HDR at W3C

Chris Lilley

Overview

- Portable Network Graphics (PNG) HDR
  - cICP, mDCV, cLLI (Third Edition)
  - dWLM (Fourth Edition?)
- Cascading Style Sheets (CSS) HDR
  - dynamic-range-limit
  - hdr-color()
  - color() with BT.2100 RGB, $J_za_zb_z$ & $J_zC_zh_z$, IC_TC_P
  - ΔEITP

Bit depth in PNG (a reminder)

- 8 or 16 bits per component
- sBIT (significant bits)
  - declares 10 or 12 padded to 16
- PNG was ready for HDR content

cICP in PNG

- Coding-independent code points for video signal type identification
- Enumerated values from ITU H.273
  - Primaries (& white point, D65 for most)
  - Transfer function
  - Matrix coefficients (for compatibility)
  - Narrow or Full range
- Adds just 16 bytes to the image

CICP, the useful bits

- BT.2100 PQ, HLG, linear
  - Perceptual Quantizer, Hybrid Log-Gamma
- Display P3, DCI-P3
- sRGB, sRGB-linear, BT.709
- (plus a bunch of historical, odd, and reserved values)

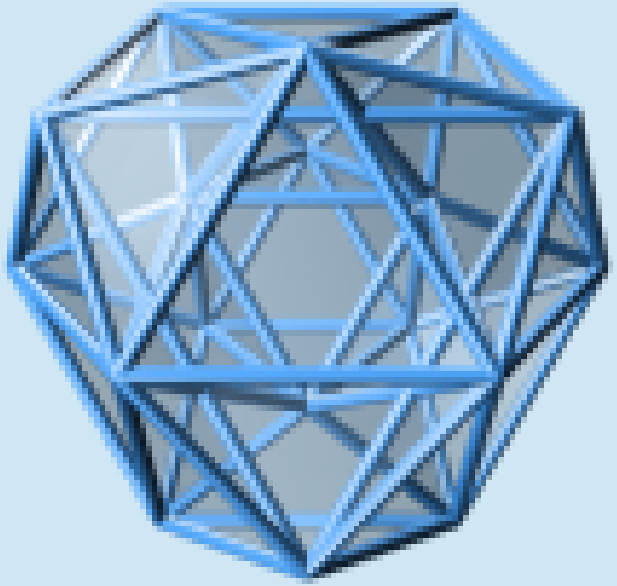
Color chunk priority

- (If more than one is present, what wins)
- cICP > iCCP > sRGB > cHRM, gAMA

mDCV in PNG

- Mastering Display Color Volume
  - Primaries, white point, min and max luminance
- From SMPTE ST-2086
- *Requires* cICP
- mDCV + cICP + cLLI = HDR10
- Hint to to optimize tone mapping, but no defined processing model
- Example: BT.2100 PQ container, mastered on Display P3

Animated PNG (a reminder)



cLLI in PNG

- Content Light Level Information
- From CTA 861.3 and SMPTE ST 2067-21
- Maximum Content Light Level (MaxCLL)
- Maximum Frame Average Light Level (MaxFALL)
  - Across all frames, in animated PNG
- Hint for tone mapping, no defined processing model

dWLM (not final)

- Diffuse white luminance metadata
- *Under consideration* for PNG 4th Edition
- From ITU BT.2048 and ISO 22028-5
- If not present, assume 203 cd/m^2

Cascading Style Sheets (CSS)

- Defines the presentation of HTML documents
- Enables responsive design
  - Adapts to screens of differing sizes and capabilities

CSS Color 4

- Previously, CSS was stuck in the “sRGB prison”
- Adds display P3, BT.2020 and other RGB spaces
- Adds CIE Lab (and Lch), D50-adapted
- Adds Oklab (and Oklch), D65 adapted
- Defines color space conversions
- Defines color interpolation (mixing, gradients)
- **SDR only**

Dynamic-range-limit in CSS Color HDR

- standard (SDR)
- no-limit (full HDR)
- constrained-high (gentle HDR)
  - Ideal for mixed SDR and HDR content
- dynamic-range-limit-mix()

HDR headroom is a tracking vector

- Exposing current HR headroom is a privacy violation
- Value is needed for good HDR display
- Value *cannot* be exposed through styling or script

dynamic-range-limit-mix()

- Mixes 2 or more dynamic-range-limit in variable proportions
- Internally, uses the actual HDR headroom
- Does not expose the actual result

hdr-color() in CSS Color HDR

- Specifies a pair of colors, each with an HDR headroom
- Interpolates the colors in D65 XYZ
  - Using the actual available HDR headroom
  - Calculated result is not exposed to style or script
  - Similar concept to ISO 21496-1 gain maps
- Smoothly adapts from SDR to HDR
- *Very new*, added to spec Feb 2025

color() additions in CSS Color HDR

- Four color spaces from ITU BT.2100
  - rec2100-pq
  - rec2100-hlg
  - rec2100-linear
  - IC_TC_P
- $J_za_zb_z$ and (polar form) $J_zC_zh_z$

ΔEITP in CSS Color HDR

- Distance metric for HDR
  - (CSS Color 4 uses ΔEOK, for SDR)
- Scaled distance in IC_TC_P
  - ΔEITP of 1.0 is one just-noticeable difference
- From ITU BT.2124

Can I Use it Now?

- PNG Third Edition
  - Stable specification, widely implemented
  - Being readied for Proposed Recommendation ballot
- CSS Color HDR
  - First Public Working Draft December 2024
  - Under active discussion
  - Early, experimental implementations