

Companion to article 3.6 of Block 3 (Codec Evolution). Print on A4 or US Letter.

Identity - two royalty-free codecs from Google's On2 acquisition

VP8	Released by On2 Sep 2008; open-sourced May 2010 after Google's \$124.6M On2 acquisition
VP9	Frozen June 2013; ~40-45% lower bitrate than VP8; ~5-15% behind HEVC at matched quality
Reference	libvpx (BSD-style licence) - the encoder both FFmpeg and the WebM project link against
Container	WebM (Matroska profile) by default; both codecs also accepted in MP4 by most players

VP9 profile + level - what to ship where

Profile @ Level	Bit depth / chroma	Resolution / fps	Where it ships
Profile 0 @ 3.1	8-bit 4:2:0	1280 x 720 @ 30	Mobile, WebM-on-the-web
Profile 0 @ 4.1	8-bit 4:2:0	2048 x 1080 @ 60	1080p60 SDR streaming
Profile 0 @ 5.0	8-bit 4:2:0	4096 x 2160 @ 30	4K30 streaming
Profile 0 @ 5.1	8-bit 4:2:0	4096 x 2160 @ 60	DEFAULT: 4K60 SDR streaming
Profile 2 @ 5.1	10/12-bit 4:2:0	4096 x 2160 @ 60	4K HDR (YouTube HDR, broadcast)
Profile 1 @ 5.1	8-bit 4:2:2/4:4:4	4096 x 2160 @ 60	Niche professional
Profile 3 @ 5.1	10/12-bit 4:2:2/4:4:4	4096 x 2160 @ 60	High-bit-depth archival
Profile 0 @ 6.1	8-bit 4:2:0	8192 x 4320 @ 60	8K future / select TVs

FFmpeg + libvpx-vp9 recipes you will actually use

2-pass 1080p60 VOD, target 3 Mbps, quality preset:

```
ffmpeg -i in.mov -c:v libvpx-vp9 -b:v 3M -minrate 1.5M -maxrate 4.35M \
-pass 1 -row-mt 1 -tile-columns 2 -speed 4 -auto-alt-ref 1 -an -f null /dev/null
ffmpeg -i in.mov -c:v libvpx-vp9 -b:v 3M -pass 2 -row-mt 1 -tile-columns 2 \
-speed 1 -auto-alt-ref 1 -lag-in-frames 25 -c:a libopus -b:a 128k out.webm
```

4K HDR Profile 2 (10-bit BT.2020 PQ), constant quality:

```
ffmpeg -i in.mxf -c:v libvpx-vp9 -profile:v 2 -pix_fmt yuv420p10le \
-crf 28 -b:v 0 -row-mt 1 -tile-columns 3 -speed 2 -auto-alt-ref 1 \
-color_primaries bt2020 -color_trc smpte2084 -colorspace bt2020nc out.webm
```

Live ingest, 720p30 CBR, low-latency:

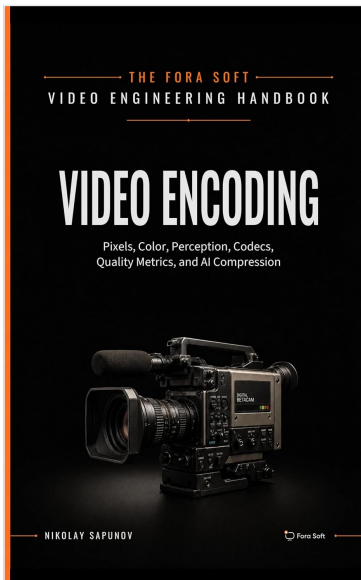
```
ffmpeg -re -i in -c:v libvpx-vp9 -b:v 2M -minrate 2M -maxrate 2M -speed 6 \
-row-mt 1 -error-resilient 1 -lag-in-frames 0 -g 60 -keyint_min 60 \
-auto-alt-ref 0 -c:a libopus -b:a 96k -f webm tcp://ingest:9000
```

WebRTC and 2026 browser / hardware decode snapshot

- VP8 is a WebRTC mandatory-to-implement video codec (RFC 7742, March 2016).
- Every Chrome, Firefox, Safari, and Edge ships VP8 + VP9 software decode in 2026.
- VP9 hardware decode: universal on Android post-2016, smart TVs post-2015, iOS 14+ (HW on A15+).
- Chrome on Linux: VP9 software decode yes; hardware decode patchy (VA-API dependent).
- VP8 hardware decode is rare - the WebRTC use case rarely needs it (CPU decode is fine).

Why VP9 is ~40-45% smaller than VP8

- 64x64 superblocks recursively split to 4x4 (VP8 fixed 16x16), with rectangular partitions.
- 10 intra modes including TrueMotion + smarter neighbour use; rectangular intra splits.
- Eighth-pixel motion + 8-tap luma filter (VP8: quarter-pel + 6-tap); 3 references incl. alt-ref.
- Transforms grow to 32x32 plus ADST for asymmetric residuals (VP8: only 4x4).
- Tile-based parallel decoding + libvpx row-mt; saturates 8-16 CPU cores at 4K60.



GO DEEPER · VOLUME 1 OF 7

Video Encoding: A Complete Guide to Video Compression

From Pixels and Color to H.264, HEVC, AV1, Quality Metrics, and AI

By Nikolay Sapunov, CEO at Fora Soft · 1,522 pages · Kindle & paperback on Amazon

Read it on Amazon →

amazon.com/dp/B0HF52B65R

This sheet keeps the VP9 profile and level matrix, working libvpx recipes and the 2026 decode snapshot on one page. Volume 1 goes deeper into the codecs behind it: VP8 and VP9 block structure and tools, how they compare with H.264, HEVC and AV1, rate control choices, and how to measure the quality you actually ship.

WHAT YOU WILL FIND INSIDE

- VP8 and VP9 internals: superblocks, intra modes, transforms
- Rate control: CRF, two-pass VBR and CBR for live
- Measuring quality with PSNR, SSIM and VMAF
- VP9 against H.264, HEVC and AV1 at matched quality
- Profiles, levels and bit depth for HDR delivery

THE FULL HANDBOOK · 7 VOLUMES · 9,000+ PAGES · ALL ON AMAZON

Vol. 1 · Video Encoding — pixels and color to H.264, HEVC, AV1, quality metrics and AI

Vol. 2 · Video Streaming I — network transport, contribution and ingest, HLS, MPEG-DASH, CMAF

Vol. 3 · Video Streaming II — ABR, CDNs, players, WebRTC, DRM and the economics of delivery

Vol. 4 · Audio for Video I — PCM, codecs, loudness, accessibility, real-time voice processing

Vol. 5 · Audio for Video II — jitter buffers, lip sync, Atmos, quality metrics, neural codecs

Vol. 6 · AI for Video I — models and inference, computer vision, speech, search, generative video

Vol. 7 · AI for Video II — real-time pipelines, agents, serving, cost, compliance, verticals

Choosing between VP9, AV1 and HEVC for your next ladder?

We will compare the codecs on your own content and devices and give you a ladder with encode cost and CDN savings worked out. 250+ video products shipped since 2005.

Book a 30-min call →

WhatsApp →

Email us →