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# Further redundancy removal  for coding palette index map

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# Overall Summary

- Syntax cleanup for coding palette index map
  - Part I: Binarization of num_palette_indices_minus1
  - Part II: Corrected formula for deriving variable PaletteMaxRun

- Average lossy BD rate savings for YUV, TGM
  - Part I: 0.0%, 0.0%, and 0.1% for AI, RA, LB, respectively
  - Part II: 0.0%, 0.0%, and 0.1% for AI, RA, LB, respectively

# Current method for coding num_palette_indices_minus1

- Using the existing binarization for coding syntax coeff_abs_level_remaining
  - Truncate Rice (TR code) + Exp-Golomb code (EGk code)
  - If level < (3<<k), using TR code
  - Otherwise, using "111" + EGk code

- The parameter cRiceParam (k) is derived by
  - cRiceParam = 3 + ( ( MaxPaletteIndex + 1 )  >>  3 )

# Binarization

- cRiceParam determines the minimal length of the FL suffix part

| k=0 | Prefix | Suffix (EG0 code) |
|-----|--------|-------------------|
| 0 | 0 | |
| 1 | 10 | |
| 2 | 110 | |
| 3 | 111 | 0 |
| 4~5 | 111 | 10X |
| 6~9 | 111 | 110XX |
| … | … | … |

| k=2 | Prefix | Suffix (EG2 code) |
|-----|--------|-------------------|
| 0~3 | 0 | XX |
| 4~7 | 10 | XX |
| 8~11 | 110 | XX |
| 12~15 | 111 | 0XX |
| 16~23 | 111 | 10XXX |
| 24~39 | 111 | 110XXXX |
| … | … | … |

# Problems

- Current method can lead to a large value of  parameter cRiceParam
  - maximal cRiceParam = 11, 19, 35, and 131 for palette size = 63, 127, 255, 1024 (32x32), respectively
  - the worst-case number of the coded bins equal to (cRiceParam+1)

- Redundant bits present with large cRiceParam
  - We need no more than Log2CUSize bins in FL binarization
    - 6, 8, and 10 bins for 8x8, 16x16, and 32x32 CUs, respectively
  - When cRiceParam >= Log2CUSize, the prefix is always equal to 0 and some redundant leading 0 bins are present
    - 6 redundant 0 bins can be present for 8x8 CU with palette size = 63

<p style="text-align:center;">0   00000XXXXXX</p>

# Proposed method

- The parameter cRiceParam (k) is derived as
  - cRiceParam = Log2CUWidth + ( ( MaxPaletteIndex + 1 ) >> 3 )

- Binarization
  - If cRiceParam >= Log2CUSize
    - FL with bit length equal to Log2CUSize
  - Else
    - Using the existing binarization for coding syntax coeff_abs_level_remaining

| | 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, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | -0.1% |
| RGB, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% |
| RGB, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.2% | 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, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% | -0.2% |
| YUV, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 0.0% | -0.2% | 0.0% | 0.0% | -0.1% | -0.5% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.2% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

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# Corrected formula for deriving PaletteMaxRun

- PaletteMaxRun = nCbS * nCbS – PaletteScanPos – 1 – remainingNumIndices – copy_above_indices_for_final_run_flag

|  | 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, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | -0.1% |
| RGB, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.2% | 0.0% |
| RGB, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | 0.0% | 0.1% | 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, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | 0.0% |
| YUV, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% | -0.1% | -0.5% | -0.6% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.2% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% |

everyday genius

# Solution 2

- Using the existing binarization for coding syntax coeff_abs_level_remaining

- The parameter cRiceParam (k) is derived as follows:

  - cRiceParam = min (3 + ( ( MaxPaletteIndex + 1 ) >> 3 ), Log2CUSize)

- Results using SCM-5.0

|  | 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, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| RGB, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 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% | 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% |
| YUV, text & graphics with motion, 1080p & 720p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, mixed content, 1440p & 1080p | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 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% |

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