

## 1 - CONTENT TYPE

- Narrative film, premium scripted VOD, music videos *use 24 fps*
- Sports, esports, live action, fast-motion broadcast *use 60 fps (50 in EU)*
- Talking heads, conferencing, UGC, web video *use 30 fps (25 in EU)*
- Slow-motion source for cinematic delivery *shoot 120 fps, deliver 24*
- VR / AR / 120 Hz display targeting *use 120 fps native*

## 2 - SHUTTER ANGLE

- 180° shutter (1 / 2x fps) for natural-looking motion *default for most production*
- 45-90° shutter for sharp, urgent, staccato motion *Saving Private Ryan style*
- 270-360° shutter for dreamy, hyper-blurred motion *music videos, dream sequences*
- Same shutter angle preserved across all takes in a scene *consistency matters more than absolute value*

## 3 - AUDIENCE AND DISPLAY

- Cinema-style content for cinema-style viewers *stick to 24 fps*
- Audience expects sports / live aesthetic *60 fps fits expectations*
- Target devices include 60 Hz screens *30 / 60 plays cleanly*
- Target devices include 120 Hz screens *120 fps plays cleanly, 24 fps too*
- Mixed 60 Hz / 120 Hz audience *30 or 60 fps safest baseline*

## 4 - PIPELINE AND BANDWIDTH

- Higher fps verified against bitrate budget *60 fps = +50-70%; 120 fps = +200-300%*
- Codec supports the frame rate (H.264 caps at 60 / 4K) *HEVC or AV1 for 120 fps*
- Decode tested on oldest target device *120 fps may fail on pre-2023 hardware*
- VFR converted to CFR at ingest *phones often produce VFR*
- `ffprobe avg_frame_rate` matches `r_frame_rate` *if not, you have VFR*

## 5 - JUDDER AND PULLDOWN

- 24 fps content not interpolated for 60 Hz playback *kills cinematic feel*
- 3:2 pulldown disabled when target supports 120 Hz *120 / 24 = 5 cleanly*
- Motion smoothing off for narrative content *soap opera effect*
- Slow camera pans at 24 fps to avoid judder *physical solution, not encoder*

### TOP-3 FRAME-RATE BUGS IN PRODUCTION

- \* Cinema content auto-interpolated to 60 fps - viewers complain of 'soap opera' look, drop in perceived quality.
- \* VFR phone footage in editing timeline - frames drift, audio sync breaks at export.
- \* 120-fps HEVC streamed to old iPhone - decode falls back to software, battery drain, dropped frames.