

**MEDIATEK**

# JCTVC-U0084 : On Palette Predictor Initialization for Screen Content Coding

Jing Ye, Shan Liu, Shawmin Lei



# Introduction

- In the 20<sup>th</sup> JCT-VC meeting, it was adopted to signal a set of palette predictor initializers in each PPS.
- In current SCM4.0, when `PalettePredInPPSEnabled` is set to be `TRUE` (and `num_palette_predictor_initializer_minus1` is greater than 3):
  - PPS is signalled about every 16 frames for AI configuration;
  - PPS is signalled about every 1 second for RA configuration;
  - PPS is signalled about every 5 seconds for LB configuration.
- It is observed that it may be sufficient to signal a set of palette predictor initializers in SPS for entire sequence.

# Proposed Method

- Proposed to allow signalling a set of palette predictor initializers in SPS to reduce the overhead of signalling them in PPS under some circumstances.
  - When `sps_palette_predictor_initializer_present_flag` is equal to 1, a set of palette predictor initializers are signalled in SPS; otherwise, the entries in the palette predictor are initialized to 0.
  - When `pps_palette_predictor_initializer_present_flag` is equal to 1, a set of palette predictor initializers are signalled in PPS; otherwise, the entries in the palette predictor are inferred to be equal to those specified by the active SPS.

# Changes to Syntax (SPS)

	Descriptor
sps_scc_extensions() {	
.....	
palette_mode_enabled_flag	u(1)
if( palette_mode_enabled_flag ) {	
.....	
sps_palette_predictor_initializer_present_flag	u(1)
if( sps_palette_predictor_initializer_present_flag ) {	
sps_num_palette_predictor_initializer_minus1	ue(v)
numComps = (chroma_format_idc == 0) ? 1 : 3	
for( i = 0; i <= sps_num_palette_predictor_initializer_minus1; i++ )	
for( comp = 0; comp < numComps; comp++ )	
sps_palette_predictor_initializers[ i ][ comp ]	u(v)
}	
}	
.....	
}	

# Changes to Syntax (PPS)

	Descriptor
pps_scc_extensions() {	
.....	
<b>pps_palette_predictor_initializer_present_flag</b>	u(1)
if( <b>pps_palette_predictor_initializer_present_flag</b> ) {	
<b>monochrome_palette_flag</b>	u(1)
<b>luma_bit_depth_entry_minus8</b>	ue(v)
if( !monochrome_palette_flag )	
<b>chroma_bit_depth_entry_minus8</b>	ue(v)
<b>pps_num_palette_predictor_initializer_minus1</b>	ue(v)
numComps = monochrome_palette_flag ? 1 : 3	
for( i = 0; i <= <b>pps_num_palette_predictor_initializer_minus1</b> ; i++ )	
for( comp = 0; comp < numComps; comp++ )	
<b>pps_palette_predictor_initializers[ i ][ comp ]</b>	u(v)
}	
}	

# Changes to Semantics (SPS)

## 7.4.3.2.3 Sequence parameter set screen content coding extensions

**sps\_palette\_predictor\_initializer\_present\_flag** equal to 1 specifies that the sequence palette predictors are initialized using the **sps\_palette\_predictor\_initializers** specified in clause 7.3.2.2.3. **sps\_palette\_predictor\_initializer\_flag** equal to 0 specifies that the entries in the sequence palette predictor are initialized to 0. When not present, the value of **sps\_palette\_predictor\_initializer\_flag** is inferred to be equal to 0.

**sps\_num\_palette\_predictor\_initializer\_minus1** specifies the number of entries in the sequence palette predictor initializer.

It is a requirement of bitstream conformance that the value of **sps\_num\_palette\_predictor\_initializer\_minus1** plus one shall be less than or equal to **PaletteMaxPredictorSize**.

**sps\_palette\_predictor\_initializers[i][comp]** specifies the value of the **comp**-th component of the **i**-th palette entry that is used to initialize the array **PredictorPaletteEntries**. For values of **i** in the range of 0 to **sps\_num\_palette\_predictor\_initializer\_minus1**, inclusive, the value of the **sps\_palette\_predictor\_initializers[i][0]** shall be in the range of 0 to  $(1 \ll \text{BitDepthY}) - 1$ , inclusive, and the values of **sps\_palette\_predictor\_initializers[i][1]** and **sps\_palette\_predictor\_initializers[i][2]** shall be in the range of 0 to  $(1 \ll \text{BitDepth-C}) - 1$ , inclusive.

# Changes to Semantics (PPS)

## 7.4.3.3.3 Picture parameter set screen content coding extensions

**pps\_palette\_predictor\_initializer\_present\_flag** equal to 1 specifies that the **picture** palette predictors are initialized using the **pps\_palette\_predictor\_initializers** specified in clause 7.3.2.3.3. **pps\_palette\_predictor\_initializer\_flag** equal to 0 specifies that the entries in the **picture** palette predictor referring to the PPS are inferred to be equal to those specified by the active SPS. When not present, the value of **pps\_palette\_predictor\_initializer\_flag** is inferred to be equal to 0.

.....

**pps\_num\_palette\_predictor\_initializer\_minus1** specifies the number of entries in the pps palette predictor initializer.

.....

**pps\_palette\_predictor\_initializers[i][comp]** specifies the value of the comp-th component of the i-th palette entry that is used to initialize the array PredictorPaletteEntries. For values of i in the range of 0 to **pps\_num\_palette\_predictor\_initializer\_minus1**, inclusive, the value of the **pps\_palette\_predictor\_initializers[i][0]** shall be in the range of 0 to  $(1 \ll \text{BitDepthEntryY}) - 1$ , inclusive, and the values of **pps\_palette\_predictor\_initializers[i][1]** and **pps\_palette\_predictor\_initializers[i][2]** shall be in the range of 0 to  $(1 \ll \text{BitDepthEntryC}) - 1$ , inclusive.

# Simulation Results (1)

- SCM4.0 anchor, 444 lossy, CTC + SPS palette initializer (proposed)

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, TGM, 1080p & 720p	0.0%	-0.1%	-0.1%	0.0%	-0.3%	-0.2%	-0.5%	-0.6%	-0.5%
RGB, mixed content, 1440p & 1080p	-0.2%	-0.2%	-0.2%	-0.1%	-0.1%	-0.1%	0.0%	0.0%	-0.3%
RGB, Animation, 720p	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%	-0.1%	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%
YUV, TGM, 1080p & 720p	-0.3%	-0.3%	0.1%	-0.1%	-0.2%	0.3%	-0.5%	-0.6%	-0.6%
YUV, mixed content, 1440p & 1080p	-0.3%	-0.4%	-0.4%	-0.1%	-0.4%	-0.4%	-0.4%	-0.3%	-0.7%
YUV, Animation, 720p	-0.1%	-0.4%	-0.4%	-0.1%	-0.4%	-0.2%	0.0%	-0.3%	-0.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%
Enc Time[%]		103%			102%			101%	
Dec Time[%]		99%			99%			101%	

# Simulation Results (2)

- SCM4.0 anchor, 444 lossy, CTC + PalettePredInPPSEnabled

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, TGM, 1080p & 720p	0.0%	-0.2%	0.0%	0.3%	0.0%	0.1%	-0.4%	-0.5%	-0.5%
RGB, mixed content, 1440p & 1080p	-0.1%	-0.2%	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.3%
RGB, Animation, 720p	-0.1%	-0.2%	-0.2%	0.1%	0.0%	0.0%	-0.1%	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%
YUV, TGM, 1080p & 720p	-0.5%	-0.5%	0.0%	0.3%	0.2%	0.7%	-0.5%	-0.5%	-0.5%
YUV, mixed content, 1440p & 1080p	-0.3%	-0.5%	-0.4%	0.0%	-0.3%	-0.4%	-0.4%	-0.3%	-0.7%
YUV, Animation, 720p	0.0%	-0.6%	-0.5%	0.3%	-0.1%	0.0%	0.0%	-0.2%	-0.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%
Enc Time[%]	103%			102%			101%		
Dec Time[%]	102%			102%			101%		

# Simulation Results (3)

- SCM4.0 anchor, 444 lossy, CTC + PPS every 1 second

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, TGM, 1080p & 720p	0.0%	-0.2%	-0.1%	0.3%	0.0%	0.1%	0.0%	-0.1%	-0.1%
RGB, mixed content, 1440p & 1080p	-0.2%	-0.2%	-0.2%	0.0%	0.0%	0.0%	0.2%	0.1%	-0.2%
RGB, Animation, 720p	-0.1%	-0.2%	-0.2%	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, TGM, 1080p & 720p	-0.4%	-0.5%	-0.1%	0.2%	0.2%	0.7%	0.0%	0.0%	0.0%
YUV, mixed content, 1440p & 1080p	-0.3%	-0.5%	-0.4%	0.1%	-0.2%	-0.3%	-0.2%	-0.1%	-0.5%
YUV, Animation, 720p	-0.1%	-0.6%	-0.5%	0.1%	-0.1%	0.0%	0.2%	0.1%	-0.2%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%
Enc Time[%]	102%			101%			102%		
Dec Time[%]	101%			99%			100%		

# Simulation Results (4)

- SCM4.0 anchor, 444 lossy, CTC + PPS every 32 frames

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, TGM, 1080p & 720p	0.0%	-0.2%	-0.1%	0.3%	0.0%	0.2%	0.0%	0.0%	-0.1%
RGB, mixed content, 1440p & 1080p	-0.2%	-0.2%	-0.2%	0.1%	0.1%	0.1%	0.3%	0.2%	0.0%
RGB, Animation, 720p	-0.1%	-0.2%	-0.2%	0.1%	0.0%	0.0%	0.0%	0.1%	0.2%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
YUV, TGM, 1080p & 720p	-0.4%	-0.5%	0.0%	0.3%	0.3%	0.8%	0.1%	0.1%	0.1%
YUV, mixed content, 1440p & 1080p	-0.3%	-0.4%	-0.4%	0.2%	-0.1%	-0.1%	0.1%	0.2%	-0.2%
YUV, Animation, 720p	-0.1%	-0.5%	-0.5%	0.2%	-0.1%	0.1%	0.2%	-0.1%	-0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.1%	0.0%	-0.1%	0.0%	0.0%	0.1%
Enc Time[%]	102%			102%			101%		
Dec Time[%]	100%			100%			99%		

# Simulation Results (5)

- SCM4.0 anchor, 444 lossy, CTC + PPS every 16 frames

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, TGM, 1080p & 720p	0.0%	-0.2%	0.0%	0.6%	0.3%	0.5%	0.5%	0.4%	0.5%
RGB, mixed content, 1440p & 1080p	-0.1%	-0.2%	-0.2%	0.2%	0.2%	0.2%	0.5%	0.5%	0.2%
RGB, Animation, 720p	-0.1%	-0.2%	-0.2%	0.2%	0.2%	0.2%	0.0%	0.2%	0.2%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%
YUV, TGM, 1080p & 720p	-0.5%	-0.5%	0.0%	0.7%	0.6%	1.1%	0.7%	0.6%	0.6%
YUV, mixed content, 1440p & 1080p	-0.3%	-0.5%	-0.4%	0.5%	0.2%	0.1%	0.5%	0.6%	0.2%
YUV, Animation, 720p	0.0%	-0.6%	-0.5%	0.4%	0.1%	0.3%	0.4%	0.1%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.1%	0.0%	-0.1%	0.0%	0.0%	0.1%
Enc Time[%]	102%			102%			102%		
Dec Time[%]	100%			100%			100%		

# Conclusion

- This document proposes to allow signalling a set of palette predictor initializers in SPS in addition to current PPS signalling scheme.
- Experimental results report B-D rate savings by using the proposed method.
- Thanks to Intel for crosscheck. (JCTVC-U0130)
- Recommend to include the proposed method in SCM and WD.