

CE6: Summary report of CE on improvements of palette mode

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SCM-2.0 Palette Gain

- **Palette gain is significant and mostly additive with colour transform gain** (also mostly additive with intra block copy gain based on previous study).

	SCM2.0, FULL Palette ON/OFF				SCM2.0-Adp Color Trans Palette ON/OFF		
	All Intra				All Intra		
	G/Y	B/U	R/V		G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	22.0%	22.3%	21.3%		26.7%	25.9%	25.5%
RGB, text & graphics with motion, 720p	14.6%	14.0%	14.3%		19.1%	16.2%	16.8%
RGB, mixed content, 1440p	3.1%	4.6%	4.3%		7.0%	5.6%	5.6%
RGB, mixed content, 1080p	5.3%	6.8%	5.6%		7.6%	7.3%	7.0%
RGB, Animation, 720p	0.0%	0.4%	0.5%		0.3%	0.8%	1.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%		-0.1%	-0.1%	0.0%
YUV, text & graphics with motion, 1080p	26.7%	30.9%	28.9%		27.1%	31.6%	29.8%
YUV, text & graphics with motion, 720p	12.8%	19.1%	24.6%		13.1%	19.5%	25.9%
YUV, mixed content, 1440p	5.2%	11.8%	12.1%		5.2%	12.4%	12.7%
YUV, mixed content, 1080p	7.2%	13.6%	13.7%		7.3%	13.8%	13.9%
YUV, Animation, 720p	-0.1%	1.6%	1.4%		-0.2%	1.8%	1.6%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%		0.0%	0.0%	-0.1%
Enc Time[%]	97%				95%		

SCM-2.0 Palette Complexity

- **Palette complexity is low.**
 - Its complexity increase can be justified by its coding gain.

Off-chip memory bandwidth	0
Additional on-chip memory	287 bytes
Worst case context coded bins per 3-component pixel	1.89
Does parsing depend on reconstructed index values?	No

Note: Worst case context coded bins per 3-component pixel for HEVC RExt is 6.19.

Overview of CE6 Tests

- All CE6 proposals are built on top of SCM-2.0 palette and tested under the full-frame IBC common test condition.
- Category A – Colour index run coding
 - 6 tests
- Category B – Colour index and escape colour coding
 - 5 tests
- Category C – Additional colour index representation modes
 - 3 tests
- Category D – Palette table coding
 - 1 test

List of CE6 Proposals

Test	Document
A.1 & A.2	Withdrawn
A.3	JCTVC-S0062
A.4	JCTVC-S0163
A.5	JCTVC-S0038
A.6	JCTVC-S0039
B.1	JCTVC-S0154
B.2	JCTVC-S0048

Test	Document
B.3	JCTVC-S0074
B.4	JCTVC-S0164
B.5	JCTVC-S0132
C.1	JCTVC-S0063
C.2	JCTVC-S0078
C.3	JCTVC-S0174
D.1	JCTVC-S0153

Test A.3 (Canon)

- When **palette_index** is larger than a CU-level signalled threshold, the **palette_run** is not signalled.

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.4%	-0.4%	-0.4%
RGB, text & graphics with motion, 720p	-0.4%	-0.3%	-0.4%
RGB, mixed content, 1440p	0.0%	0.0%	0.0%
RGB, mixed content, 1080p	-0.1%	-0.1%	-0.1%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.5%	-0.5%	-0.5%
YUV, text & graphics with motion, 720p	-0.3%	-0.4%	-0.4%
YUV, mixed content, 1440p	0.0%	0.1%	0.0%
YUV, mixed content, 1080p	0.0%	0.0%	0.1%
YUV, Animation, 720p	0.0%	0.1%	0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	99%		
Dec Time[%]	101%		

Note: Parsing depends on reconstructed palette index values.

Test A.4 (MediaTek) Techniques

- Binarization for **palette_run** equal to x

- Prefix: $\text{msb_id_plus1} = \text{floor}(\text{Log2}(x)) + 1$, if $x > 0$;
0, otherwise.

truncated unary binarization, due to known maximum context coded

binIdx	0	1	2	3	4	> 4
COPY_ABOVE_MODE	5	6	6	7	7	bypass
INDEX_MODE	0,1,2	3	3	4	4	bypass

- Suffix: **refinement_bits** present when $\text{msb_id_plus1} > 1$
truncated binarization with max. length = $\text{msb_id_plus1} - 1$
 $\text{refinement_bits} = x - (1 \ll (\text{msb_id_plus1} - 1))$
Bypass coded

- Decoder:

$x = (1 \ll (\text{msb_id_plus1} - 1)) + \text{refinement_bits}$, if $\text{msb_id_plus1} > 1$;
 msb_id_plus1 , otherwise.

Test A.4 (MediaTek) Results

- **Test A.4.1:** Parsing depends on **reconstructed** palette index values.
- **Test A.4.2:** Parsing depends on **parsed** palette index values.

Test A.4.1

Test A.4.2

	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-1.6%	-1.6%	-1.6%	-1.5%	-1.5%	-1.6%
RGB, text & graphics with motion,720p	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.8%
RGB, mixed content, 1440p	-0.3%	-0.4%	-0.4%	-0.3%	-0.4%	-0.4%
RGB, mixed content, 1080p	-0.4%	-0.5%	-0.4%	-0.4%	-0.4%	-0.4%
RGB, Animation, 720p	0.0%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-1.9%	-1.9%	-1.9%	-1.8%	-1.8%	-1.9%
YUV, text & graphics with motion,720p	-1.1%	-1.1%	-1.4%	-1.0%	-1.0%	-1.3%
YUV, mixed content, 1440p	-0.5%	-0.8%	-0.9%	-0.5%	-0.7%	-0.9%
YUV, mixed content, 1080p	-0.5%	-0.9%	-0.8%	-0.5%	-0.8%	-0.8%
YUV, Animation, 720p	0.0%	-0.3%	-0.3%	0.0%	-0.3%	-0.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			102%		

Test A.5 (Qualcomm)

- Two additional contexts to code the 'greater than zero' bin for 'INDEX' runs

Index	0	[1, 2]	Greater than 2
Run context	0	1	2

- Test A.5.1:** Parsing depends on **reconstructed** palette index values.
- Test A.5.2:** Parsing depends on **parsed** palette index values.

Test A.5.1

Test A.5.2

	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.6%	-0.6%	-0.6%	-0.5%	-0.5%	-0.5%
RGB, text & graphics with motion, 720p	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%
RGB, mixed content, 1440p	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%
RGB, mixed content, 1080p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.6%	-0.7%	-0.7%	-0.6%	-0.6%	-0.6%
YUV, text & graphics with motion, 720p	-0.3%	-0.4%	-0.4%	-0.2%	-0.3%	-0.4%
YUV, mixed content, 1440p	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.2%
YUV, mixed content, 1080p	-0.1%	-0.2%	-0.2%	-0.1%	-0.2%	-0.1%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Test A.6 (Qualcomm) Techniques

- Binarization for **palette_run**
 - Concatenation of unary code and exponential Golomb code of order 0 (switching point at 1)

Symbol	Prefix	Suffix	length
0	1		1
1	01		2
[2, 3]	001	X	4
[4, 7]	0001	XX	6
...			

- Since maximum is known, truncated codewords are used.
- The first 3 prefix bins are context coded, while the rest bins are bypass coded.
- **Binarization of Test A.4 is exactly the same as that of Test A.6**, and only context formation methods are different.

Test A.6 (Qualcomm) Results

- In addition to Test A.6, the combination of Test A.5.1 and Test A.6 is also tested.

Test A.6

Test A.5.1 + Test A.6

	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.8%	-0.8%	-0.8%	-1.4%	-1.4%	-1.4%
RGB, text & graphics with motion, 720p	-0.5%	-0.5%	-0.5%	-0.8%	-0.9%	-0.8%
RGB, mixed content, 1440p	-0.2%	-0.2%	-0.3%	-0.3%	-0.4%	-0.4%
RGB, mixed content, 1080p	-0.2%	-0.3%	-0.2%	-0.4%	-0.4%	-0.4%
RGB, Animation, 720p	0.0%	-0.1%	-0.1%	0.0%	0.0%	-0.1%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-1.1%	-1.0%	-1.0%	-1.7%	-1.7%	-1.7%
YUV, text & graphics with motion, 720p	-0.5%	-0.5%	-0.6%	-1.0%	-1.0%	-1.2%
YUV, mixed content, 1440p	-0.3%	-0.5%	-0.6%	-0.4%	-0.7%	-0.8%
YUV, mixed content, 1080p	-0.3%	-0.4%	-0.5%	-0.5%	-0.7%	-0.8%
YUV, Animation, 720p	0.0%	-0.3%	-0.2%	0.0%	-0.2%	-0.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note: Parsing depends on reconstructed palette index values in Test A.5.1.

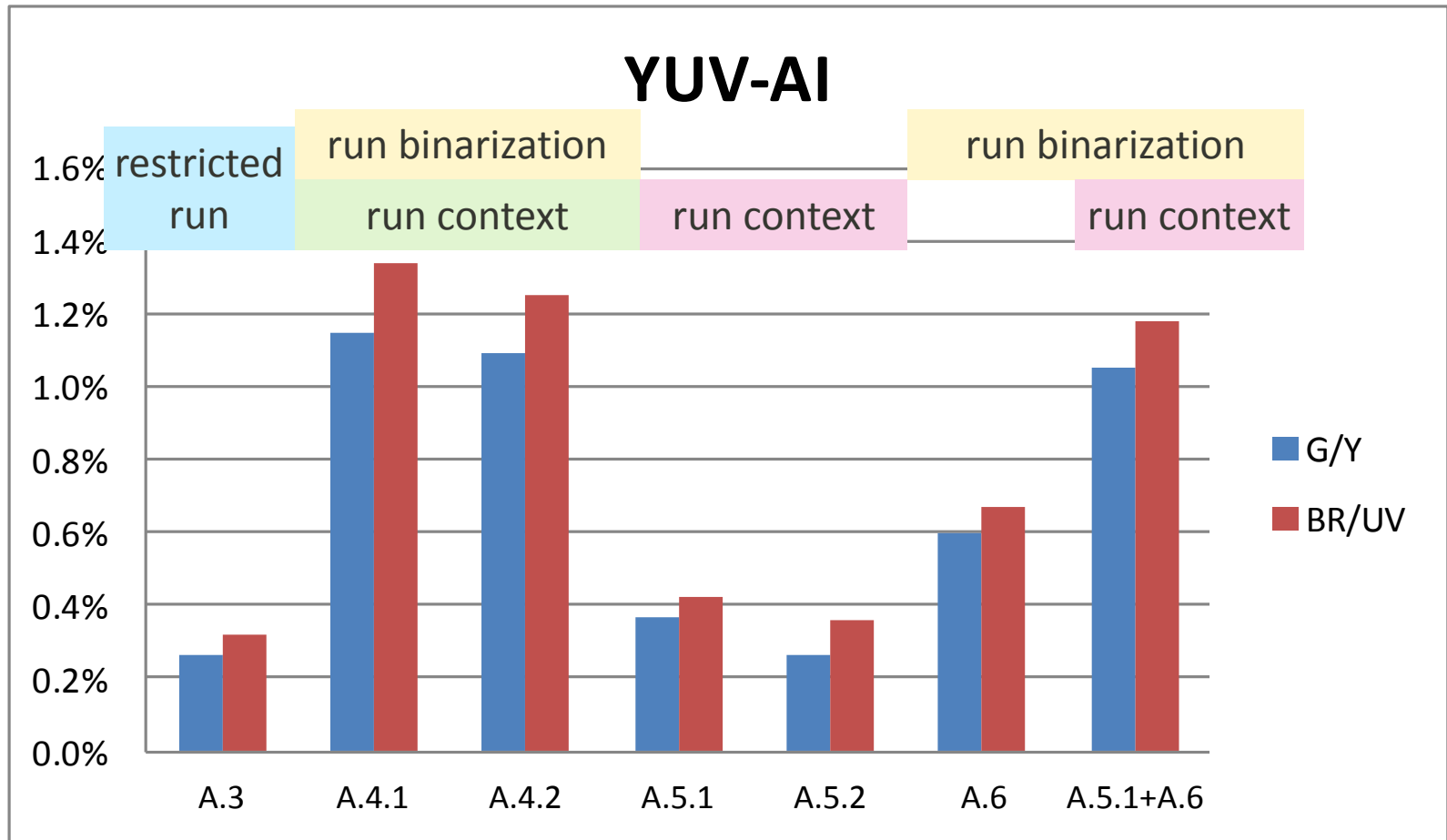
Results of Category A Tests

- B/U and R/V are averaged.

	A3		A4.1		A4.2		A5.1		A5.2		A6		A5.1+A6	
	All Intra		All Intra		All Intra		All Intra		All Intra		All Intra		All Intra	
	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV
RGB, text & grapHcs with motion, 1080p	-0.4%	-0.4%	-1.6%	-1.6%	-1.5%	-1.5%	-0.6%	-0.6%	-0.5%	-0.5%	-0.8%	-0.8%	-1.4%	-1.4%
RGB, text & grapHcs with motion,720p	-0.4%	-0.4%	-0.9%	-0.9%	-0.9%	-0.9%	-0.4%	-0.4%	-0.3%	-0.3%	-0.5%	-0.5%	-0.8%	-0.8%
RGB, mixed content, 1440p	0.0%	0.0%	-0.3%	-0.4%	-0.3%	-0.4%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.3%	-0.3%	-0.4%
RGB, mixed content, 1080p	-0.1%	-0.1%	-0.4%	-0.4%	-0.4%	-0.4%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.3%	-0.4%	-0.4%
RGB, Animation, 720p	0.0%	0.0%	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	-0.1%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & grapHcs with motion, 1080p	-0.5%	-0.5%	-1.9%	-1.9%	-1.8%	-1.8%	-0.6%	-0.7%	-0.6%	-0.6%	-1.1%	-1.0%	-1.7%	-1.7%
YUV, text & grapHcs with motion,720p	-0.3%	-0.4%	-1.1%	-1.2%	-1.0%	-1.1%	-0.3%	-0.4%	-0.2%	-0.3%	-0.5%	-0.6%	-1.0%	-1.1%
YUV, mixed content, 1440p	0.0%	0.1%	-0.5%	-0.9%	-0.5%	-0.8%	-0.1%	-0.1%	-0.1%	-0.1%	-0.3%	-0.5%	-0.4%	-0.7%
YUV, mixed content, 1080p	0.0%	0.0%	-0.5%	-0.9%	-0.5%	-0.8%	-0.1%	-0.2%	-0.1%	-0.2%	-0.3%	-0.5%	-0.5%	-0.7%
YUV, Animation, 720p	0.0%	0.1%	0.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.2%	0.0%	-0.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Comparison of Category A Tests

- BD-rate savings of the first four classes are averaged.



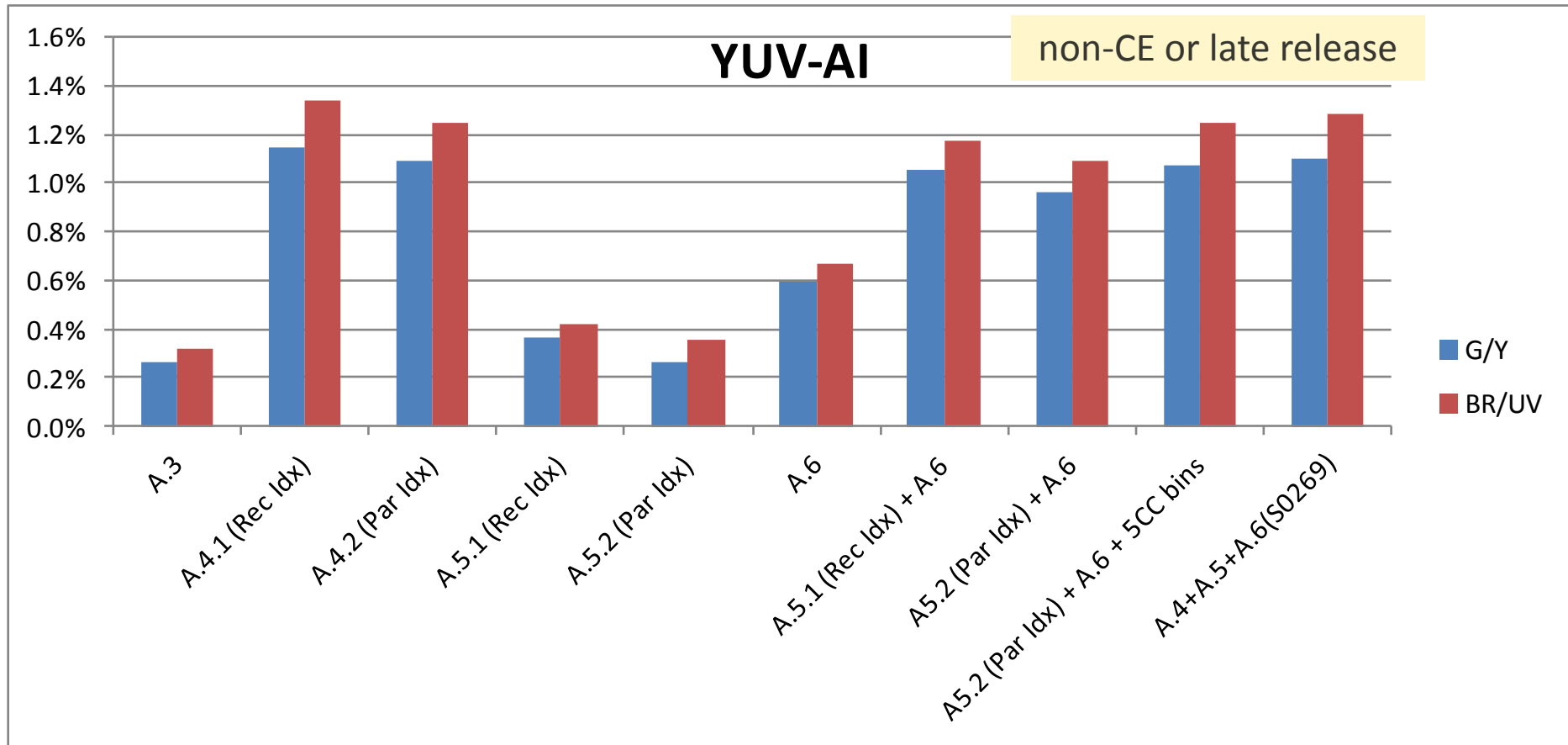
Parsing depends on reconstructed palette index values in Tests A.3, A.4.1, A.5.1, and A.5.1+A.6.

Category A Remarks

- In Tests A.3, A.4.1, and A.5.1, parsing depends on reconstructed palette index values.
- Tests A.4.2, A.5.2, and A.6 show acceptable gain-complexity tradeoffs.
- Additional Test A.6 results were released late on Oct. 15.
 - Not crosschecked
- Related non-CE proposal: JCTVC-S0269
 - Harmonization of Tests A.4, A.5, and A.6

Comparison with Cat. A Related Non-CE

- BD-rate savings of the first four classes are averaged.



Parsing depends on reconstructed palette index values in Tests A.3, A.4.1, A.5.1, and A.5.1+A.6.

Test B.1 (Qualcomm)

- Context coded bin for CU-level escape colour flag
- Test B.1.1:** Two contexts by checking whether `palette_size < max_palette_size`
- Test B.1.2:** Single context

Test B.1.1

Test B.1.2

	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.1%	0.0%	-0.1%	-0.1%	0.0%	-0.1%
RGB, text & graphics with motion, 720p	-0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%
RGB, mixed content, 1440p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, mixed content, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.2%	-0.1%	-0.2%	-0.2%	-0.1%	-0.2%
YUV, text & graphics with motion, 720p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%
YUV, mixed content, 1440p	0.0%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%
YUV, mixed content, 1080p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Test B.2 (ITRI)

- Non-normative and encoder-only
- In addition to the the original size of major colour table (M), search M-1, M-2, and M-3 using RDO

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.3%	-0.3%	-0.3%
RGB, text & graphics with motion, 720p	-0.3%	-0.3%	-0.2%
RGB, mixed content, 1440p	-0.2%	-0.2%	-0.3%
RGB, mixed content, 1080p	-0.3%	-0.4%	-0.3%
RGB, Animation, 720p	0.0%	-0.1%	-0.1%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.2%	-0.5%	-0.5%
YUV, text & graphics with motion, 720p	-0.2%	-0.3%	-0.6%
YUV, mixed content, 1440p	-0.1%	-0.5%	-0.5%
YUV, mixed content, 1080p	-0.1%	-0.3%	-0.4%
YUV, Animation, 720p	0.0%	-0.3%	-0.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	103%		
Dec Time[%]	99%		

Test B.3 (University of Hanover)

- The most significant bin of the palette_index syntax element is context coded.

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.1%	-0.1%	-0.1%
RGB, text & graphics with motion, 720p	-0.1%	0.0%	0.0%
RGB, mixed content, 1440p	0.0%	0.0%	0.0%
RGB, mixed content, 1080p	0.0%	0.0%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.1%	-0.1%	-0.1%
YUV, text & graphics with motion, 720p	0.0%	-0.1%	0.0%
YUV, mixed content, 1440p	0.0%	0.0%	0.0%
YUV, mixed content, 1080p	0.0%	0.0%	0.0%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	102%		
Dec Time[%]	99%		

Test B.4 (MediaTek)

- Use the binarization of palette_run in Test A.4 for the binarization of palette_index
- Use up to 5 context coded bins for palette_index

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.1%	-0.1%	-0.1%
RGB, text & graphics with motion, 720p	0.0%	-0.1%	0.0%
RGB, mixed content, 1440p	0.1%	0.1%	0.1%
RGB, mixed content, 1080p	0.0%	0.1%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.1%	-0.1%	-0.1%
YUV, text & graphics with motion, 720p	0.0%	-0.1%	0.0%
YUV, mixed content, 1440p	0.1%	0.1%	0.1%
YUV, mixed content, 1080p	0.1%	0.1%	0.1%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	100%		
Dec Time[%]	100%		

Test B.5 (InterDigital)

- An explicit flag to indicate if the current escape colour pixel is the same as the previous escape colour pixel. If not, predict the current escape colour from an entry in the palette table and a previous coded escape colour.

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.2%	-0.1%	-0.1%
RGB, text & graphics with motion, 720p	-0.2%	-0.1%	-0.1%
RGB, mixed content, 1440p	-0.1%	0.0%	-0.1%
RGB, mixed content, 1080p	-0.1%	0.0%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.1%	-0.2%	-0.2%
YUV, text & graphics with motion, 720p	0.0%	0.0%	0.0%
YUV, mixed content, 1440p	0.0%	0.0%	0.0%
YUV, mixed content, 1080p	0.0%	0.0%	-0.1%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	113%		
Dec Time[%]	101%		

Up to 4% bit saving for lossless all intra with 22% encoding time increase

Is run time accurate?

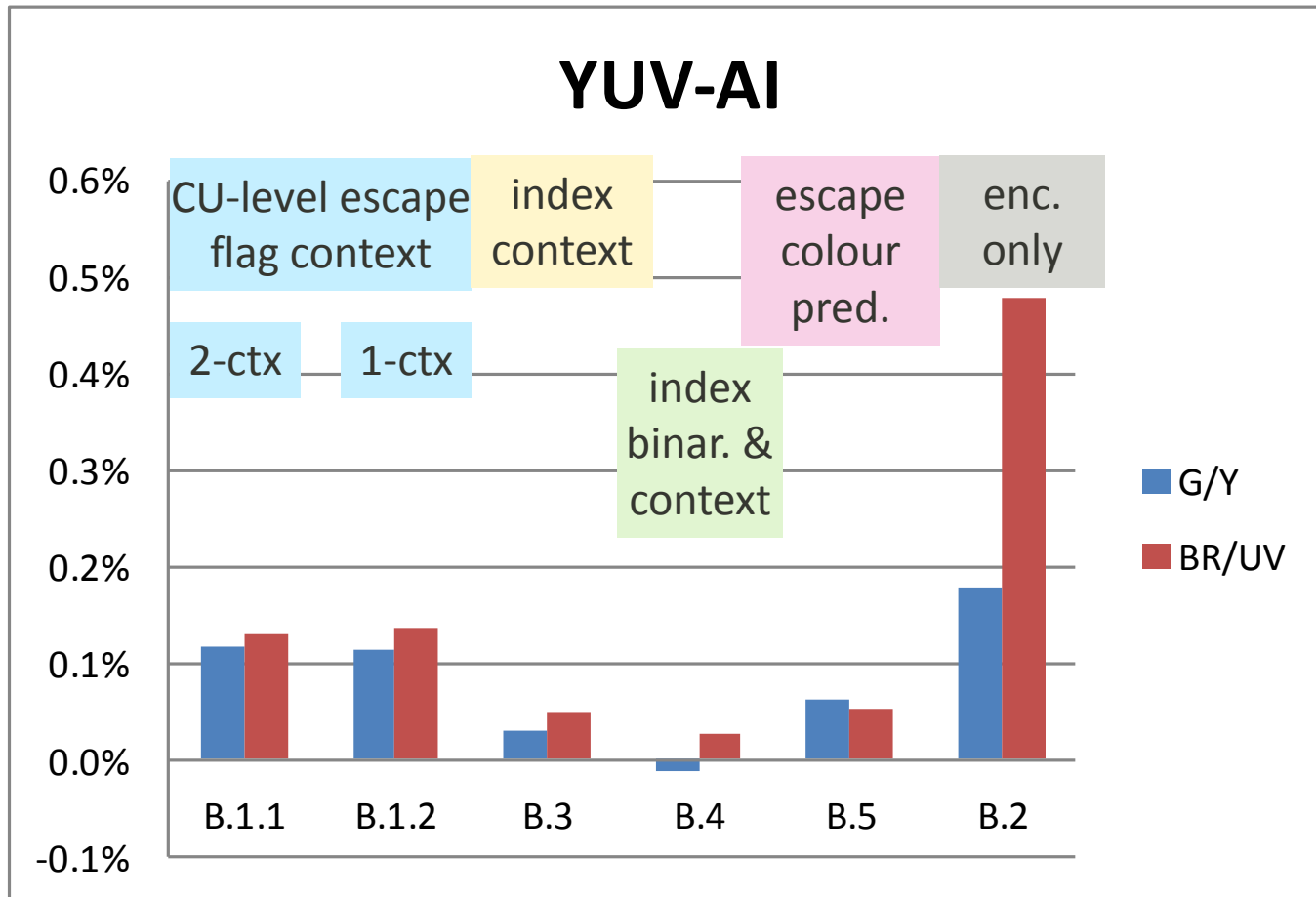
Results of Category B Tests

- B/U and R/V are averaged.

	B.1.1		B.1.2		B.2		B.3		B.4		B.5	
	All Intra		All Intra		All Intra		All Intra		All Intra		All Intra	
	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV
RGB, text & graphcs with motion, 1080p	-0.1%	0.0%	-0.1%	0.0%	-0.3%	-0.3%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%
RGB, text & graphcs with motion, 720p	-0.1%	0.0%	-0.1%	0.0%	-0.3%	-0.2%	-0.1%	0.0%	0.0%	0.0%	-0.2%	-0.1%
RGB, mixed content, 1440p	0.0%	0.0%	0.0%	0.0%	-0.2%	-0.2%	0.0%	0.0%	0.1%	0.1%	-0.1%	0.0%
RGB, mixed content, 1080p	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphcs with motion, 1080p	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.5%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%
YUV, text & graphcs with motion, 720p	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.5%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
YUV, mixed content, 1440p	0.0%	-0.1%	0.0%	-0.1%	-0.1%	-0.5%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
YUV, mixed content, 1080p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.3%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	102%		104%		103%		102%		100%		113%	
Dec Time[%]	103%		104%		99%		99%		100%		101%	

Comparison of Category B Tests

- BD-rate savings of the first four classes are averaged.

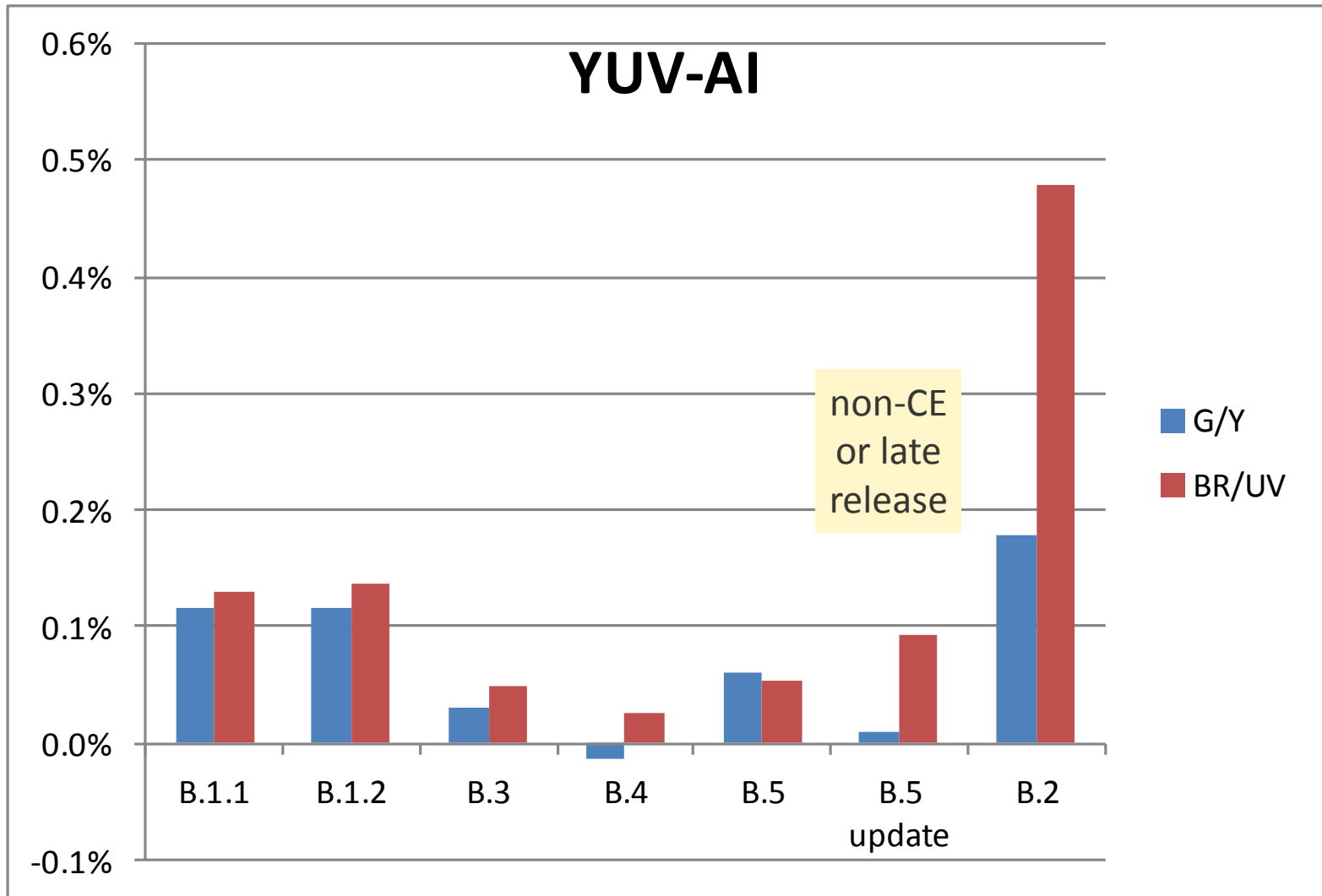


Category B Remarks

- Category B gains are not attractive in lossy conditions.
- Test B.5 has up to 4% bit saving in lossless conditions but with 22% encoding time increase.
- Updated Test B.5 results were released late on Oct. 14.
 - Not crosschecked

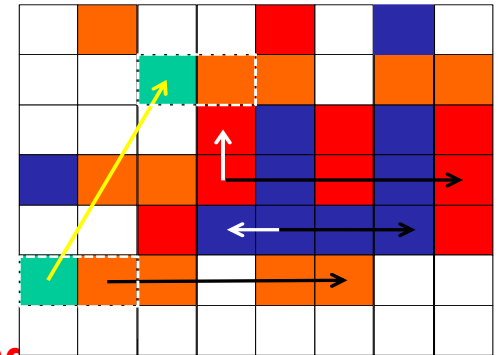
Comparison with Cat. B Related Non-CE

- BD-rate savings of the first four classes are averaged.



Test C.1 (Canon)

- Store the “last transition pixel” of pilot pixel
- Transition copy (TC) + run: Repeat the stored samples for N times
- Restricted TC syntax
 - TC syntax presence depends on reconstructed palette index values.**
- An RDO parameter is changed.



	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.6%	-0.7%	-0.7%
RGB, text & graphics with motion, 720p	-0.4%	-0.4%	-0.4%
RGB, mixed content, 1440p	-0.1%	-0.1%	-0.1%
RGB, mixed content, 1080p	-0.2%	-0.3%	-0.3%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.8%	-0.9%	-0.9%
YUV, text & graphics with motion, 720p	-0.2%	-0.5%	-0.4%
YUV, mixed content, 1440p	-0.1%	-0.2%	-0.2%
YUV, mixed content, 1080p	-0.1%	-0.4%	-0.3%
YUV, Animation, 720p	0.0%	-0.1%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	99%		
Dec Time[%]	100%		

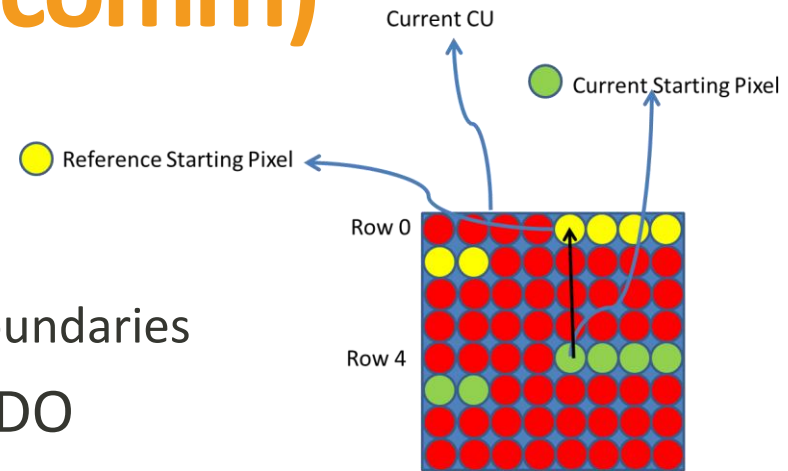
Test C.2 (MediaTek)

- Main concept similar to Test C.1,
- TC table inheritance from the last palette CU
- Maintain TC tables according to traverse scan
- TC syntax presence is independent of palette indices.
 - When a TC predictor is redundant, use a replacement predictor.
- An RDO parameter is changed.

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-1.1%	-1.2%	-1.2%
RGB, text & graphics with motion, 720p	-0.8%	-0.8%	-0.8%
RGB, mixed content, 1440p	-0.1%	-0.1%	-0.1%
RGB, mixed content, 1080p	-0.2%	-0.3%	-0.3%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-1.2%	-1.4%	-1.4%
YUV, text & graphics with motion, 720p	-0.4%	-0.8%	-1.0%
YUV, mixed content, 1440p	0.0%	-0.2%	-0.2%
YUV, mixed content, 1080p	-0.1%	-0.4%	-0.4%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	105%		
Dec Time[%]	101%		

Test C.3 (Qualcomm)

- Copy-previous-row (CPR) mode
 - Run and row index are both signalled.
 - No index prediction/copy across CU boundaries
- A more accurate bit estimation in RDO processes is applied.



	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-1.2%	-1.4%	-1.4%
RGB, text & graphics with motion, 720p	-0.6%	-0.7%	-0.7%
RGB, mixed content, 1440p	-0.1%	-0.2%	-0.2%
RGB, mixed content, 1080p	-1.2%	-1.6%	-1.3%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-1.4%	-1.5%	-1.5%
YUV, text & graphics with motion, 720p	-0.5%	-0.7%	-1.0%
YUV, mixed content, 1440p	-0.3%	-0.7%	-0.6%
YUV, mixed content, 1080p	-1.2%	-3.3%	-2.7%
YUV, Animation, 720p	0.0%	-0.1%	-0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	103%		
Dec Time[%]	100%		

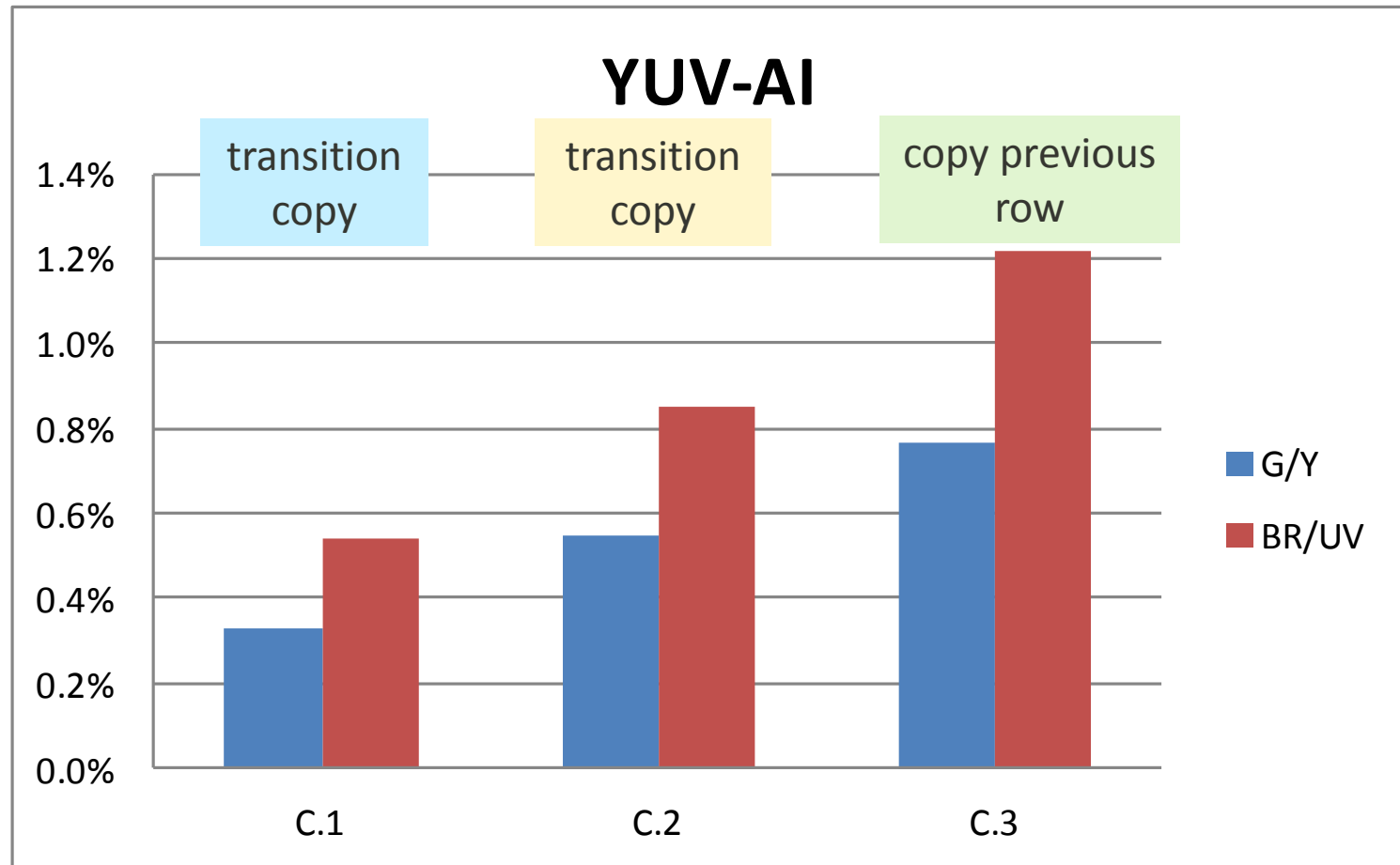
Results of Category C Tests

- B/U and R/V are averaged.

	C.1		C.2		C.3	
	All Intra		All Intra		All Intra	
	G/Y	BR/UV	G/Y	BR/UV	G/Y	BR/UV
RGB, text & graphCs with motion, 1080p	-0.6%	-0.7%	-1.1%	-1.2%	-1.2%	-1.4%
RGB, text & graphCs with motion, 720p	-0.4%	-0.4%	-0.8%	-0.8%	-0.6%	-0.7%
RGB, mixed content, 1440p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%
RGB, mixed content, 1080p	-0.2%	-0.3%	-0.2%	-0.3%	-1.2%	-1.4%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphCs with motion, 1080p	-0.8%	-0.9%	-1.2%	-1.4%	-1.4%	-1.5%
YUV, text & graphCs with motion, 720p	-0.2%	-0.5%	-0.4%	-0.9%	-0.5%	-0.8%
YUV, mixed content, 1440p	-0.1%	-0.2%	0.0%	-0.2%	-0.3%	-0.7%
YUV, mixed content, 1080p	-0.1%	-0.4%	-0.1%	-0.4%	-1.2%	-3.0%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	99%		105%		103%	
Dec Time[%]	100%		101%		100%	

Comparison of Category C Tests

- BD-rate savings of the first four classes are averaged.



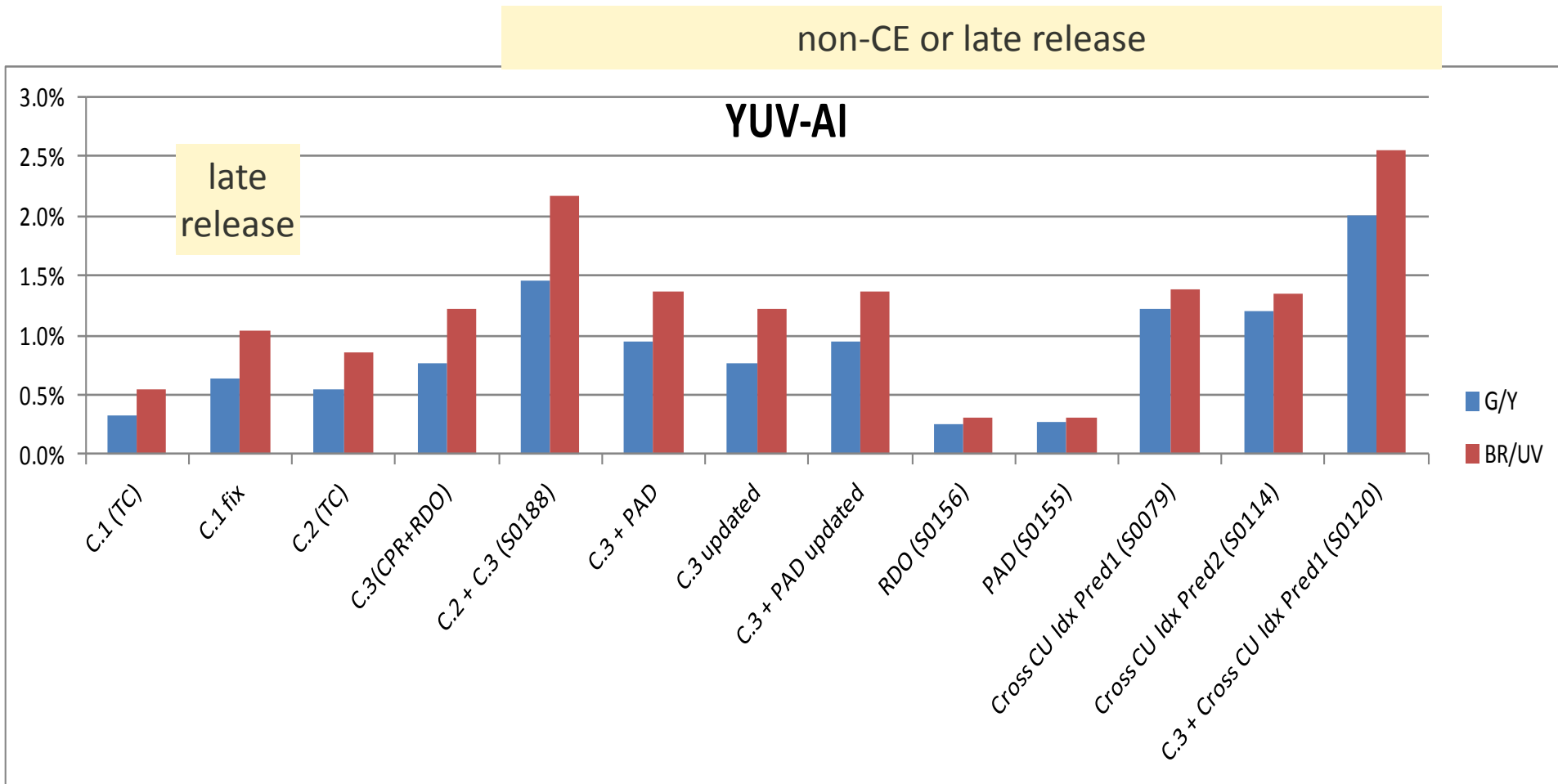
Parsing depends on reconstructed palette index values in Test C.1.

Category C Remarks

- Both transition copy (TC) and copy-previous-row (CPR) can provide non-trivial gains, and the gains are additive (shown later).
- Fixed Test C.1 results were released late on Oct. 6.
 - As Test C.2, maintain TC tables according to traverse scan
 - Not crosschecked
- Additional Test C.3 results
 - Test C.3 with padding was released on Aug. 24
 - Updated Test C.3 was released on Oct. 8 (not crosschecked)
 - Updated Test C.3 with padding was released on Oct. 8 (not crosschecked)
- Related non-CE proposals:
 - Padding only (JCTVC-S0155), RDO only (JCTVC-S0156), C.2+C.3 (JCTVC-S0188), cross-CU index prediction (JCTVC-S0079/S0114), C.3 with cross-CU index prediction (JCTVC-S0120)

Comparison with Cat. C Related Non-CE

- BD-rate savings of the first four classes are averaged.



Parsing depends on reconstructed palette index values in Tests C.1 & C.1-fix.

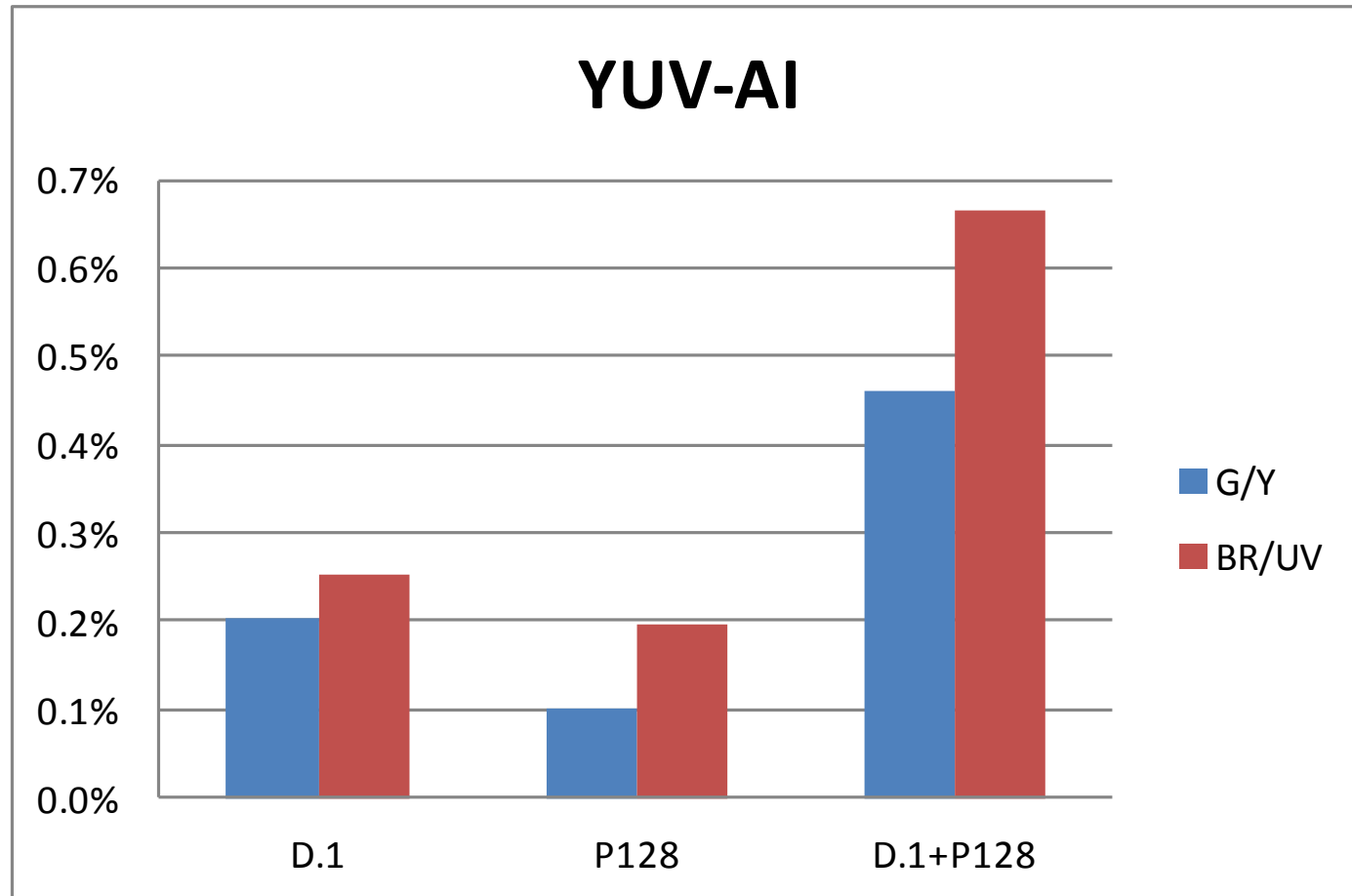
Test D.1 (Qualcomm)

- Run-length coding for palette reuse flags

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-0.2%	-0.2%	-0.3%
RGB, text & graphics with motion, 720p	-0.2%	-0.2%	-0.2%
RGB, mixed content, 1440p	-0.1%	-0.1%	-0.1%
RGB, mixed content, 1080p	-0.1%	-0.1%	-0.1%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-0.3%	-0.3%	-0.3%
YUV, text & graphics with motion, 720p	-0.2%	-0.2%	-0.3%
YUV, mixed content, 1440p	-0.1%	-0.2%	-0.2%
YUV, mixed content, 1080p	-0.1%	-0.2%	-0.2%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	100%		
Dec Time[%]	100%		

Test D.1 (Qualcomm) Additional Results

- The gain will increase if the palette predictor size increases from 64 to 128.



Category D Remarks

- In comparison with the current SCM-2.0 palette reuse flag coding, the run-length coding method for palette reuse flags has higher gain and can significantly simplify text specification.

THANK YOU