

AV1 Image File Format (AVIF)

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Symposium 2019

Outline

- Overview of the format
- Compression and decoding speed evaluations
- Conclusions

AV1 Image File Format (AVIF)

v1.0.0, 19 February 2019

This version:

<https://AOMediaCodec.github.io/av1-avif>

Issue Tracking:

[GitHub](#)

Editors:

[Cyril Concolato](#) (Netflix)

[Anders Klemets](#) (Microsoft)

Abstract

This document specifies syntax and semantics for the storage of [\[AV1\]](#) images in the generic image file format [\[HEIF\]](#), which is based on [\[ISOBMFF\]](#). While [\[HEIF\]](#) defines general requirements, this document also specifies additional constraints to ensure higher interoperability between writers and readers when [\[HEIF\]](#) is used with [\[AV1\]](#) images. These constraints are based on constraints defined in the Multi-Image Application Format [\[MIAF\]](#) and are grouped into profiles inspired by the profiles defined in [\[MIAF\]](#).

Technology stack (1)

<p>ISOBMFF ISO/IEC 14496-12</p>	<ul style="list-style-type: none">● Base elements<ul style="list-style-type: none">○ Syntactical elements: “boxes”(e.g. MetaBox)○ Logical concepts: “tracks” and “items”○ Storage concepts: streaming, interleaving, ...
<p>IFF (HEIF) ISO/IEC 23008-12</p>	<ul style="list-style-type: none">● Image-specific and codec-agnostic definitions<ul style="list-style-type: none">○ image sequences vs image items○ coded images vs. derived images (crop, rotate, mirror)○ master images vs. auxiliary images (alpha, depth) vs. thumbnail images○ image collection and alternate images○ multi-layer images○ overlaid images, image grid○ metadata association

Technology stack (2)

<p>MIAF ISO/IEC 23000-22</p>	<ul style="list-style-type: none">● No new technology● Additional structural constraints on ISO/BMFF/IFF<ul style="list-style-type: none">○ Self-containment○ Single-layer present○ Thumbnail size and grid limitations○ Track limitations (same duration, loops)○ Alpha plane constraints (same codec)● Application-level constraints<ul style="list-style-type: none">○ Progressive○ Animation○ Image Bursts○ Fragmented and fragmented alpha-video
<p>AVIF AOM specification</p>	<ul style="list-style-type: none">● Mapping of AV1 KeyFrame/Temporal Units into items and tracks● Profiles (Basic and Advanced)

AVIF capabilities

- 8, 10, 12 bits
- Lossless or not
- Monochrome (alpha/depth) or multi-components
- Any color-space
 - ISO/IEC CICP (color, transfer, matrix, range)
 - ICC profiles
- Chroma subsampling: 4:2:0, 4:2:2, 4:4:4.
- HDR
- Film-grain

<https://aomediacodec.github.io/av1-avif/>

Comparison @ 0.5 bpp

JPEG



JPEG 2000



AVIF



Comparison @ 0.2 bpp

JPEG



Comparison @ 0.2 bpp

JPEG 2000



Comparison @ 0.2 bpp

AVIF



AVIF HDR Image



[Visualizing HDR images](#)

(<https://medium.com/netflix-techblog/enhancing-the-netflix-ui-experience-with-hdr-1e7506ad3e8>)

More images: <https://github.com/AOMediaCodec/av1-avif/tree/master/testFiles>

Results

Results



Low-res images (Kodak test set, 768x512)

File size reduction vs. JPEG, **4:2:0**

	WebP	JPEG 2000	HEVC	AVIF
VMAF = 75	-11.8%	-35.7%	-44.0%	-47.7%
VMAF = 85	-14.7%	-30.8%	-33.1%	-37.7%
VMAF = 95	-20.9%	-25.0%	-30.1%	-36.7%

Results



Low-res images (Kodak test set, 768x512)

File size reduction vs. JPEG, **4:4:4**

	JPEG 2000	HEVC	AVIF
VMAF = 75	-46.4%	-53.1%	-55.4%
VMAF = 85	-39.3%	-41.4%	-44.0%
VMAF = 95	-23.1%	-32.5%	-38.7%

Results

Low-res Netflix UI images (571x800)
File size reduction vs. JPEG, **4:2:0**



	WebP	JPEG 2000	HEVC	AVIF
VMAF = 75	-13.1%	-45.5%	-56.1%	-63.2%
VMAF = 85	-28.9%	-29.4%	-46.3%	-53.6%
VMAF = 95	-12.0%	-12.8%	-35.4%	-43.3%

Results

Low-res Netflix UI images (571x800)
File size reduction vs. JPEG, 4:4:4



	JPEG 2000	HEVC	AVIF
VMAF = 75	-46.4%	-53.1%	-55.4%
VMAF = 85	-39.3%	-41.4%	-44.0%
VMAF = 95	-23.1%	-32.5%	-38.7%

Results



High-res images (Netflix UI billboard images, 2048x1152)
File size reduction vs. JPEG, **4:2:0**

	WebP	JPEG 2000	HEVC	AVIF
VMAF = 75	-24.5%	-52.9%	-56.3%	-61.1%
VMAF = 85	-20.7%	-40.9%	-44.6%	-50.3%
VMAF = 95	-19.4%	-34.2%	-38.0%	-42.1%

Results



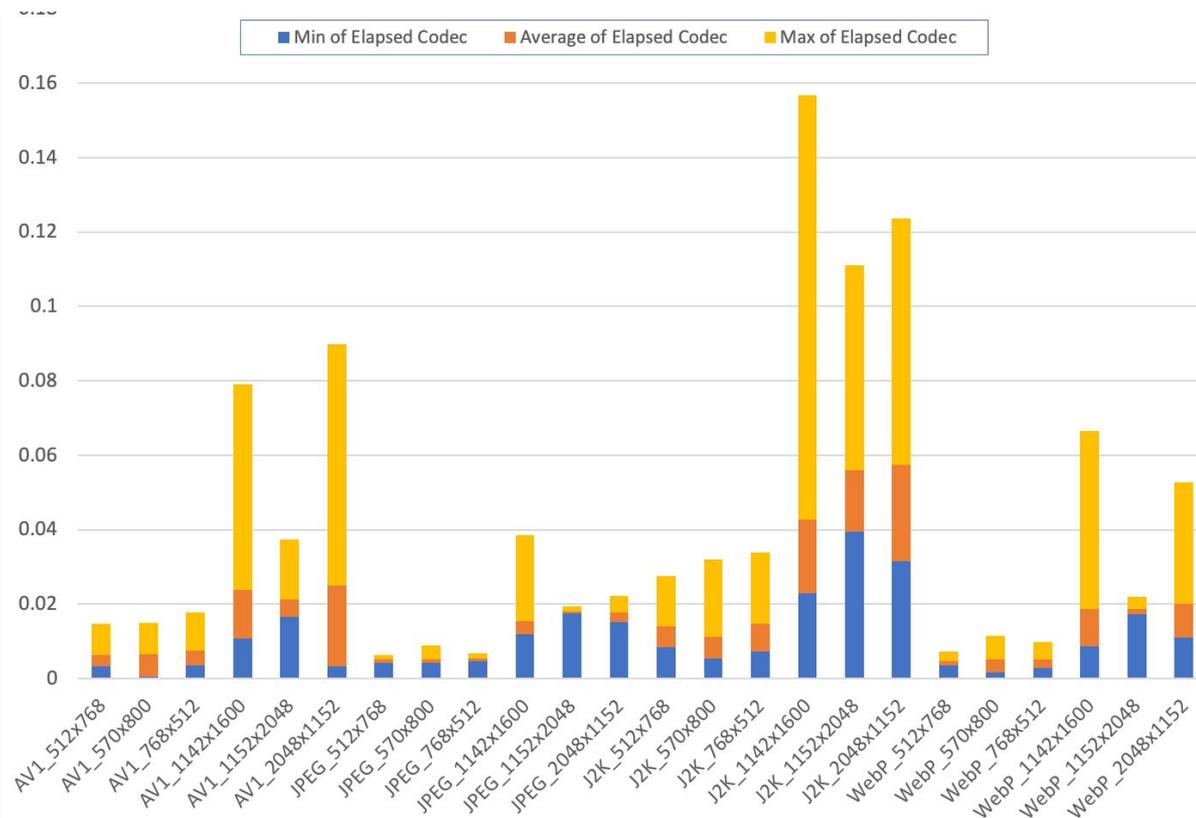
High-res images (Netflix UI billboard images, 2048x1152)
File size reduction vs. JPEG, **4:4:4**

	JPEG 2000	HEVC	AVIF
VMAF = 75	-61.7%	-67.7%	-69.3%
VMAF = 85	-47.0%	-54.6%	-58.0%
VMAF = 95	-28.0%	-35.1%	-37.0%

Decoding comparisons

- How fast can AVIF decoding be?
- Timing with [colorist-benchmark](https://github.com/joedrago/colorist/) (<https://github.com/joedrago/colorist/>) comparing
 - AVIF: libavif with dav1d 0.4.0+
 - JPEG: libjpeg-turbo
 - J2K: openjpeg
 - WebP: libwebp

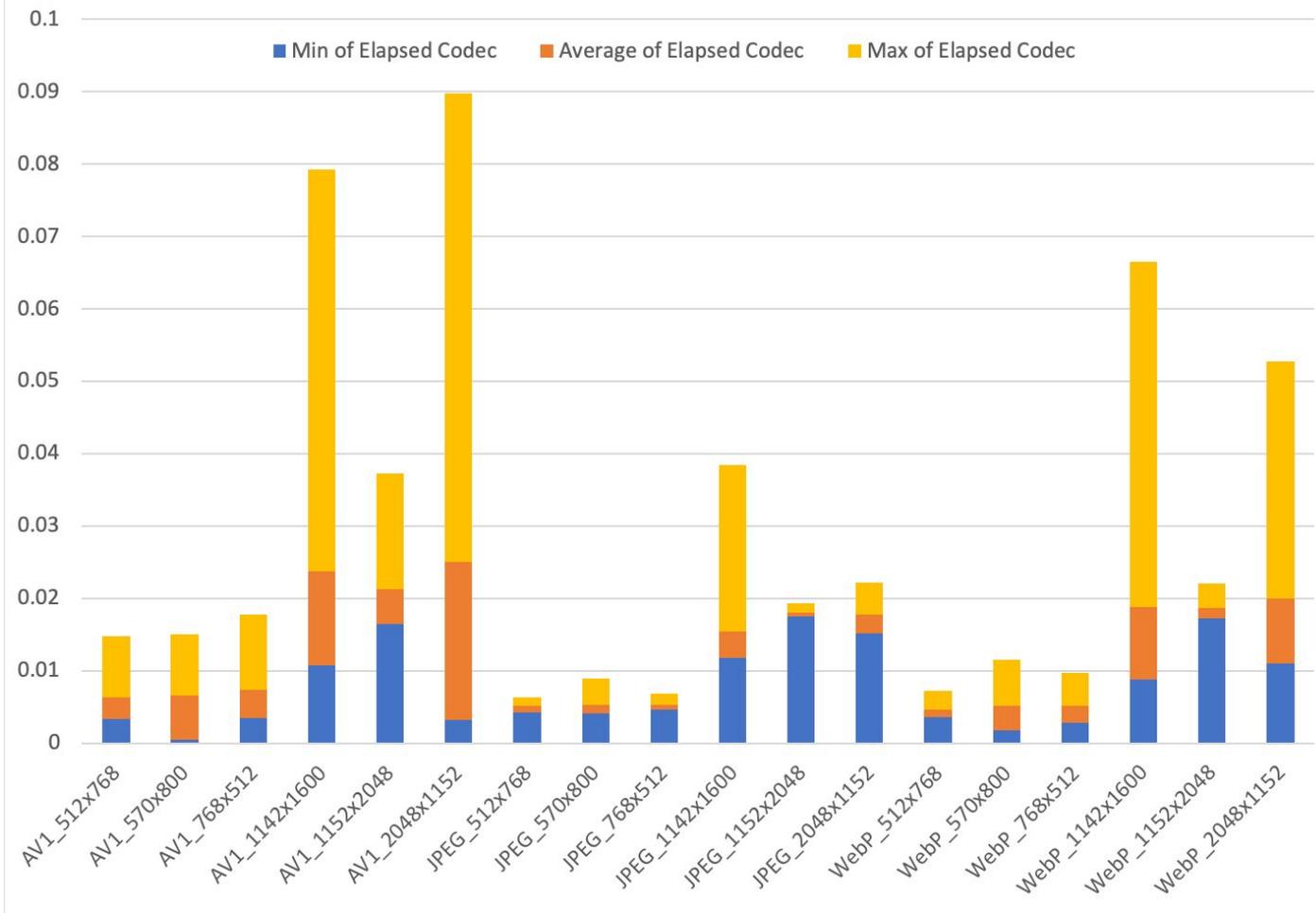
Results



12k 8b 4:2:0
encodes

6 resolutions

Time (ms) on Mac



non-J2K 8b
encodes

Conclusions

AVIF Tools

- Writers
 - Libavif (<https://github.com/AOMediaCodec/libavif>): lightweight, image-friendly C library
 - colorist (converter or synthetic image generator)
 - aomenc (encoder) + mp4box (file format packager)
 - Windows (Paint, etc.)
- Readers/Renderers
 - libavif
 - Chrome (integration of libavif in-progress)
 - Firefox (planned)
 - Windows (OS support)
 - Various Javascript libraries

Summary

- AVIF is the most compressed image format (to date), with an 8-bit decoding speed slightly slower than legacy formats
 - Looking forward for 10b dav1d optimizations
- AVIF integration is on-going in Web tools and image-community tools and large-scale deployments are expected soon
 - You can start using it today!

Questions?

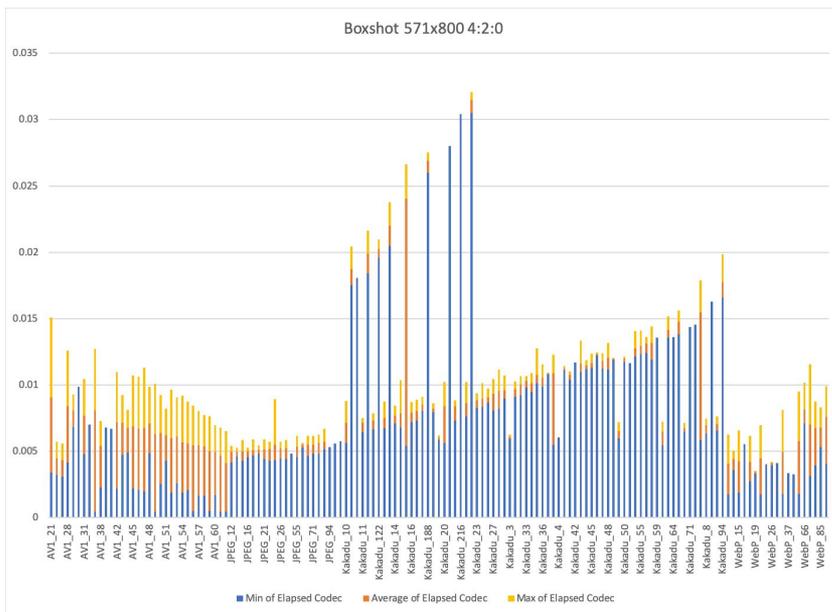


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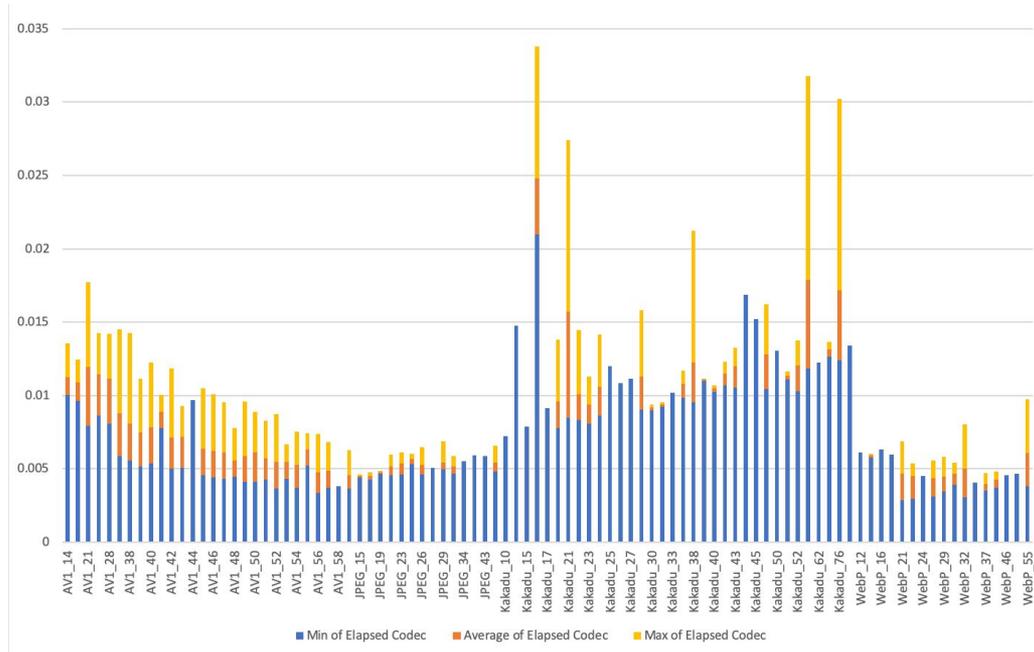
Low-res Netflix UI images (571x800) 4:2:0



Results



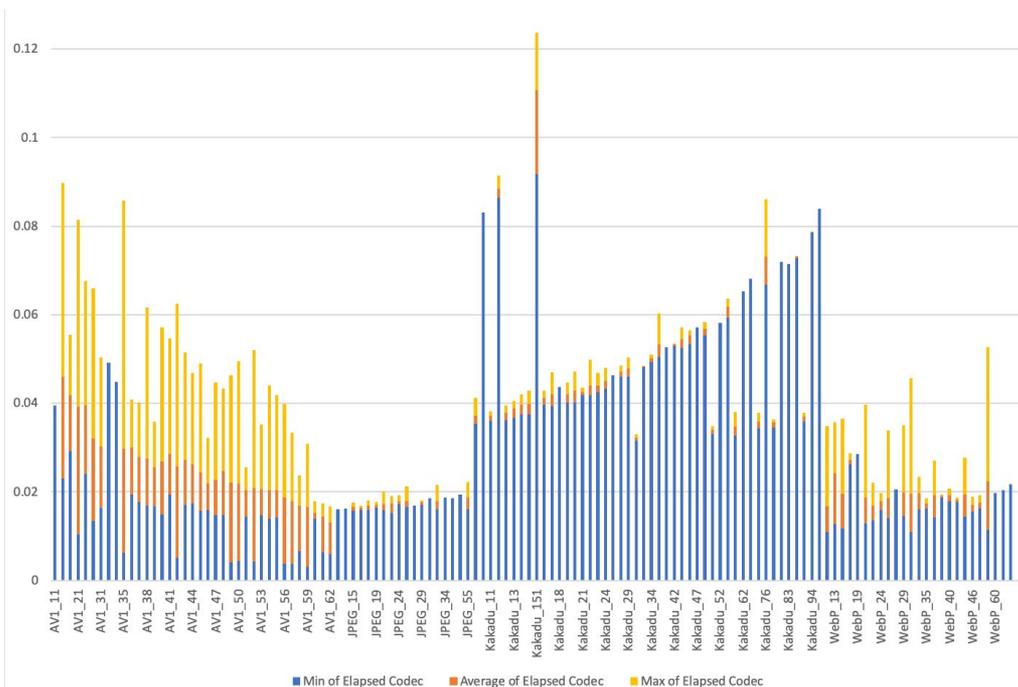
Low-res images (Kodak test set, 768x512) 4:2:0



Results



High-res images (Netflix UI billboard images, 2048x1152) 4:2:0



Quantitative results

High-res images (Netflix UI billboard images)

