RDO and encoder-preset tuning - cheat sheet

Mode decision, lambda, RDOQ, presets - one page

Companion to article 4.12 of Block 4. Print on A4.

1. Lambda from QP (HEVC reference, x265, VVenC, SVT-AV1 tuned variant)

lambda_mode = 0.85 * 2^((QP - 12) / 3) lambda_motion = sqrt(lambda_mode)

QP	lambda_mode	lambda_motion	Use case
17	1.7	1.30	Visually lossless mezzanine, mastering
22	6.8	2.61	High-quality VOD (Netflix premium tier)
27	27.2	5.21	Streaming mainline (1080p H.264 / HEVC)
32	108.8	10.43	Mobile, bandwidth-constrained streaming
37	435	20.86	Bandwidth-limited surveillance, fallback

2. The cost equation

Per candidate: J = D + lambda * R where D = SSD vs original, R = entropy-coded bits.
Per coefficient (RDOQ): pick level that minimizes J including CABAC context cost; trellis-zeroes the tail.
Per block: enumerate -> SATD pre-filter to top-K -> full RDO on survivors -> pick min J -> commit.

3. Encoder presets (BD-rate vs CPU, indicative)

Encoder	Preset / flag	BD-rate vs slowest	CPU vs fastest
x264 (H.264)	--preset medium	+1-3%	~6x
x264 (H.264)	--preset placebo	0%	~80x
x265 (HEVC)	--preset medium --rd 3	+6%	~6x
x265 (HEVC)	--preset slower --rd 5	+1%	~20x
x265 (HEVC)	--preset placebo --rd 6	0%	~120x
SVT-AV1	--preset 8 --rdoq-level 1	+5%	~4x
SVT-AV1	--preset 4 --rdoq-level 1	+1%	~18x
libaom (AV1)	--cpu-used 4	+3%	~10x
VVenC	fast	+7%	~6x
VVenC	medium	+3%	~14x

4. RDOQ knobs - which flag turns it on

x264 - --trellis 0 / 1 / 2 (default 1 at medium; 2 at slow and above).
x265 - --rdoq-level 0 / 1 / 2; implicitly enabled at --rd 4, 5, 6.
libaom (AV1) - on by default at slow presets; disable with --disable-trellis-quant.
SVT-AV1 - --rdoq-level 0 / 1; default 1 at preset <= 8.
VVenC - --rdoq 0 / 1 / 2; default 1 at preset >= fast.
VTM (VVC reference) - RDOQ config key in cfg file; default ON in Random Access.

5. Debugging quick reference

Visible blocking at expected QP - check that deblocking and RDOQ are both on; not all presets enable RDOQ.
Slower preset increases bitrate - you compared at the same CRF, not the same VMAF; compare at iso-quality.
Screen content looks crunchy - enable --tune zerolatency + --tune-content screen (or codec equivalent).
x265 logs show ME/ME-RD ratios - high MV cost ratio means lambda_motion is dominating; investigate --psy-rd.
Aurora1 / neural mode aides - 1-2% BD-rate gain on top of fast presets; SATD replacement is the visible win.
Compare presets only at iso-bitrate or iso-VMAF, never iso-CRF; iso-CRF is misleading by design.

6. One-line CI contract

Run two encodes of the same source: preset A vs preset B at iso-bitrate; compute VMAF on both.
Assertion: VMAF(B) >= VMAF(A) - delta_target; CPU(B) <= cpu_budget; bitrate within +/-2% of target.
Catalog the (encoder, preset, CRF, VMAF, CPU) tuple in a benchmark table and re-run quarterly.