High Dynamic Range in AV1

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IBC 2018
Open Codecs At Google

AV1  
DRACO  
VP9  
opus  
VP8  
webp  

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Why Codecs?
Unlock
The World
Unlock The Future

IBC 2018
Track Record: VP9 + YouTube

YouTube VP9 watch time gains vs. H.264

+25%
+20%
+15%
+10%
+5%
+2%
Who is

ALLIANCE FOR OPEN MEDIA

Founded in Fall 2015, 36 companies came together to develop next generation codecs for the web.
Goals for Video Codec for the Web
With state of the art compression efficiency

Open source & royalty-free
Grounded in the WebM philosophy

Deploy Widely & Quickly
Developed faster than standards bodies and supported across platforms
VOD Services

Member companies with video-on-demand streaming consumer products & services
Live/RTC Services

Member companies with live streaming and/or real time communication consumer products & services.
Results: **BITMOVIN**

**Average weighted PSNR BD-rate delta of AV1 vs HEVC**

- **all**: 17.08%
- **>=720p**: 37.81%
- **>=1080p**: 30.90%
- **>=1440p**: 34.04%
- **2160p**: 43.90%

AV1 compared vs HEVC
Results:

AV1 BD-rate saving in terms of PSNR for CRF/QP mode
Results:
Results:
### Results:

The image shows a screenshot of a web page with various technical details and graphs. The screenshot includes a table with columns labeled `Completed Run`, `Active Run`, `All Run`, and `Share`. The table contains entries for different runs with details such as `Run ID`, `Status`, and `Time`. Additionally, there is a graph with a line plot, showing data points that suggest a linear trend. The graph is labeled `Total` on the y-axis and `MS SSDM` on the x-axis.
Where We Are

1. Tools Selected (Completed)
2. Codebase frozen (Completed)
3. Spec Published (Completed)
4. Support in Chrome (Q3 2018)
5. SoC Hardware (2020)

IBC 2018
Google is Committed to AV1
Demo

- Download Chrome Canary / Dev Channel
- "Enable AV1 Video Decoding" to "Enabled" in chrome://flags
- Playback
More Demos!

Check out our partners’ demos here at IBC2018

BOOTH SU10725MR
BOOTH SU3710
BOOTH SU9901
Learn More

- Project Site: https://aomedia.org
- Source code: https://aomedia.googlesource.com/
- Bitstream specification: https://aomedia.org/av1-bitstream-and-decoding-process-specification/
High Dynamic Range in AV1

An Alternative Future for HDR
The real world

Very wide range of lighting

✖ Peak luminance is NOT 1,000 or even 10,000 nits
✔ Need to be “scene-referred”

A single candle lit in dark a room has a dynamic range 16.8 million to 1 (24 stops)
HD-TV
1000 pixels
35%
50 fps
Now with 10,000 nits

UHD-TV
4000 pixels
85%
120 fps

Colour Gamut
Wow! 4K!

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What we did

- Added existing HLG and PQ (HDR10)
- New HDR methods – scene referred
  - PTF (Gamma) – real-time, on-the-fly adaptive to:
    - ambient light, creative intent, display luminance
- Ratnajit – faithfully preserves colour
Why

- Scene referred
- HDR viewed under “normal” ambient lighting
- Future proof
Complexity

\[ PQ_{\text{forward}}(V) = \left( \frac{V^{1/m_2} - c_1}{c_2 - c_3 V^{1/m_2}} \right)^{1/m_1} \]

where: \( m_1 = \frac{2610}{4096} \times 1 \frac{1}{4}, m_2 = \frac{2523}{4096} \times 128, c_1 = \frac{3424}{4096}, c_2 = \frac{2413}{4096} \times 32, c_3 = \frac{2392}{4096} \times 32 \)

\[ HLG_{\text{encode}}(V) = \begin{cases} r \sqrt{V} & V \leq 1 \\ a \log(V - b) + c & V > 1 \end{cases} \]

where: \( r = 0.5, a = 0.17883277, b = 0.28466892, c = 0.55991073 \)

\[ PTF_{\gamma}(V) = V^{d/\gamma} \]

where: \( \gamma = \text{variable}, V \text{ is normalised HDR} \)
Figure 3: Difference in decoding time in frames per second between PTF₄, PQ and a generic LUT (PTF₄ in this case) across a range of sequence and averaged over 5 tests per sequence on a workstation PC (Higher is better)
Not in a dark room

outside
80,000 lux

4,000 nits
10,000 nits
HDR in AV1
An Alternative Future for HDR!

✓ Open, royalty-free HDR video coding
✓ No more watching HDR in the dark
✓ High quality, efficient codecs
✓ Wide scope of devices and platforms

University of Warwick (UK) | trueDR (UK) | Google (US) | SIM2 (IT) | ORF (A) | Vicomtech (ES)
Enhanced viewing experience

“See! I told you there is another springbok in the shade!”
HDR-AV1 is here

➢ For TVs, movies …
Even (shortly) for mobile devices …