Transform Stage — cheat sheet

DCT, DST, ADST and integer transforms across H.264, HEVC, VP9, AV1, VVC. Companion to article 4.7 of Block 4. Print on A4.

1. Transform menu by codec

Codec	Primary	Secondary	Block sizes	Notes
H.264 / AVC	Integer DCT-II	Hadamard (DC)	4 / 8	4x4 core + 8x8 High profile
HEVC / H.265	DCT-II + DST-VII	–	4–32	DST-VII at 4x4 luma intra only
VP9	DCT + ADST	–	4–32	ADST for directional intra
AV1	DCT/ADST/FLIPADST/IDTX	–	4–64	Up to 16 2D transforms per block
VVC / H.266	DCT-II/DCT-VIII/DST-VII	LFNST	4–64	MTS or LFNST per block, not both
AV2 (draft)	Redesigned + DDTs	IST	4–64	Data-driven transforms, intra+inter IST

2. When each transform kernel wins

Kernel	Best on	Typical gain over DCT-only baseline
DCT-II	smooth inter residuals, flat regions	baseline
DST-VII	4x4 intra luma in HEVC	~1 %
DCT-VIII	small intra blocks in VVC	~0.5 %
ADST	directional intra residuals (VP9, AV1)	~2 %
FLIPADST	reverse-slope intra residuals (AV1)	~0.5–1 %
IDTX	screen content, isolated spikes (AV1, VVC TS)	5–15 % on screen
LFNST	low-frequency corner of intra blocks (VVC)	~1–2 %

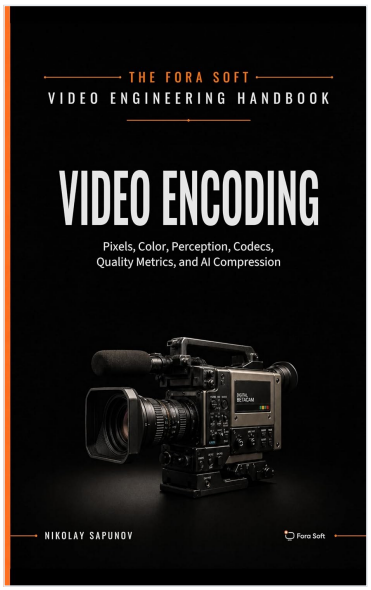
3. Tuning recipes by workload

Workload	Codec	Transform stage settings
VOD premium	AV1 / VVC	Full transform menu + LFNST/IST (intra), --tune=psnr or --tune=ssim
Live OTT 4K60	HEVC / AV1	DST-VII at 4x4 intra; tile-aligned transforms; --tune=zerolatency
WebRTC SFU	H.264	4x4 integer + Hadamard DC only; avoid 8x8 to keep CPU per stream low
Surveillance	HEVC / VVC	MTS on; LFNST off (sub-frames lose the gain); transform skip for screen
Screen content	AV1 / VVC	Allow IDTX / Transform Skip; expect 5–15 % win on text-heavy content

4. Pitfalls to avoid

- Blaming the transform for blockiness or banding — the loss happens at quantization. Lower QP instead.
- Leaving AV1's full transform search on for live — 3× encode time for ~2 % bitrate. Restrict the menu.
- Stacking VVC MTS and LFNST in vendor presets that ignore the mutual-exclusivity rule. Read the docs.
- Forgetting that H.264's 4x4 integer transform is a SCALED approximation — scaling lives in the quantizer.
- Using H.264 8x8 transform on Baseline decoders — it is High profile only and will not play.

Companion to: 'Transform Coding: DCT, ADST, and Integer Transforms'
www.forasoft.com/learn/video-encoding/articles/transform-coding-dct-adst-integer-transforms



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This sheet maps which transform each codec offers and when each kernel wins. Volume 1 goes inside the block: the DCT and its integer approximations, ADST and DST for intra residuals, quantization, and how H.264, HEVC and AV1 build on them, with quality metrics to check the gains.

WHAT YOU WILL FIND INSIDE

- DCT, ADST and integer transforms
- Coding tools in H.264, HEVC and AV1
- Quantization and where the loss happens
- Quality metrics to verify encoder tuning

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