Entropy Coding Cheat Sheet

Which entropy coder ships in which codec, plus quick-pick guidance for encoder builders.

1 · The three algorithms

Algorithm	What it does	Trade-off
Huffman (1952)	Optimal whole-bit prefix code. Wastes up to 1 bit/symbol vs Shannon limit.	Fast table lookup.
Arithmetic (1970s)	Fractional bits/symbol. Tracks Shannon limit almost exactly.	Serial data dependency.
CABAC (2003)	Binary AC + context modelling. 10–15% over CAVLC at same quality.	Throughput bottleneck.

2 · Which entropy coder ships in which codec

Codec	Entropy coder	Alphabet	Note
MPEG-2	Huffman (static tables)	Symbol-by-symbol	Set-top box era; required all profiles.
H.264 Baseline / Extended	CAVLC	Symbol-by-symbol	Universal fallback; no CABAC in these profiles.
H.264 Main / High	CABAC	Binary	Default for streaming; 10–15% smaller than CAVLC.
HEVC / H.265	CABAC (redesigned)	Binary	Mandatory in all profiles; 153 contexts.
VP9	Boolean binary AC	Binary	Predecessor of AV1.
AV1	Multi-symbol AC (daala_ec)	Up to 16 symbols	Patent-aware; better hardware parallelism.
H.266 / VVC	CABAC + multi-hypothesis	Binary	+3–5% bitrate savings traced to entropy stage.

3 · Quick-pick guidance

Streaming OTT / VOD	H.264 High + CABAC for broad reach; AV1 where decoders allow.
Surveillance / IoT camera	Often H.264 Baseline (CAVLC) by default — switch to Main + CABAC if hardware allows.
Live low-latency	CABAC; tune encoder preset for throughput. HEVC tiles help parallelism.
Premium HDR / 4K master	HEVC or VVC; the entropy stage carries 3–5% of VVC's gain.
Bandwidth-constrained mobile delivery	AV1 when supported; CABAC fallback on H.264 Main/High.

4 · Common mistakes

- Entropy coding is lossless — switching coders changes file size, not picture quality at the same bitrate.
- CABAC is NOT always on in H.264. Baseline / Extended profiles use CAVLC only. Check the profile, not the codec name.
- AV1 does not use CABAC. It uses daala_ec, a multi-symbol arithmetic coder with up to 16 symbols per step.
- Wider Huffman tables eventually cost more than they save — the rounding waste fix is arithmetic coding.