Transcoding Pipeline Cheat Sheet

Five stages, two data types, four common pitfalls, the FFmpeg recipes

Companion to article 5.8 of Block 5. Print on A4 or US Letter. May 2026

The five stages and the data they pass

Stage	Input	Output	CPU share	What it does
Demux	bytes	packets	<1%	Unpacks the container (MP4, MKV) into streams
Decode	packets	frames	8-15%	Decompresses packets back into pixels or samples
Filter	frames	frames	5-15%	Scale, deinterlace, colour, denoise, overlay
Encode	frames	packets	70-85%	Compresses pixels into the target codec
Mux	packets	bytes	<1%	Interleaves and writes the output container

First decision: do you actually need to transcode?

Change container only (MKV -> MP4, MP4 -> TS)? -> **REMUX**. No decode, no encode.

```
ffmpeg -i in.mkv -c copy out.mp4
```

Change codec, resolution, bitrate, colour? -> **TRANSCODE**. Full pipeline.

FFmpeg recipes you will actually use

VOD H.264 1080p, x264 slow, CRF 21:

```
ffmpeg -i in.mov -c:v libx264 -preset slow -crf 21 -c:a aac -b:a 128k out.mp4
```

3-rung ABR ladder (1080/720/480) in one command:

```
ffmpeg -i in.mov -filter_complex "[0:v]split=3[a][b][c];\
  [a]scale=1920:1080[v1];[b]scale=1280:720[v2];[c]scale=854:480[v3]" \
  -map "[v1]" -c:v:0 libx264 -crf 21 -map "[v2]" -c:v:1 libx264 -crf 22 \
  -map "[v3]" -c:v:2 libx264 -crf 23 out_%v.mp4
```

GPU pipeline (NVDEC -> scale_npp -> NVENC), no PCIe round-trip:

```
ffmpeg -hwaccel cuda -hwaccel_output_format cuda -i in.mp4 \
  -vf "scale_npp=1920:1080" -c:v h264_nvenc -preset p5 -cq 23 out.mp4
```

Live ingest cleanup (regenerate timestamps):

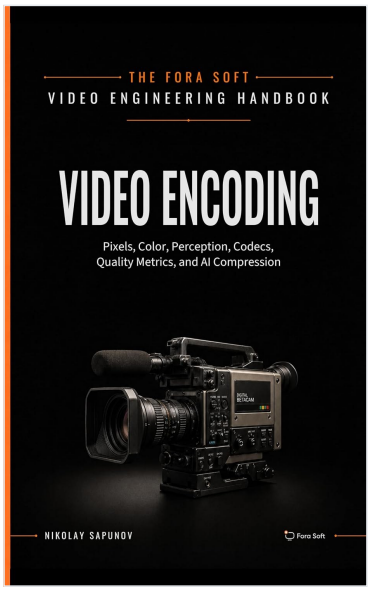
```
ffmpeg -fflags +genpts -avoid_negative_ts make_zero -i in.ts out.mp4
```

Four pitfalls to avoid

1. Re-encoding when you only needed to remux. Always ask: change container or change pixels?
2. Mixing CPU and GPU stages. Pick one device for the whole pipeline; PCIe copies kill speed.
3. Forgetting -map 0:a. Audio silently dropped is the most common output-is-silent bug.
4. Trusting live ingest timestamps. Use -fflags +genpts and -avoid_negative_ts make_zero.

> **Free 2-3x speedup on many-core machines**
>
> Upgrade past FFmpeg 7.0. Per-stage scheduler runs every demuxer, decoder, filter, encoder and muxer on its own thread, with bounded queues. No command change required.

Companion to: 'Transcoding Pipeline in Depth'
www.forasoft.com/learn/video-encoding/articles/transcoding-pipeline-decode-filter-encode-mux



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This sheet maps the five stages of a transcoding pipeline and gives you FFmpeg recipes for VOD, ABR ladders, GPU and live ingest. Volume 1 explains what happens inside the encode stage that takes most of the CPU: codecs and their tools, presets, rate control, and how to keep quality measurable across a ladder.

WHAT YOU WILL FIND INSIDE

- Where the encode stage spends its CPU
- Scaling, colour conversion and bit depth in the filter stage
- Presets and rate control in x264, x265 and SVT-AV1
- Measuring each ladder rung with VMAF

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