DATASHEET

Alliance for Open Media Video 1

30% more efficient than HEVC and VP9

What is the AV1 Codec?

AV1 is an open, royalty-free, next-generation video coding format from the Alliance for Open Media. It is designed to succeed Google's VP9 and compete with H.265/HEVC.

The Origin and Development of AV1

In September 2015 the Alliance for Open Media (AOMedia) was founded by leading companies from various industries with an association to media technology. Among them are browser vendors like Google, Mozilla, Apple, and Microsoft, hardware vendors like AMD, ARM, Intel, and NVIDIA, and content providers like Amazon and Netflix.

AV1 will deliver compression improvements of around 30% over VP9 and HEVC, but when comparing AV1 specifically with HEVC, one of the biggest competitive advantages is that AV1 is royalty-free. There are 3 major HEVC patent pools plus some HEVC IP owners who have yet to join a pool and now several years after the pools were first established, the future of the ever-changing royalty situation around HEVC (and its successor VVC) remains uncertain. This is obviously not satisfactory for the industry and especially encoding, distribution, content, and hardware companies who face unclear licensing fees or potential liability.

The AV1 codec has its roots in the codebase of Google's VP9/ VP10 codec with over 100 additional coding tools that have been added. While the bitstream specification for AV1 was frozen in 2018 to allow for hardware and commercial application development, work to improve computational efficiency has been ongoing. In 2022, the speed of the AV1 reference encoder is now within the same order of magnitude as other common codecs.

✔ Interoperable and open

✔ Optimized for the Internet

✔ Designed with a low computational footprint and optimized for hardware

✔ Scalable to any modern device at any bandwidth

✔ Capable of consistent, highest-quality, real-time video delivery

✔ Flexible for both commercial and non-commercial content, including user-generated content

Bitmovin AV1 VoD

Bitmovin's containerized and scalable chunk based encoding service can deliver fast, reliable, high-quality AV1 encoding in the cloud, with efficiency that drastically cuts bandwidth and delivery costs.

AV1 Chunked Encoding

In April 2017, we were proud to deliver the world's first AV1 live stream, winning the Best of NAB Award from Streaming Media magazine. At the time it required over 200 processor cores to stream. Just five months later at the IBC show in Amsterdam, we delivered the same demonstration using just 32 cores. Since then we have continued to improve our AV1 technology, and the performance has drastically improved in the last 5 years. We encourage everyone to give it a try to see the performance for themselves. As more companies begin to use and support the codec, this development will only accelerate.

Chunk-based encoding, which is at the core of the Bitmovin VoD Encoder, is perfect for managing the additional processing power required to encode AV1. This approach allows us to speed up encoding almost linearly with the number of instances that are added to the encoding cluster.

As a result, we can reach the same encoding speeds for AV1 that our customers have come to expect for H264, VP9, and HEVC encoding, which now makes the codec effectively usable for media companies and content providers throughout the industry.

First AV1 Playback in Firefox

Bitmovin partnered with the team at Mozilla to debut the world's first web-based AV1 playback support as part of the Firefox Nightly advance releases in November 2017.

Since then, browser support has expanded with Firefox making it official in early 2019. They are joined by Chrome, Edge and Opera, as well as the Android, Silk, and Tizen Browsers on compatible mobile devices and TVs, which now all support AV1 playback.
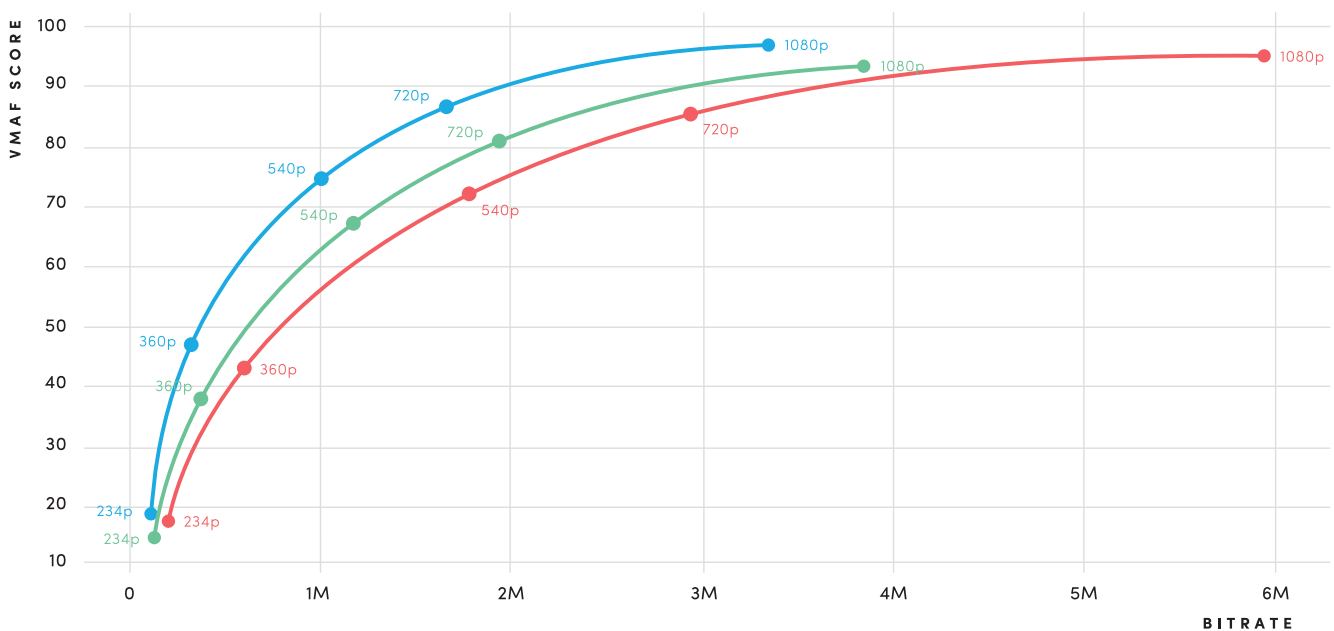
AV1 vs H264 and HEVC

As part of our efforts in bringing AV1 to everyone in the media industry, we have been also extensively testing and benchmarking the codec compression performance of AV1. We have found that the AV1 offered via our API performs significantly better than the traditional codecs H264 and HEVC. The quality results based on internal testing are summarized in the table below.

CODEC	BD-Rate (IN %)	BD-VMAF
H264	–50.2	12.3
HEVC	–28.9	6.3

Summary of Quality Results [Results benchmarked for encoder version v2.110.0]

On average we found that AV1 can offer the same visual quality at 50% less bitrate and 30% less bitrate, for H264 and HEVC respectively. These values are averaged out over several kinds of inputs, of varying complexity and lengths, and output profile configurations.
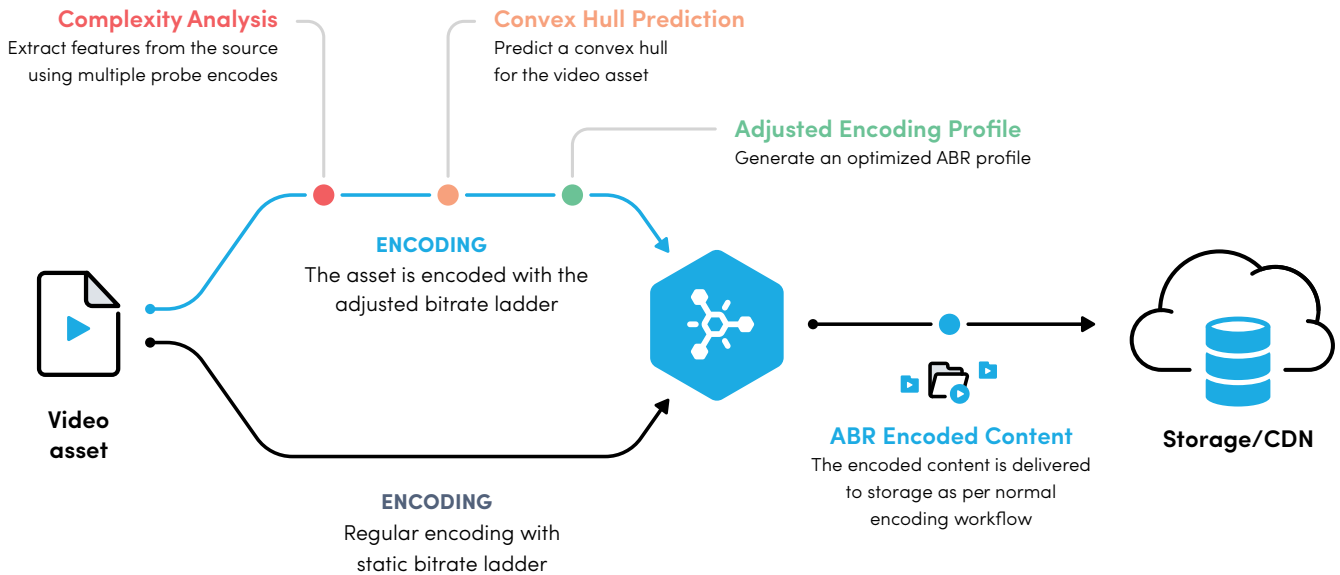
Rate Distortion – Arithmetic Mean (Football)

Quality (vs) Bitrate graph ■ *AV1* ■ *HEVC* ■ *H264*

The exact compression performance benefits will depend on your use case. Reach out to us if you have any more questions regarding our quality data! We would be happy to guide you through how much you can expect to gain by adding AV1 and the return on your investment based on your current CDN delivery and storage costs.

AV1 Per-Title Encoding Optimization

Bitmovin's Per-Title ABR Optimization algorithm is one of our biggest competitive advantages and has been our most popular feature for H264, HEVC, and VP9 encoding for some time now.

As of encoder version 2.109.0, we support Per-Title encoding with AV1, allowing you to automatically analyze and set the optimal adaptive bitrate ladder for every video, enabling the best quality of experience and most efficient data usage.

Complexity Analysis
Extract features from the source using multiple probe encodes

Convex Hull Prediction
Predict a convex hull for the video asset

Adjusted Encoding Profile
Generate an optimized ABR profile

ENCODING
The asset is encoded with the adjusted bitrate ladder

Video asset

ENCODING
Regular encoding with static bitrate ladder

ABR Encoded Content
The encoded content is delivered to storage as per normal encoding workflow
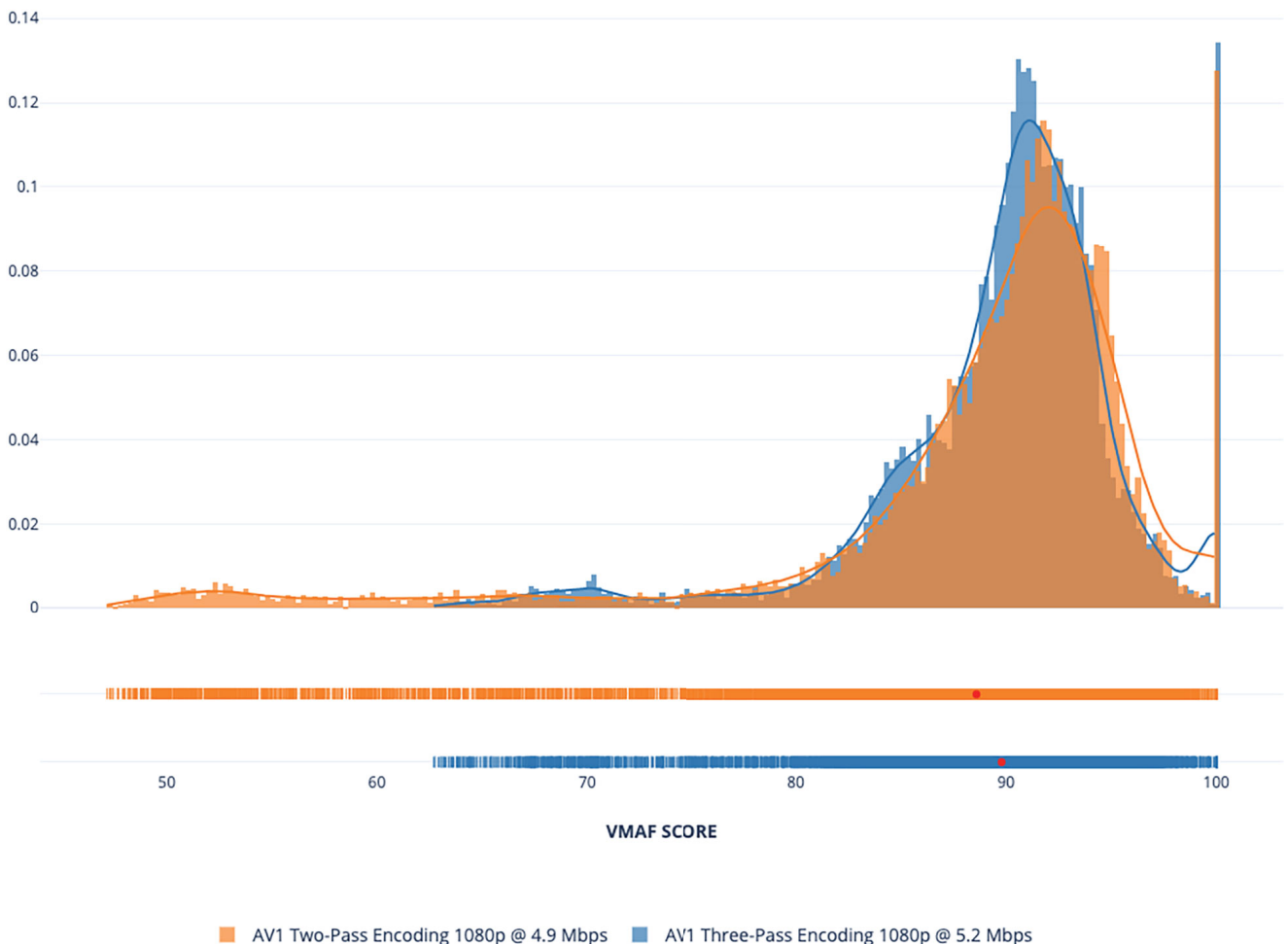
Storage/CDN

AV1 Three-Pass Encoding

Three-Pass Encoding offers unparalleled results by analyzing the asset as a whole, followed by chunking the asset into smaller components and then finally encoding in a parallel fashion at the chunk level. Bitmovin offers Three-Pass encoding for H264, HEVC, and VP9 codecs and since encoder version 2.104.0, Three-Pass is also available for AV1!

The end result for our customers is that we offer a better distribution of bitrates across the AV1 encoded video using our internal, innovative heuristic approach. For the end user, this means less compression artifacts, fewer noticeable drops in quality and a better overall viewing experience. This plot compares the VMAF quality scores for Two-pass vs Three-pass encoding for every frame of the same video. The Three-pass version is more consistent and has a much higher average quality, with every frame scoring above 60 VMAF.

Quality Distribution

VMAF SCORE

■ AV1 Two-Pass Encoding 1080p @ 4.9 Mbps   ■ AV1 Three-Pass Encoding 1080p @ 5.2 Mbps

AV1 Smart Presets

Codecs in general have a broad set of settings and options, and finding the right mix of configurations can be very time consuming, requiring deep knowledge of how a particular codec works. We wanted to eliminate this arduous process of optimizing encoder settings so that our customers can instead focus on their workflows. As a solution, we came up with presets that offer a quick and easy way to choose the optimal encoder settings depending on your priorities and use case. We already offered presets for H264, HEVC, and VP9 and with the release of encoder version 2.110.0, we also offer three smart presets for AV1:

- **VOD_QUALITY** – Higher quality

- **VOD_STANDARD** – Default quality and speed

- **VOD_SPEED** – Faster encoding

AV1 Innovation

As the video industry evolves, so does the technology that drives it.

Bitmovin has been a first mover in almost every significant development in online video, from building and deploying the world's first (and fastest) commercial adaptive streaming (MPEG-DASH/HLS) HTML5 Player, to being the first to achieve 100x real-time encoding speeds in the cloud. Bitmovin provides multi-codec UHD, HDR and high-frame rate encoding and built the first containerized video encoding solution with Docker and Kubernetes. In the same spirit, we have been working to enhance our AV1 offering to make it as useful and powerful as possible. The results of this hard work are two pending patented technologies around AV1. The details cannot yet be divulged, but we have developed one technique that is cutting the processing time of AV1 3-pass encoding by an impressive 40% and another that provides a significantly improved turnaround time for our AV1 PerTitle encoding. This is not the end, we will continue to innovate relentlessly to transform AV1 encoding as a competitive advantage for our customers.

To find out more about Bimovin's AV1 encoding or other video infrastructure solutions, contact **sales@bitmovin.com** or visit us at **bitmovin.com**.

> **"A trusted partner for Integrators, Solution Providers and Content Providers alike."**

Want to learn more?

Check out our resources page: www.bitmovin.com/resources

Contact us at

US Headquarters
41 Drumm Street
San Francisco, CA 94111

European Headquarters
Schleppe Platz 7,
Klagenfurt, Austria 9020

Email us at
sales@bitmovin.com

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