How can MPEG-5 LCEVC improve UGC deployment?

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Executive summary

User-generated content (UGC) platforms like YouTube, TikTok, and Meta deliver billions of videos daily, with mobile devices driving most consumption. This creates two major challenges: ensuring smooth playback across all smartphones, including budget devices, and managing the vast compute and bandwidth demands of encoding billions of daily uploads.

AV1, the chosen royalty-free codec for UGC, offers strong compression but faces adoption hurdles. Hardware support on smartphones remains below 10 percent, while software decoding increases battery drain and CPU load. Encoding AV1 at scale also consumes enormous processing power, often limiting its practical efficiency.

MPEG-5 LCEVC provides a scalable solution. By combining a lower-resolution AV1 base layer with a lightweight enhancement stream, LCEVC reduces complexity while preserving quality. Independent results from Meta, Intel, and V-Nova show:

- ~40% less encoder compute at the same quality.
- Up to 50% longer battery life on mobile devices.
- ~20% bitrate savings in transcoding workflows.

Deployment is already viable. LCEVC is supported in FFmpeg, GStreamer, and encoders from Harmonic, ATEME, and MainConcept, with playback integrated into Shaka Player, TheoPlayer, and demonstrated on devices from Hisense, Realtek, and Amlogic.

For UGC platforms, this means faster and more cost-effective AV1 adoption. The result is higher-quality video, extended device battery life, and reduced infrastructure costs — delivering sustainable growth at global scale.

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Description of the use case

UGC services such as Meta (Facebook, Instagram), YouTube, TikTok all have a massive amount of content to be delivered to all types of devices, mobile being the most popular one.

The traffic on mobile devices for most viral content can be counted in billions of views, and it is therefore important for UGC services to offer the best possible compression technology that will bring the best quality of experience at the lowest transmission cost. In addition, UGC companies are also very sensitive to the licensing terms associated with codecs. After the bad experience they had with HEVC, they all decided to create the Alliance of Open Media (AOM), which defined the AV1 codec, known for being royalty free, to succeed already established AVC and VP9 codecs. As with any new codec, AV1 implementation takes time, especially on mobile. Waiting for hardware implementation was not an option, especially to address the low budget phones that do not have the latest generation chipsets.

UGC companies therefore had to look at different alternatives, and in this white paper we will see how MPEG-5 LCEVC can play a role.

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The current situation

Decoding challenges

AV1 on mobile is a topic that is now better documented after the announcement in 2023 of the introductions of hardware AV1 decoders in chipsets such as Qualcomm Snapdragon 8 Gen 2 and Apple A17 Pro.

ScientiaMobile is tracking [1] the AV1 support on mobile devices, and we show the progress over the last quarters in figure 1.

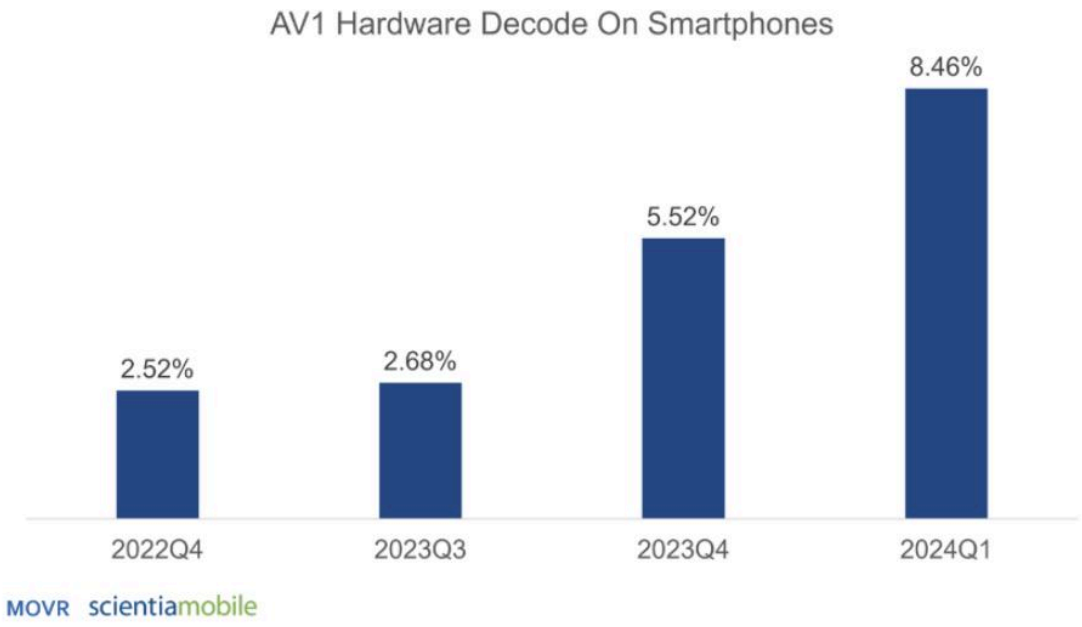


Figure 1: AV1 hardware decode on smartphones.

The 8.46 percent for AV1 has to be compared to HEVC, which has a penetration of 95.86 percent, more than 10 times higher.

Meta has proposed a software implementation of AV1 on mobile, which can be understood since most of the video usage is short form video binge watching on Instagram. We know that on mobile phones the CPU power plays a larger role than on tablets, where the battery is larger to drive the display and therefore a software decoder is accepted. The software decoder proposed by Meta on phones has been watched closely by the industry, which until now has always used hardware decode.

AOM commissioned Videolan in 2018 to implement an optimised AV1 decoder (dav1d) that could be ported to any platform. See Videolan's presentation [2] of the work achieved.

Meta took the dav1d decoder and deployed it on mobile phones as part of their app and shared the results in a blog [3].

A few takeaways from the Meta publication:

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- On a variety of Android phones AV1 real time playback of 720p 30fps at 2 Mbps is feasible for low end devices with 4 threads, and 1080p30fps at 4 Mbps is feasible for high end and mid-range devices with 4 threads using the dav1d decoder.
- The overall Facebook MOS was improved by 0.6 MOS points after the introduction of AV1.
- The bandwidth decreased by 12 percent after the introduction of AV1.
- Once AV1 was introduced, the watch time on iPhone went up to 70 percent versus other codecs (AVC, VP9).

There is no information on the software dav1d decoder performance versus the hardware decoder provided by either Qualcomm or Apple, but [4] compares the VP9 hardware decoder with the AV1 software decoder on Mac.

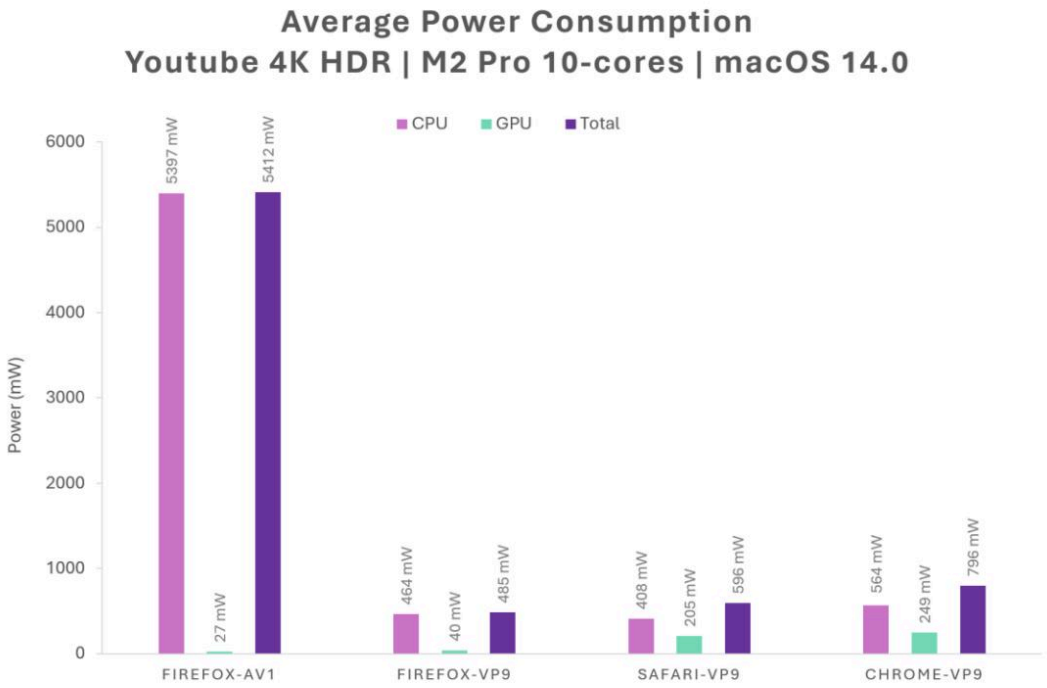


Figure 2: Software (AV1) vs hardware (VP9) on Mac Pro.

The comparison shows clearly that a hardware decoder is going to use much lower battery compared to a software one (up to a factor of 10), although we are talking about different codecs and not using the dav1d decoder.

The dav1d decoder has now been integrated by Google in the Android 14 release, so it will be a native player in upcoming releases of Android. Of course, the performance of the phone will have an impact on the dav1d decoder performance. We saw in a recent article [5] the report of power consumption of a mobile device using the dav1d decoder in the YouTube app, showing us that software decoding of AV1 at full HD resolution is still a challenge. YouTube has since decided to send AV1 only to mobile devices that have a hardware decoder.

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Once the software player concept was validated, the challenge for Meta was how to scale AV1 deployment on phones that do not have enough processing power to support AV1, or that use too much battery to decode AV1. This applies mainly to Android devices in emerging countries priced between 100 and 300 dollars.

Encoding challenges

UGC companies have to encode billions of assets per day, and the vast majority of those assets will be watched only by a few people. They have therefore established a tiered encoding strategy depending on viewership, with the goal of optimising processing resources depending on content popularity:

- H.264/AVC, which is the lowest complexity and lowest compression efficiency, is used for low viewership (below a few thousand views).
- VP9, which is more complex but also more efficient in terms of compression, is used for medium popularity content (from a few thousand to a few million views).
- AV1, which is the most complex but also the most efficient in terms of compression, is used for high popularity (above a few million views).

As software is not scalable enough to encode billions of assets per day, UGC companies have decided to accelerate encoding with hardware. YouTube developed [6] a dedicated ASIC chip that can encode in both AVC and VP9 formats, but for AV1 they still rely on software encoding. As AV1 is more complex than VP9, it requires more CPU resources. Less efficient encoding is therefore selected, bringing results very close to VP9 hardware-based encoding, which defeats the purpose of AV1 compression gains.

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LCEVC improving AV1 implementation

The concept

LCEVC enables lower complexity on the encoding side, since the base codec it enhances is used at a quarter resolution. This also reduces complexity on the decoder side.

When using LCEVC for HD resolution (up to 1080p):

The encoder encodes the SD base layer and produces the additional LCEVC enhancement layer to help the reconstruction of the HD input signal.

The player decodes the AV1 base layer in SD and adds the LCEVC enhancement layer to reconstruct the HD signal.

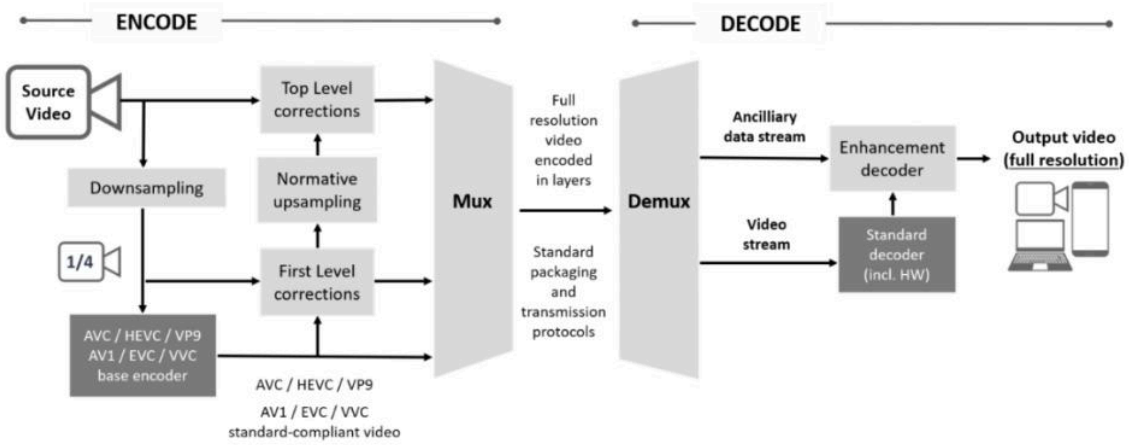


Figure 3: LCEVC processing workflow.

The concept

A paper jointly written [7] by Meta, Intel, and V-Nova looks specifically at SVT-AV1, the open-source software encoder developed initially by Intel and maintained by the Alliance for Open Media. In the case of SVT-AV1, LCEVC yields an approximate 40 percent reduction in computations while achieving the same quality levels according to VMAF_NEG (80 percent and higher according to VMAF).

LCEVC also enlarges the set of mobile devices capable of playing HD as well as high frame rate content encoded with AV1 and extends mobile battery life by up to 50 percent compared to state-of-the-art AV1 software decoding (for example dav1d).

In terms of quality, in the conservative convex hull transcoding scenario, LCEVC provides about 20 percent bitrate saving for the same computational complexity and quality level according to VMAF, and 5 to 10 percent according to VMAF_NEG.

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Integration

Encoder

On the encoder side, integration can be done easily, especially since V-Nova has developed an LCEVC SDK that has already been used by professional encoders for AVC, HEVC and VVC (including Harmonic, ATEME, MainConcept). It has also been integrated into popular open-source frameworks such as FFmpeg and GStreamer for enhancement of all codecs, including AV1 both in software with SVT-AV1 and hardware accelerated on platforms such as NVIDIA GPUs.

Decoder

On the player side, V-Nova provides an SDK through its download portal [8], including a native decoding library (LCEVCdec) and a JS/WebASM library (LCEVCdecJS), both available on GitHub. The LCEVC decoder is available for integration [9] into players using ExoPlayer (AndroidX-media3) from Google or AVPlayer from Apple. It has already been integrated by popular web players such as Shaka Player and TheoPlayer and is now appearing on the chipsets that power STBs and TVs, with recent demonstrations by Hisense, Realtek and Amlogic.

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Conclusion

LCEVC can provide a boost to AV1 for UGC applications not only on the encoding side, significantly reducing the encoder processing power (40 percent in convex hull tests), but also by increasing mobile battery life by 50 percent compared to a full AV1 resolution transmission. This is achieved while maintaining encoding efficiency and enabling a scalable multi-layer approach, which is relevant for many use cases.

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About MPEG-5 LCEVC technology

MPEG-5 Part 2 LCEVC is an ISO/IEC video compression standard from MPEG that works alongside any codec to improve efficiency and quality. It delivers up to 40% better compression and can cut transcoding costs and power use by up to 70%. Now mandated as part of Brazil's DTV+ (TV 3.0) standard, LCEVC runs across broadcast, streaming and device platforms and is supported by LCEVC capable devices and AI ready workflows. Learn more at www.lcevc.org.

About V-Nova

V-Nova, a London based IP and software company, is dedicated to improving data compression by building a vast portfolio of innovative technologies based on the game-changing use of AI and parallel processing for data, video, imaging, point cloud compression, with applications across several verticals.

This is achieved through deep-science R&D (300+ international patents) and the development of products that test, prove and continuously enhance the technology portfolio.

V-Nova LCEVC is the industry's first highly optimized library for encoding and decoding enhanced video streams with MPEG-5 Part 2, Low-Complexity Enhancement Video Coding (LCEVC). V-Nova VC-6 is a high-performance AI-powered software library for SMPTE VC-6 (ST-2117-1) which is used primarily for professional production workflows and imaging applications.

V-Nova has developed multiple award-winning software products to kickstart the ecosystems for its technologies and allow their immediate deployment, addressing use cases in TV, media, entertainment, social networks, eCommerce, ad-tech, security, aerospace, defence, automotive and gaming. V-Nova's business model is to monetize its technologies through software licensing, IP royalties and product sales.

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