

Enhancing Video Quality in Transcoding Pipelines: Boost your VMAF and save on delivery with lower bitrate

Optimizing Quality of Experience (QoE) and delivery cost with VisualOn Optimizer integration in Cires21 solutions

Executive Summary.

In a previous white paper, we assessed that **VisualOn's Optimizer** integrated into the **Cires21** video transcoding pipeline shows drastic quality improvements — measured with VMAF scores — for all popular codecs (AVC, HEVC, AV1) on all tested platforms: software encoding, GPU encoding and VPU encoding.

In this update, we focus on **average bitrate**, and we can confirm: not only does the solution bring better quality, it also delivers that quality at a lower average bitrate — translating immediately into cost savings on CDN expenditure and storage.

Key Results

- 01.** Software encoding holds or improves visual quality while cutting average bitrate by 59% to 76% across the whole ABR ladder.
- 02.** NETINT and Intel QuickSync combine drastic quality gains on the lower rungs with 39% to 63% bitrate savings.
- 03.** On NVIDIA NVENC the quality boost of 6 to 15 VMAF points is achieved at iso-bitrate — better pictures at no extra delivery cost.

Methodology.

Retaking the extensive tests performed for the previous white paper — where the focus was on visual quality — Cires21 wanted to make sure that the quality gains were not obtained at the price of a higher bitrate.

To verify this, each output file after transcoding has been measured in terms of average bitrate, comparing what is achieved with "standard" transcoding and what is achieved with Optimizer, rung by rung across the same ABR ladder.

Reading the tables: VMAF is a perceptual quality metric where 100 is identical to the source and a difference of 6 points is generally considered one Just Noticeable Difference (JND). Bitrate figures are averages in kbps; the bitrate delta is expressed as savings versus standard transcoding, so a negative value means a slight bitrate increase.

Software encoders offer flexibility but often struggle to balance CPU load with quality. The integration of the Optimizer showed **huge savings in bitrate across the whole ABR ladder**, while keeping or improving the visual quality.

H.265/HEVC (Software)

An impressive gain of 59% for 1080p, rising above 70% for the lower resolutions, while still matching or improving visual quality.

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	90.56	92.95	+2.39	4298.3	1780.9	59%
720p	84.45	88.57	+4.12	3432.3	1083.4	68%
540p	76.02	82.05	+6.03	2118.9	656.0	69%
423p	66.64	65.78	-0.86	1260.6	368.1	71%
360p	56.27	56.06	-0.21	829.1	248.7	70%

H.264/AVC (Software)

Similarly for H.264, the Optimizer needs a lot fewer bits – 64% to 76% less – while improving visual quality almost up to the level of HEVC at 1080p.

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	86.49	93.04	+6.55	5000.7	1809.0	64%
720p	81.92	88.79	+6.87	4000.7	1087.8	73%
540p	73.64	80.48	+6.84	2500.7	617.0	75%
423p	64.62	63.24	-1.38	1500.7	354.1	76%
360p	54.51	52.99	-1.52	1000.7	240.1	76%

Software-Based Encoding.

NVIDIA NVENC

With NVIDIA's NVENC, the Optimizer achieves massive gains in quality across all tested codecs while keeping the average bitrate on par: **the quality boost is not paid for with a higher bitrate.**

H.265/HEVC (NVENC)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	87.32	95.15	+7.83	4346.7	4438.6	-2%
720p	79.96	91.10	+11.14	3511.5	3543.4	-1%
360p	50.88	66.23	+15.35	878.7	888.1	-1%

H.264/AVC (NVENC)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	87.02	94.70	+7.68	5000.1	5000.1	0%
720p	80.23	91.04	+10.81	4000.1	4000.1	0%
360p	50.95	66.12	+15.17	1000.1	1000.1	0%

AV1 (NVENC)

Even with the modern AV1 codec, the Optimizer provides essential gains, particularly stabilizing the lower resolutions.

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	88.22	94.63	+6.41	4636.0	4987.7	-8%
360p	52.02	66.76	+14.74	997.1	947.2	5%

Hardware Acceleration.

NETINT

Using NETINT ASIC-based transcoding, the Optimizer gives its full power: visual quality is improved at all rungs, **with drastic bitrate reduction in all cases.**

H.265/HEVC (NETINT)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	87.63	88.89	+1.26	4466.6	1815.2	59%
720p	78.79	88.91	+10.12	3560.4	1511.8	58%
432p	53.58	73.04	+19.46	1338.0	715.2	47%
360p	45.32	63.79	+18.47	895.2	497.7	44%

H.264/AVC (NETINT)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	87.21	86.83	-0.38	4472.6	2196.8	51%
360p	45.09	63.67	+18.58	896.0	546.2	39%

AV1 (NETINT)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	87.89	79.11	-8.78*	4467.8	946.7	79%
720p	78.97	82.96	+3.99	3559.7	751.5	79%
360p	48.33	56.64	+8.31	896.9	253.3	72%

*This abnormality in VMAF degradation at 1080p is not related to the Optimizer; the case has been reported to NETINT.

Hardware Acceleration.

Intel OneVPL / QuickSync

With Intel's QuickSync, the Optimizer brings the lower resolutions to a much better quality, while reducing the average bitrate by more than half.

H.265/HEVC (Intel)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	94.08	95.18	+1.10	4999.6	1970.0	61%
720p	78.61	95.98	+17.37	3999.8	1488.1	63%
576p	62.47	91.93	+29.46	2500.0	924.9	63%
423p	51.25	67.89	+16.64	1500.2	562.1	63%
360p	45.76	62.63	+16.87	1000.3	392.1	61%

H.264/AVC (Intel)

Resolution	VMAF			Average bitrate (kbps)		
	Standard	Optimizer	Δ	Standard	Optimizer	Saving
1080p	94.08	94.62	+0.54	4999.6	1970.5	61%
720p	78.61	92.20	+13.59	3999.8	1653.1	59%
576p	62.47	85.35	+22.88	2500.0	1054.9	58%
423p	51.25	66.59	+15.34	1500.2	646.4	57%
360p	45.67	58.25	+12.58	1000.3	437.3	56%

Hardware Acceleration.

The integration of **VisualOn's Optimizer** into the **Cires21** ecosystem delivers measurable, high-impact improvements across almost all tested scenarios in terms of visual quality, alongside more than substantial savings in average bitrate.

This is a double win: more quality for the end users, less cost for content delivery and storage.

Key Findings

- 01. Software encoding.** The Optimizer matches or slightly improves visual quality, with 59% to 76% bitrate savings.
- 02. Intel QuickSync and NETINT.** Both benefit from the same level of savings, with at the same time drastic quality improvement — especially for the lower rungs in the bitrate ladder.
- 03. NVIDIA NVENC.** The quality boost is achieved at iso-bitrate; further work might bring this platform to the same level as the others for bitrate savings.
- 04. Flexibility.** The tests conducted for this paper all used the Optimizer's default target quality setting. The Optimizer can be easily tuned to balance the quality / savings factor, enabling less or more savings and more or less quality depending on your needs and use case.

Conclusion.

For Cires21 customers, this translates directly into **lower CDN and storage costs at equivalent or better quality**, and a more consistent viewing experience regardless of the end user's device or network conditions.