JCTVC-W0033
HDR CE2: report of experiment CE2.b-1

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Experiment purpose

CE2-b.1 based on ETM in reshapeSetting 1 configuration

- Luma: intra-plane PWP 8 pieces
- Chroma: cross-plane PWL 8 or more pieces
- Tuning algo for generating an SDR bwd compatible reshaped content

Main goal

- Explore improvements of visual quality of SDR resulting from reshaping for SDR bwd compatibility

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Starting point: ETM reshape setting 1 configuration

ETM reshaper design in reshapeSetting 1 configuration
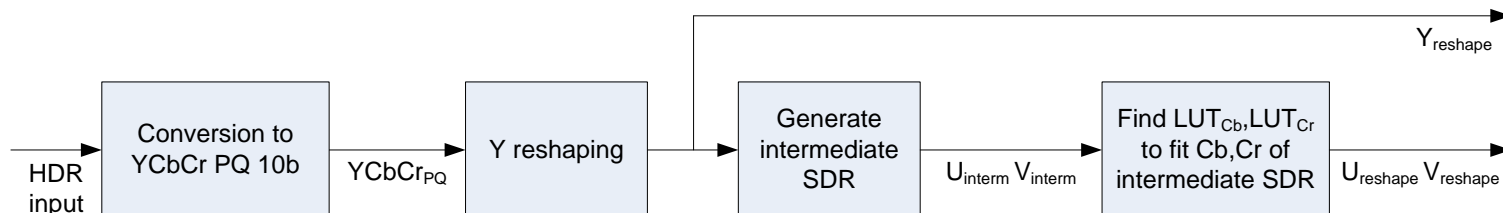
- Y reshaping is based on function $F(L) = \log(1 + (L/Ba)^g) / \log(1 + (Peak/Ba)^g)$
  - Automatic tuning of (g,Ba) based on average luminance (with temporal smoothing and change detection to signal metadata only when needed)

- Generation intermediate SDR to adjust cross-plane chroma functions
  - RGB → luminance L_{hdr}
  - $Y_{reshape}$ → linear-light Lreshape
  - RGB rescaled by ratio $L_{reshape}/L_{hdr}$
  - Convert to SDR R',G',B' : $X' = 1023 * (X_{scaled})^{0.45}$, X=R, G or B
  - Convert & downsample to 4:2:0 10b Y'CbCr → YUV_{interm}

- Find cross-plane LUT_U and LUT_V to map UV_{pq} to UV_{interm} so that
  - $(C_{reshape}-512) = (1 / LUT_C[Y_{reshape}]) * (C_{pq}-512)$ close to $(C_{interm}-512)$ with C=U,V

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CE2-b.1 changes to ETM

Main change: Yreshape modified to fit Yinterm

- **Using weighted Least Mean Squares**

$$LUTy[y] = \sum_{\substack{p=(x,y)\ such \\ that\ Y_{pq}(p)=y}} [w(y, Y_{interm}(p)) * Y_{interm}(p)]$$
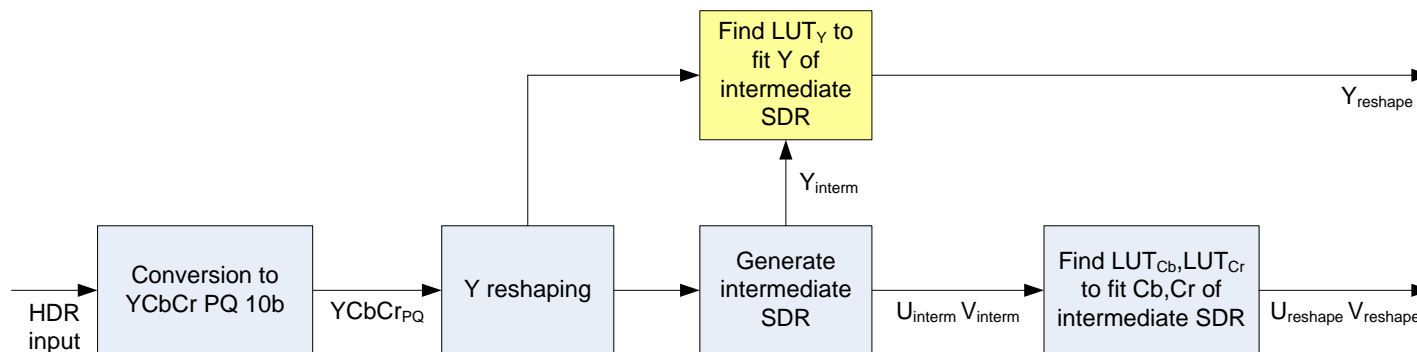
Other changes

- Reduce g value in initial Y reshaping to get more contrasted pictures
- Cross-plane chroma PWL model using 32 pieces instead of 8 to get more accurate color matching

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Objective metrics

Cross-checked by Dolby (JCTVC-W0121)

	X	Y	Z	XYZ	tOSNR-XYZ	DE100	MD100	PSNRL100
FireEaterClip4000r1	29.3%	18.1%	70.9%	35.6%	77.9%	46.6%	-43.9%	15.2%
Market3Clip4000r2	10.1%	5.2%	12.5%	9.5%	8.7%	34.8%	-94.7%	-3.4%
SunRise	13.5%	10.7%	10.8%	11.7%	9.5%	44.0%	-44.2%	-1.2%
BikeSparklers cut 1	3.8%	1.3%	10.3%	5.3%	8.7%	22.6%	-29.0%	5.8%
BikeSparklers cut 2	4.9%	3.1%	8.6%	5.5%	9.9%	21.4%	-47.6%	8.0%
GarageExit	8.5%	4.5%	9.3%	7.2%	8.1%	29.3%	-56.5%	2.5%
ShowGirl2Teaser	24.5%	18.3%	45.7%	29.8%	71.5%	17.2%	-82.1%	8.6%
StEM_MagicHour cut 1	-1.0%	1.7%	5.9%	3.0%	2.3%	-12.1%	-40.8%	-0.9%
StEM_MagicHour cut 2	4.5%	4.5%	9.1%	6.7%	6.4%	-5.4%	-29.8%	2.0%
StEM_MagicHour cut 3	8.0%	5.7%	25.7%	16.5%	17.4%	11.4%	-7.1%	0.6%
StEM_WarmNight cut 1	2.4%	3.3%	1.4%	2.1%	3.3%	-13.3%	-19.8%	-1.0%
StEM_WarmNight cut 2	9.3%	4.8%	11.7%	9.2%	17.9%	-3.8%	-74.6%	-2.3%
BalloonFestival	11.0%	8.5%	16.8%	13.0%	17.7%	39.5%	-64.2%	-6.2%
EBU_04_Hurdles	7.1%	-1.7%	-0.8%	0.8%	-1.2%	22.7%	27.9%	-8.1%
EBU_06_Start	14.1%	-1.8%	14.5%	8.9%	8.5%	56.2%	-8.3%	-10.2%
Overall	10.0%	5.7%	16.8%	11.0%	17.8%	20.7%	-41.0%	0.6%

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PWL 8 vs 16/32 pieces

Visually some benefits – better fitting of the curves

- Even with 32 pieces, metadata cost is from 0.03% to 1.03% (for lowest rate of Fire 500kbps)

- SDR rendering with PWL 16 very similar to PWL 32

- Noimpact on HDR compression

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PWL 8

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