



# JCTVC-X0050

## AHG13: $IC_T C_P$ Compression Using HEVC Main 10

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# Background

- $IC_T C_P$  colour representation is specified in the ITU-R Draft New Recommendation BT.[HDR-TV].
  - JCTVC-W0050: overview of  $IC_T C_P$ 
    - Better Performance for Large Color Volumes
      - Constant Intensity
      - Constant Hues
      - Perceptually Uniform
      - Improved Baseband Quantization
    - Same Operations as NCL Y'CbCr
      - Iso-luminance: no need to use closeloop luma adjustment to fix 4:2:0 distortion.
  - $IC_T C_P$  white paper: <http://www.dolby.com/us/en/technologies/dolby-vision/ICtCp-white-paper.pdf>
- This proposal: shows simulation results that  $IC_T C_P$  signal can be compressed well using HEVC Main 10 codec.

# Proposed Setting

- Encoder Design
  - Use HDR Anchor 3.2 HM encoder software
    - Change configuration parameters to fit  $I C_T C_P$  signal
  - Follow luma/chroma bitrate allocation behavior of Y'CbCr PQ => same QP used as Anchor
- Anchor 3.2 HM encoder: two changes compared to HM16.7
  - A specific chroma QP offset process is applied to better control the chroma shifting;
  - A specific control of the luma delta QP is applied to better balance the bitrate between dark and bright areas.
- $I C_T C_P$  signal characteristics:
  - I component has similar variance level as Y' => no change in luma delta QP setting
  - $C_T C_P$  component has higher variance than CbCr => modify configuration parameters for chroma QP Offset.

# Chroma QP Offset Configuration Setting

- Chroma QP Offset algorithm in HM Anchor 3.2

$\text{CbOffset} = \text{clip3}(-12, 0, \text{round}(\text{CbQpScale} \cdot (\text{QpScale} \cdot \text{baseQP} + \text{QpOffset})))$

$\text{CrOffset} = \text{clip3}(-12, 0, \text{round}(\text{CrQpScale} \cdot (\text{QpScale} \cdot \text{baseQP} + \text{QpOffset})))$

$\text{Act\_CbQpOffset} = \text{clip3}(-12, 12, \text{CbOffset} + \text{CbQpOffset})$

$\text{Act\_CrQpOffset} = \text{clip3}(-12, 12, \text{CrOffset} + \text{CrQpOffset})$

Chroma QP offset parameters for Y'CbCr PQ signal

Type	QpScale	QpOffset	CbQpScale	CrQpScale	CbQPoffset	CrQPoffset
709	-0.46	9.26	1.14	1.79	0	0
P3	-0.46	9.26	1.04	1.39	0	0

Chroma QP offset parameters for  $IC_T C_P$  PQ signal

Type	QpScale	QpOffset	CbQpScale	CrQpScale	CbQPoffset	CrQPoffset
709	-0.46	10	0.9	1.6	6	6
P3	-0.46	10	0.5	0.9	8	7

# Simulation Setting

- Conversion: HDRTools-0.1.1 dev branch

Configuration parameters for conversion in HDRTools

	Y'CbCr PQ	IC <sub>T</sub> C <sub>P</sub> PQ
ColorSpace	1	10
ColorPrimaries	0	9
ClosedLoopConversion	5	0

No need of closedloop luma adjustment;  
**Significant conversion complexity reduction!**  
(speed up at least 3x)

- HM Anchor 3.2 configuration:

- Chroma QP Offset setting
- Luma dQP
- VUI setting

VUI parameters in HM encoding

	Y'CbCr PQ	IC <sub>T</sub> C <sub>P</sub> PQ
MatrixCoefficients	9	14

# Compression Results

- Objective metrics: Some **BD-rate savings** in tPSNRY (-0.8%), DE100 (-12.3%), PSNRL100 (-0.9%) are observed:
  - Gains are simultaneously found in both texture (psnrY, psnrL) and color (DE), not trading one for the other;

		X	Y	Z	XYZ	tOSNR-XYZ	DE100	MD100	PSNRL100
class A	FireEaterClip4000r1	-17.3%	-6.2%	77.4%	6.4%	-0.7%	-21.6%	-15.2%	-7.2%
	Market3Clip4000r2	-2.2%	-0.2%	-0.7%	-1.0%	-1.3%	-13.4%	-89.0%	0.0%
	SunRise	-4.4%	0.1%	-0.6%	-1.7%	-4.4%	-41.7%	-18.8%	-0.9%
class B	BikeSparklers cut 1	-5.5%	-1.6%	6.6%	-0.1%	-1.6%	-6.9%	-14.6%	-1.2%
	BikeSparklers cut 2	-5.2%	-1.3%	8.2%	0.2%	-0.8%	-4.6%	-4.8%	-0.7%
	GarageExit	-6.2%	-1.9%	2.1%	-1.8%	-1.6%	-2.4%	5.6%	-2.0%
class C	ShowGirl2Teaser	-6.5%	-0.6%	4.1%	-1.0%	-1.8%	-9.7%	-10.6%	-1.1%
class D	StEM_MagicHour cut 1	-8.9%	-0.6%	5.8%	0.4%	0.0%	-12.9%	-10.5%	-0.8%
	StEM_MagicHour cut 2	-5.3%	0.2%	2.3%	-0.2%	-0.4%	-7.1%	-12.2%	0.0%
	StEM_MagicHour cut 3	-5.4%	-0.5%	7.9%	2.6%	2.9%	-3.2%	-2.9%	-0.6%
	StEM_WarmNight cut 1	-6.9%	-0.2%	7.7%	1.3%	0.7%	-17.1%	-5.4%	-0.3%
	StEM_WarmNight cut 2	-11.2%	-1.6%	29.3%	8.8%	9.4%	-15.5%	-36.4%	-1.1%
class G	BalloonFestival	-0.7%	0.4%	2.9%	1.1%	1.6%	4.5%	-34.0%	-0.2%
class H	EBU_04_Hurdles	-6.0%	0.5%	-0.4%	-1.6%	-2.7%	-18.3%	-1.6%	0.9%
	EBU_06_Start	-4.2%	1.6%	-7.5%	-3.6%	-4.8%	-14.9%	-29.2%	1.6%
	<b>Overall</b>	<b>-6.4%</b>	<b>-0.8%</b>	<b>9.7%</b>	<b>0.7%</b>	<b>-0.4%</b>	<b>-12.3%</b>	<b>-18.7%</b>	<b>-0.9%</b>

- Subjective checking:
  - With the proposed setting,  $IC_7C_p$  signal has at least **comparable subjective quality** as Anchor.

# Conclusion

- $IC_T C_p$  signal can be compressed well using HEVC Main 10.
  - Encoder setting are derived based on the rate allocation behavior in encoding Y'CbCr PQ signal as in Anchor v3.2.
  - Without further optimization, coding efficiency of encoding  $IC_T C_p$  signal is at least comparable to that of encoding Y'CbCr PQ signal.

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Q & A

