

Companion to article 5.4 of Block 5.

## 1. Pick a method (walk top to bottom)

- Q1. Live or VOD? LIVE -> go to Q2 ; VOD -> go to Q3
- Q2. Latency budget under 2 seconds? YES -> Audience-adaptive ladder ; NO -> Neural-network inference
- Q3. View count above 100k/year per title? YES -> Brute-force test encodes ; NO -> Lookahead + CAE model
- Q4. In all branches: layer context-aware encoding (CAE) on top to prune by audience devices + bandwidth.

## 2. Brute-force test-encode grid (Netflix-style convex hull)

Resolution	QP / CRF sweep	Output points	Notes
360p	CRF 22, 26, 30, 34	4 points	Sets the floor
480p	CRF 22, 26, 30, 34	4 points	Often wins below 1.0 Mbps
720p	CRF 20, 24, 28, 32	4 points	Typical mid-range winner
1080p	CRF 18, 22, 26, 30	4 points	Wins above ~5 Mbps on complex content
1440p	CRF 18, 22, 26	3 points	Add only for >100k/year titles
2160p	CRF 18, 22, 26	3 points	Add for premium VOD only

## 3. Convex hull picker (after the test encodes)

- Plot every (bitrate, VMAF) point. Discard any point dominated by another (higher bitrate AND lower VMAF).
- Trace the upper envelope through the survivors - that is the convex hull for this title.
- Pick rungs along the hull at the bitrates your audience actually uses (from playback analytics).
- Target VMAF for top rung: 95 (broadcast-grade). Target for bottom rung: 70-75 (recognisable).

## 4. Live streaming variants

Variant	Latency	Typical saving	Used by
Chunk-level rate control	2-6 s	5-15%	Most cloud encoders
Audience-adaptive ladder	Stream-wide	5-15%	Mux, AWS MediaLive
Online per-scene (OPSE)	1-3 s	~25%	Research (ATHENA), early prod
Neural-net per-title	Milliseconds	15-35%	Mux Instant Per-Title

## 5. Pre-flight before shipping a new ladder

- [ ] Test encoded ladder against a known-hard clip (action / sports) and a known-easy clip (talking-head).
- [ ] Confirm shot boundaries align with GOP boundaries; force keyframes at every detected shot cut.
- [ ] Verify CDN egress estimate on top-3 most-watched titles vs current ladder.
- [ ] Run constrained-bandwidth playback test (cap to 1.5 Mbps, 3 Mbps, 6 Mbps); confirm switch behaviour.
- [ ] Record baseline VMAF per rung; gate any future encoder change on matching or beating that VMAF.