

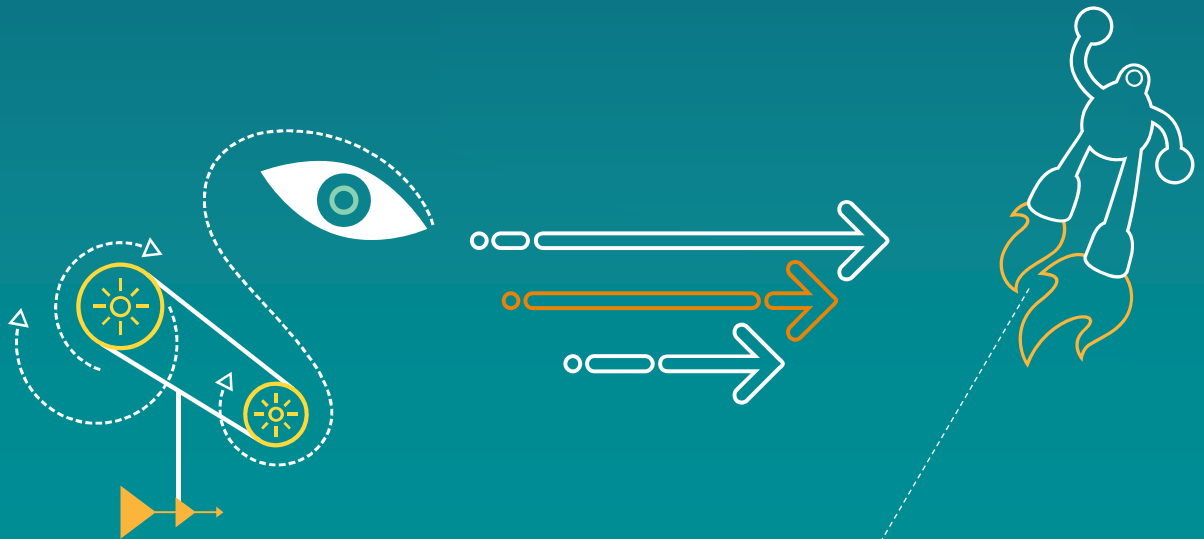
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**JCTVC-R0229**

**Non-SCCE3: Palette predictor resetting**

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# Palette predictor resetting in SCCE3 base SW

- Predictor is reset (length is zero) at every CTB row in SCCE3 base software

PltPred = {0}				
...			CTB	
PltPred = {0}				

- Up to 1.2% loss

SCCE3 C4v3

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.2%	-10.9%	-10.7%
RGB, text & graphics with motion, 720p	-9.6%	-8.4%	-8.6%
RGB, mixed content, 1440p	-5.2%	-4.2%	-4.4%
RGB, mixed content, 1080p	-5.2%	-4.9%	-4.8%
RGB, Animation, 720p	-0.2%	-0.6%	-0.7%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-13.0%	-12.7%
YUV, text & graphics with motion, 720p	-6.4%	-9.3%	-11.3%
YUV, mixed content, 1440p	-4.1%	-8.8%	-9.1%
YUV, mixed content, 1080p	-4.8%	-9.3%	-9.3%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	104%		
Dec Time[%]	98%		

C4v3 with reset

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-10.4%	-10.1%	-9.9%
RGB, text & graphics with motion, 720p	-8.3%	-7.1%	-7.2%
RGB, mixed content, 1440p	-4.7%	-3.7%	-3.9%
RGB, mixed content, 1080p	-4.8%	-4.6%	-4.5%
RGB, Animation, 720p	-0.1%	-0.5%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-10.3%	-11.8%	-11.5%
YUV, text & graphics with motion, 720p	-5.1%	-7.6%	-9.4%
YUV, mixed content, 1440p	-3.4%	-7.4%	-8.0%
YUV, mixed content, 1080p	-4.1%	-7.8%	-8.6%
YUV, Animation, 720p	0.1%	-1.3%	-1.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	103%		
Dec Time[%]	98%		

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# Proposed modification (#1)

- Palette predictor reset is applied only in the following cases:
  - In the beginning of each slice
  - In the beginning of each tile
  - For each CTB row when wavefront is enabled
- Signal a PPS flag to indicate palette predictor reset at every CTB row
  - To enable encoder parallelization
- Advantage
  - Performance improvement up to 1.2% based on SCCE3 C4v3 test
  - Keep palette predictor reset for parallel processing

# Flexible palette predictor resetting (#2)

- Palette predictor reset is applied as in #1
- Palette predictor is reset if current CU doesn't have predicted entries
  - For encoder parallelization
- Advantage
  - Performance improvement up to 1.2% based on SCCE3 C4v3 test
  - Keep palette predictor reset for parallel processing
  - Encoder can control palette predictor

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.2%	-10.9%	-10.7%
RGB, text & graphics with motion,720p	-9.6%	-8.4%	-8.6%
RGB, mixed content, 1440p	-5.2%	-4.2%	-4.4%
RGB, mixed content, 1080p	-5.2%	-4.9%	-4.8%
RGB, Animation, 720p	-0.2%	-0.6%	-0.7%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-13.0%	-12.7%
YUV, text & graphics with motion,720p	-6.4%	-9.3%	-11.3%
YUV, mixed content, 1440p	-4.1%	-8.8%	-9.1%
YUV, mixed content, 1080p	-4.8%	-9.3%	-9.3%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	104%		
Dec Time[%]	98%		

C4v3

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.1%	-10.7%	-10.6%
RGB, text & graphics with motion,720p	-9.5%	-8.2%	-8.4%
RGB, mixed content, 1440p	-4.9%	-3.9%	-4.1%
RGB, mixed content, 1080p	-5.0%	-4.7%	-4.7%
RGB, Animation, 720p	-0.2%	-0.5%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-12.9%	-12.6%
YUV, text & graphics with motion,720p	-6.3%	-9.1%	-11.1%
YUV, mixed content, 1440p	-3.9%	-8.4%	-8.7%
YUV, mixed content, 1080p	-4.7%	-9.0%	-9.1%
YUV, Animation, 720p	0.1%	-1.3%	-1.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	105%		
Dec Time[%]	99%		

C4v3 with flexible reset

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# Conclusion

- No CTB palette predictor reset brings up to 1.2% luma BD-rate gain
- Only CTB resetting is not enough for parallel entropy coding
  - Slices and tiles should be considered
- Proposed methods:
  - #1: signal a flag to indicate a palette predictor reset
  - #2: reset a predictor if predicted palette entries are not used

# CTB palette predictor reset (lossy)

## Full Frame IBC

	C4v3			C4v3 with CTB reset		
	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.2%	-10.9%	-10.7%	-10.4%	-10.1%	-9.9%
RGB, text & graphics with motion,720p	-9.6%	-8.4%	-8.6%	-8.3%	-7.1%	-7.2%
RGB, mixed content, 1440p	-5.2%	-4.2%	-4.4%	-4.7%	-3.7%	-3.9%
RGB, mixed content, 1080p	-5.2%	-4.9%	-4.8%	-4.8%	-4.6%	-4.5%
RGB, Animation, 720p	-0.2%	-0.6%	-0.7%	-0.1%	-0.5%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-13.0%	-12.7%	-10.3%	-11.8%	-11.5%
YUV, text & graphics with motion,720p	-6.4%	-9.3%	-11.3%	-5.1%	-7.6%	-9.4%
YUV, mixed content, 1440p	-4.1%	-8.8%	-9.1%	-3.4%	-7.4%	-8.0%
YUV, mixed content, 1080p	-4.8%	-9.3%	-9.3%	-4.1%	-7.8%	-8.6%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%	0.1%	-1.3%	-1.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	104%			103%		
Dec Time[%]	98%			98%		

## 2CTU IBC

	C4v3			C4v3 with CTB reset		
	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-13.2%	-12.8%	-12.7%	-12.7%	-12.3%	-12.2%
RGB, text & graphics with motion,720p	-11.5%	-10.3%	-10.6%	-10.7%	-9.4%	-9.6%
RGB, mixed content, 1440p	-6.8%	-5.7%	-5.9%	-6.4%	-5.3%	-5.5%
RGB, mixed content, 1080p	-7.4%	-7.0%	-7.1%	-7.1%	-6.7%	-6.8%
RGB, Animation, 720p	-0.3%	-0.6%	-0.7%	-0.2%	-0.5%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-13.6%	-15.1%	-14.9%	-13.0%	-14.4%	-14.2%
YUV, text & graphics with motion,720p	-8.4%	-11.1%	-13.1%	-7.5%	-9.8%	-11.7%
YUV, mixed content, 1440p	-5.8%	-10.7%	-11.0%	-5.2%	-9.5%	-10.0%
YUV, mixed content, 1080p	-7.3%	-12.1%	-12.1%	-6.7%	-11.3%	-11.7%
YUV, Animation, 720p	0.1%	-1.5%	-1.3%	0.1%	-1.3%	-1.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	101%			103%		
Dec Time[%]	95%			97%		

# Flexible palette predictor reset (lossy)

## Full Frame IBC

	C4v3			C4v3 with flexible reset		
	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.2%	-10.9%	-10.7%	-11.1%	-10.7%	-10.6%
RGB, text & graphics with motion,720p	-9.6%	-8.4%	-8.6%	-9.5%	-8.2%	-8.4%
RGB, mixed content, 1440p	-5.2%	-4.2%	-4.4%	-4.9%	-3.9%	-4.1%
RGB, mixed content, 1080p	-5.2%	-4.9%	-4.8%	-5.0%	-4.7%	-4.7%
RGB, Animation, 720p	-0.2%	-0.6%	-0.7%	-0.2%	-0.5%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-13.0%	-12.7%	-11.5%	-12.9%	-12.6%
YUV, text & graphics with motion,720p	-6.4%	-9.3%	-11.3%	-6.3%	-9.1%	-11.1%
YUV, mixed content, 1440p	-4.1%	-8.8%	-9.1%	-3.9%	-8.4%	-8.7%
YUV, mixed content, 1080p	-4.8%	-9.3%	-9.3%	-4.7%	-9.0%	-9.1%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%	0.1%	-1.3%	-1.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	104%			105%		
Dec Time[%]	98%			99%		

## 2CTU IBC

	C4v3			C4v3 with flexible reset		
	All Intra			All Intra		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-13.2%	-12.8%	-12.7%	-13.1%	-12.7%	-12.5%
RGB, text & graphics with motion,720p	-11.5%	-10.3%	-10.6%	-11.4%	-10.2%	-10.5%
RGB, mixed content, 1440p	-6.8%	-5.7%	-5.9%	-6.5%	-5.5%	-5.6%
RGB, mixed content, 1080p	-7.4%	-7.0%	-7.1%	-7.3%	-6.8%	-6.9%
RGB, Animation, 720p	-0.3%	-0.6%	-0.7%	-0.2%	-0.6%	-0.6%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-13.6%	-15.1%	-14.9%	-13.6%	-15.1%	-14.9%
YUV, text & graphics with motion,720p	-8.4%	-11.1%	-13.1%	-8.3%	-11.0%	-13.0%
YUV, mixed content, 1440p	-5.8%	-10.7%	-11.0%	-5.6%	-10.5%	-10.7%
YUV, mixed content, 1080p	-7.3%	-12.1%	-12.1%	-7.2%	-11.9%	-12.0%
YUV, Animation, 720p	0.1%	-1.5%	-1.3%	0.1%	-1.4%	-1.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	101%			103%		
Dec Time[%]	95%			97%		

# CTB palette predictor reset (lossless)

C4v3

Full Frame IBC	All Intra			
	Bit-rate saving (Total)	Bit-rate saving (Average)	Bit-rate saving (Min)	Bit-rate saving (Max)
RGB, text & graphics with motion, 1080p	5.5%	5.7%	3.2%	8.6%
RGB, text & graphics with motion, 720p	3.3%	3.3%	0.3%	6.7%
RGB, mixed content, 1440p	0.7%	0.7%	0.7%	0.8%
RGB, mixed content, 1080p	0.7%	0.7%	0.7%	0.7%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	7.0%	7.3%	2.8%	10.3%
YUV, text & graphics with motion, 720p	3.7%	3.9%	0.2%	7.7%
YUV, mixed content, 1440p	0.7%	0.7%	0.5%	1.0%
YUV, mixed content, 1080p	0.6%	0.6%	0.6%	0.6%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	101%			
Dec Time[%]	97%			

C4v3 with CTB reset

All Intra			
Bit-rate saving (Total)	Bit-rate saving (Average)	Bit-rate saving (Min)	Bit-rate saving (Max)
5.0%	5.1%	3.1%	7.6%
3.1%	2.9%	0.1%	6.5%
0.6%	0.6%	0.5%	0.8%
0.6%	0.6%	0.6%	0.6%
0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%
6.4%	6.6%	2.7%	9.3%
3.5%	3.4%	0.1%	7.5%
0.5%	0.5%	0.2%	0.9%
0.6%	0.6%	0.6%	0.6%
0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%
111%			
99%			



# Flexible palette predictor reset (lossless)

C4v3

Full Frame IBC	All Intra			
	Bit-rate saving (Total)	Bit-rate saving (Average)	Bit-rate saving (Min)	Bit-rate saving (Max)
RGB, text & graphics with motion, 1080p	5.5%	5.7%	3.2%	8.6%
RGB, text & graphics with motion, 720p	3.3%	3.3%	0.3%	6.7%
RGB, mixed content, 1440p	0.7%	0.7%	0.7%	0.8%
RGB, mixed content, 1080p	0.7%	0.7%	0.7%	0.7%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	7.0%	7.3%	2.8%	10.3%
YUV, text & graphics with motion, 720p	3.7%	3.9%	0.2%	7.7%
YUV, mixed content, 1440p	0.7%	0.7%	0.5%	1.0%
YUV, mixed content, 1080p	0.6%	0.6%	0.6%	0.6%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	101%			
Dec Time[%]	97%			

C4v3 with flexible reset

All Intra			
Bit-rate saving (Total)	Bit-rate saving (Average)	Bit-rate saving (Min)	Bit-rate saving (Max)
5.2%	5.4%	3.0%	7.9%
3.2%	3.2%	0.2%	6.6%
0.7%	0.7%	0.6%	0.8%
0.6%	0.6%	0.6%	0.6%
0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%
6.7%	7.0%	2.6%	9.5%
3.7%	3.9%	0.1%	7.6%
0.6%	0.7%	0.4%	0.9%
0.6%	0.6%	0.6%	0.6%
0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%
111%			
100%			