixed content, 1440p	1.1	1.2	0.2	0.2	0.1	0.2
YUV, mixed content, 1080p	1.8	1.8	0.3	0.3	0.1	0.2
Enc Time[%]	118%	115%	104%	103%	104%	103%
Dec Time[%]	101%	101%	100%	103%	100%	100%

CE4 Test A.2: Full-frame Configuration

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* SCM-2.0

CU Size	8x8				16x16			Others
PU Type	-	4x4	4x8/8x4	8x8	-	8x16/16x8	16x16	
Search Range	-	2-CTUs	2-CTU	Full Frame	-	X	Full Frame	X

* CE4 Test A.2

CU Size	8x8				16x16			Others
PU Type	Line	4x4	4x8/8x4	8x8	Line	8x16/16x8	16x16	
Search Range	2-CTU	2-CTU	2-CTU	Full Frame	X	X	Full Frame	X

Full-frame Configuration

Lossy (G/Y BD-rate)	All Intra		Random Access		Low Delay B	
	Proposed	CE4 Test A2	Proposed	CE4 Test A2	Proposed	CE4 Test A2
RGB, text & graphics with motion, 1080p	-4.4	-3.8	-2.4	-2.2	-1.5	-1.5
RGB, text & graphics with motion, 720p	-1.5	-1.3	-1.2	-1.1	-0.5	-0.7
RGB, mixed content, 1440p	-1.7	-1.5	-1.1	-1.1	-0.6	-0.6
RGB, mixed content, 1080p	-2.5	-2.2	-1.9	-1.6	-0.7	-0.6
YUV, text & graphics with motion, 1080p	-4.4	-3.7	-2.2	-2.0	-1.3	-1.3
YUV, text & graphics with motion, 720p	-1.5	-1.2	-1.1	-0.9	-0.7	-0.5
YUV, mixed content, 1440p	-1.6	-1.4	-1.1	-1.0	-0.6	-0.7
YUV, mixed content, 1080p	-2.5	-2.1	-1.8	-1.6	-0.7	-0.7
Enc Time[%]	117%	117%	107%	103%	108%	101%
Dec Time[%]	102%	101%	104	101%	104%	103%

Lossless (G/Y BD-rate)	All Intra		Random Access		Low Delay B	
	Proposed	CE4 Test A2	Proposed	CE4 Test A2	Proposed	CE4 Test A2
RGB, text & graphics with motion, 1080p	4.9	4.6	3.4	3.2	2.8	2.7
RGB, text & graphics with motion, 720p	1.0	1.0	0.5	0.5	0.3	0.3
RGB, mixed content, 1440p	0.6	0.7	0.1	0.1	0.1	0.1
RGB, mixed content, 1080p	0.8	0.8	0.1	0.1	0.1	0.1
YUV, text & graphics with motion, 1080p	5.1	4.6	3.6	3.4	3.0	2.6
YUV, text & graphics with motion, 720p	1.2	1.1	0.6	0.6	0.4	0.4
YUV, mixed content, 1440p	0.7	0.7	0.1	0.1	0.1	0.1
YUV, mixed content, 1080p	0.9	0.9	0.2	0.2	0.1	0.1
Enc Time[%]	115%	115%	103%	104%	102%	102%
Dec Time[%]	101%	101%	100%	101%	100%	100%

- * 3 solutions are proposed to reduce context-coded bins for ILC, showing
 - 4 extra context-coded bins in the worst case
 - 0.1-0.3% BD-rate savings relative to CE4 Test A
- * Recommend further study of these solutions in CE
- * Thank Huawei for cross-checking this proposal