

Major Metrics and Key Indicators of Video Quality Faults in Linear Broadcasting

How to measure perceptual
video quality when the source
file is missing



Presented by:

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Why measuring quality is important for cable operators



The challenge most operators face today is how to keep the subscriber base loyal, provide the same or higher quality of video content as compared with OTT, IPTV and Satellite operators.

Obstacles

- No source/raw video
- Several subsequent transcodings of the content
- Various encoding parameters for different delivery channels

Video compression quality metrics



PSNR

APSNR

MSE

SSIM

VQM

MSAD

DLM

DELTA

MCPD

VIF

VMAF

VMAF phone

NQI

AN-SNR



PSNR – Peak Signal to Noise Ratio

Concept	Measures actual distortion		
Formula	$PSNR = 10 \cdot \log_{10} \left(\frac{MAX_I^2}{MSE} \right)$, where $MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i, j) - K(i, j)]^2$ <p>$I(i, j)$ – original pixels $K(i, j)$ – pixels distorted by lossy compression</p>		
Human perception	Actual distortion is correlated with distortion visible by human eyes, but it is far from being 100% accurate		
Interpretation	<table border="1"><tr><td>> 45 – nobody can see any difference 40-45 - very high quality 38-40 – good enough</td><td>35-38 – visible artifacts 30-35 – poor quality < 30 – very bad quality</td></tr></table>	> 45 – nobody can see any difference 40-45 - very high quality 38-40 – good enough	35-38 – visible artifacts 30-35 – poor quality < 30 – very bad quality
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VMAF – Video Multi-Method Assessment Fusion

Concept	<p>Predicts subjective video quality based on a reference and distorted video sequence.</p> <p>Combination of four metrics:</p> <ul style="list-style-type: none">• VIF (Visual Information Fidelity)• DLM (Detail Loss Metric)• MCPD (Mean Co-Located Pixel Difference)• AN-SNR (Anti Noise Signal to Noise Ratio)
Formula	<p>Formulas are ten times longer than SSIM's</p>
Human perception	<p>Highest approximation to human vision among all metrics.</p>
Interpretation	<p>Range: 0-100 < 50 – bad quality 75-85 – good > 95 – very good</p>

Encoded video with PSNR = 27.2 vs Raw



Images look very similar

Elecard VideoQuest 4

File View Navigation Help

Temperature Stream A RAW

A : part6_hm13_qp32.h265 Diff : Temperature RAW : part6_1920x1080_420.yuv

Graphics

stream frame 79 PSNR

name	value
A - RAW	
Y	27.209
U	31.738
V	37.651

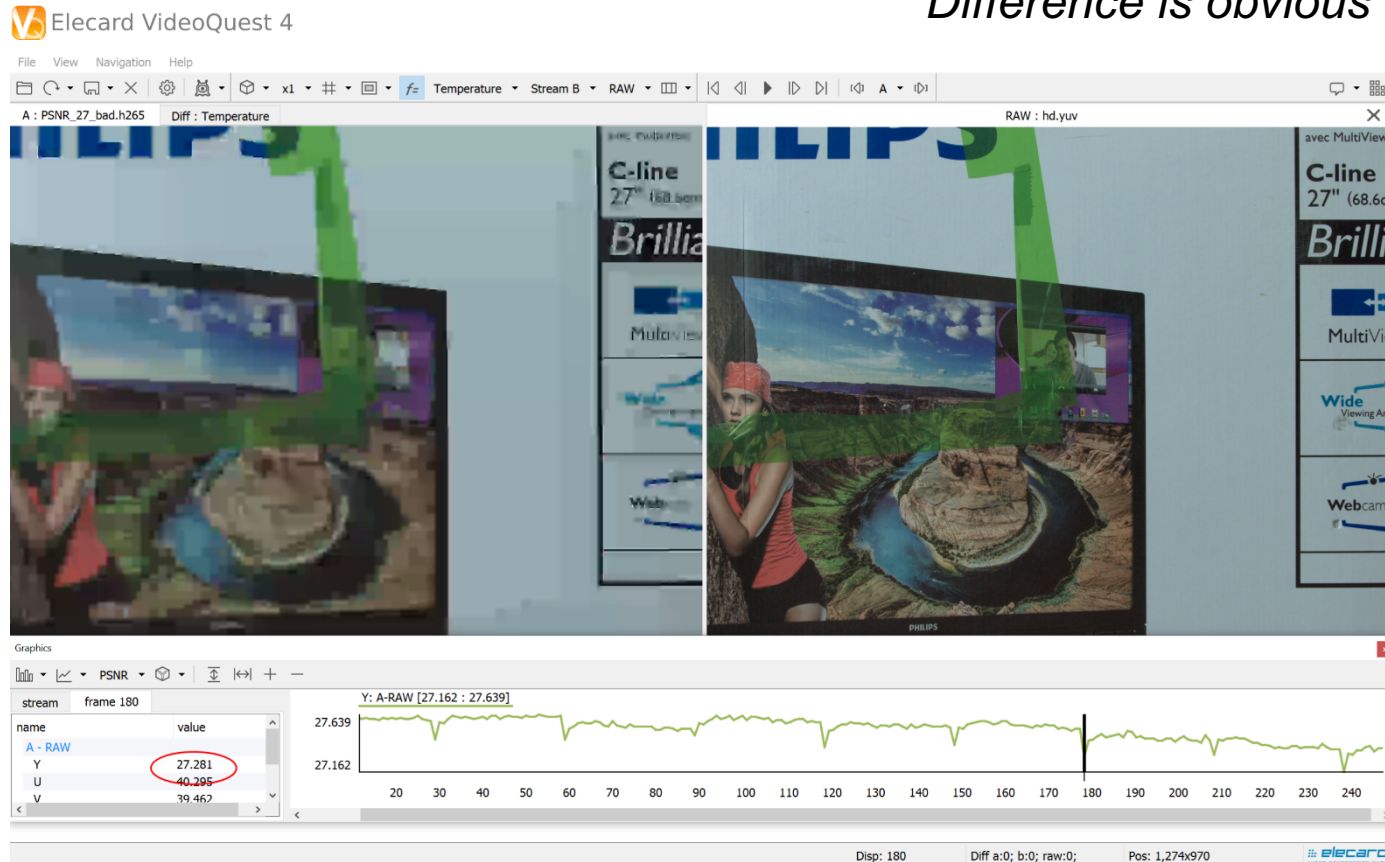
Y: A-RAW [27.209 : 33.972] Bit Allocation A_i

Disp: 79 Diff a:0; b:0; raw:0; Pos: 1,278x904 elecard

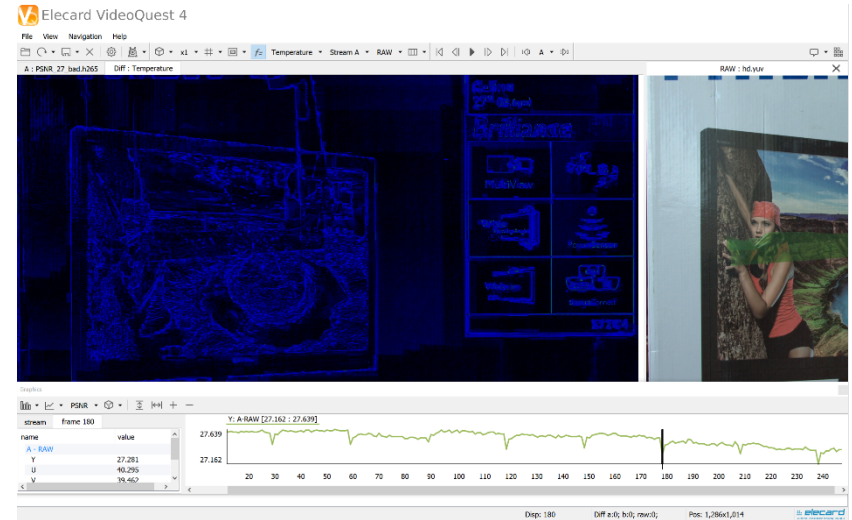
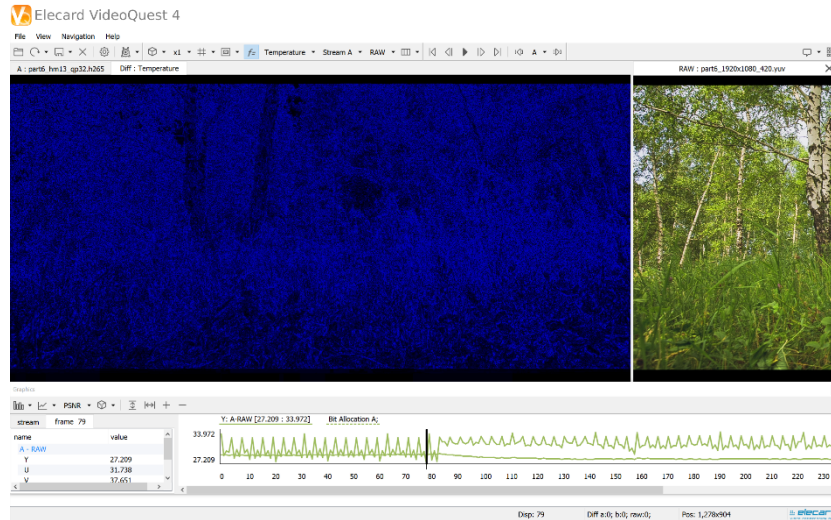
Encoded video with PSNR = 27.2 vs Raw



Difference is obvious



Calculated difference between compressed and original images



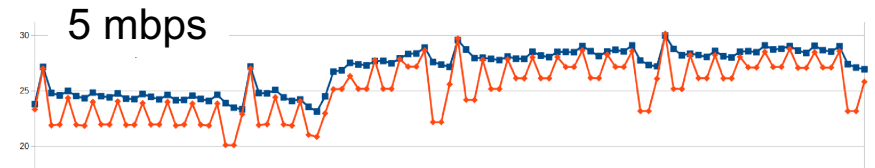
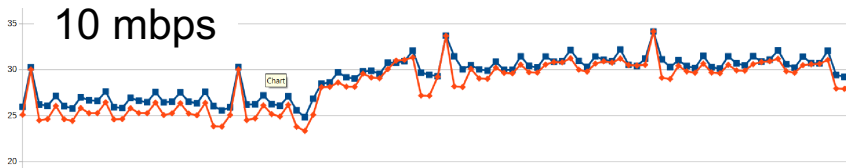
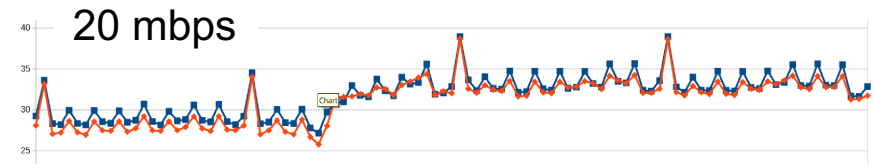
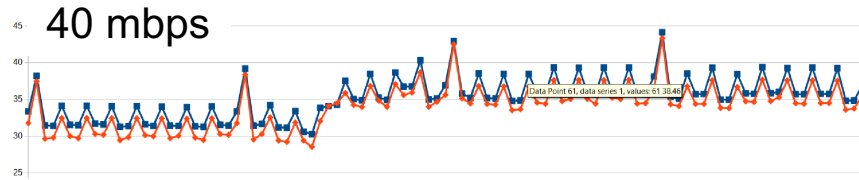
EPSNR - Estimated Peak to Signal Ratio

Metric developed by Elecard



Concept	Estimate how much video was affected during the last compression in case of absence of source video
Formula	EPSNR measures a relative size of quantizer to quantized DCT coefficient
Human perception	Works better with higher coefficients and lower quantizers, i.e. for high motion, detailed video encoded at high bitrates.
Interpretation	The same as PSNR Common range: 0.9 – 1 Good quality > 0.95

EPSNR - Estimated Peak to Signal Ratio Metric developed by Elecard

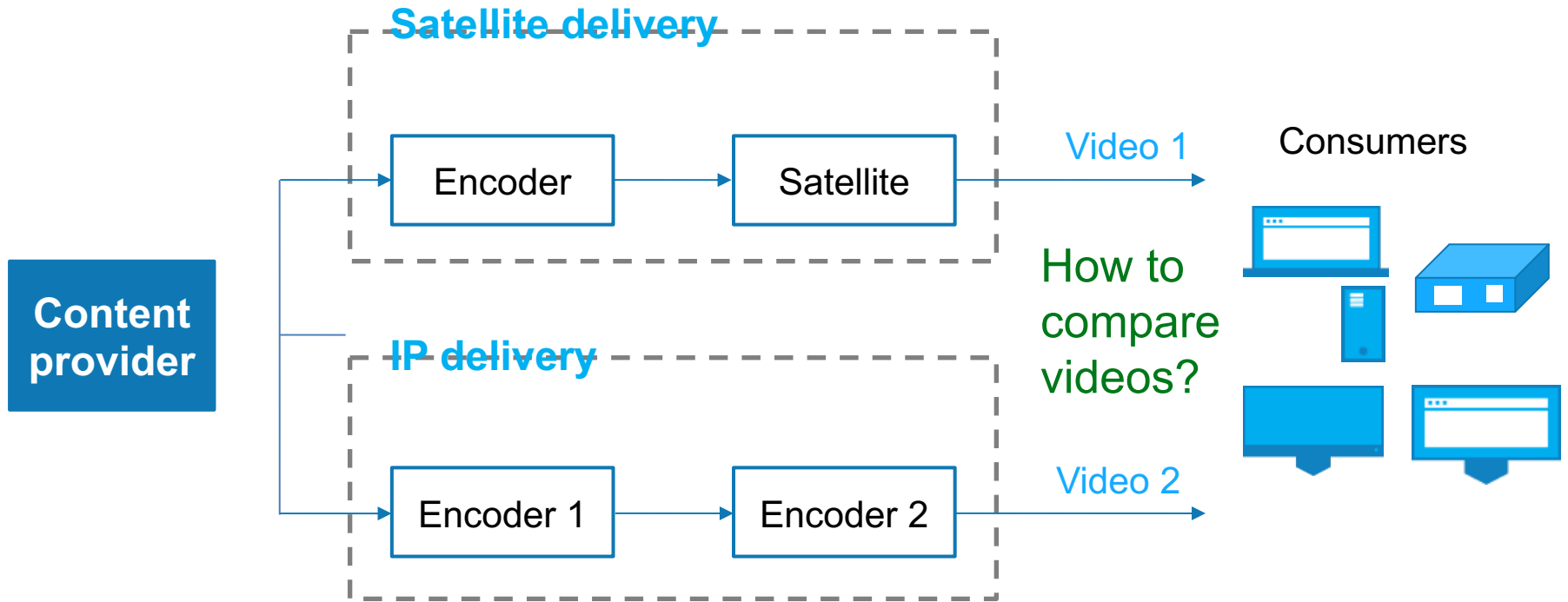


PSNR EPSNR

Scale in db, Video – 1080p, a lot of small details, extremely hard to encode

Model works fine for the range 10-40 mbps, while at 5 mbps shows significant problems with B-frames. EPSNR measures distortion of the latest compression and doesn't work well if there has been a few compressions in a row.

Comparing quality of streams delivered via IP and satellite

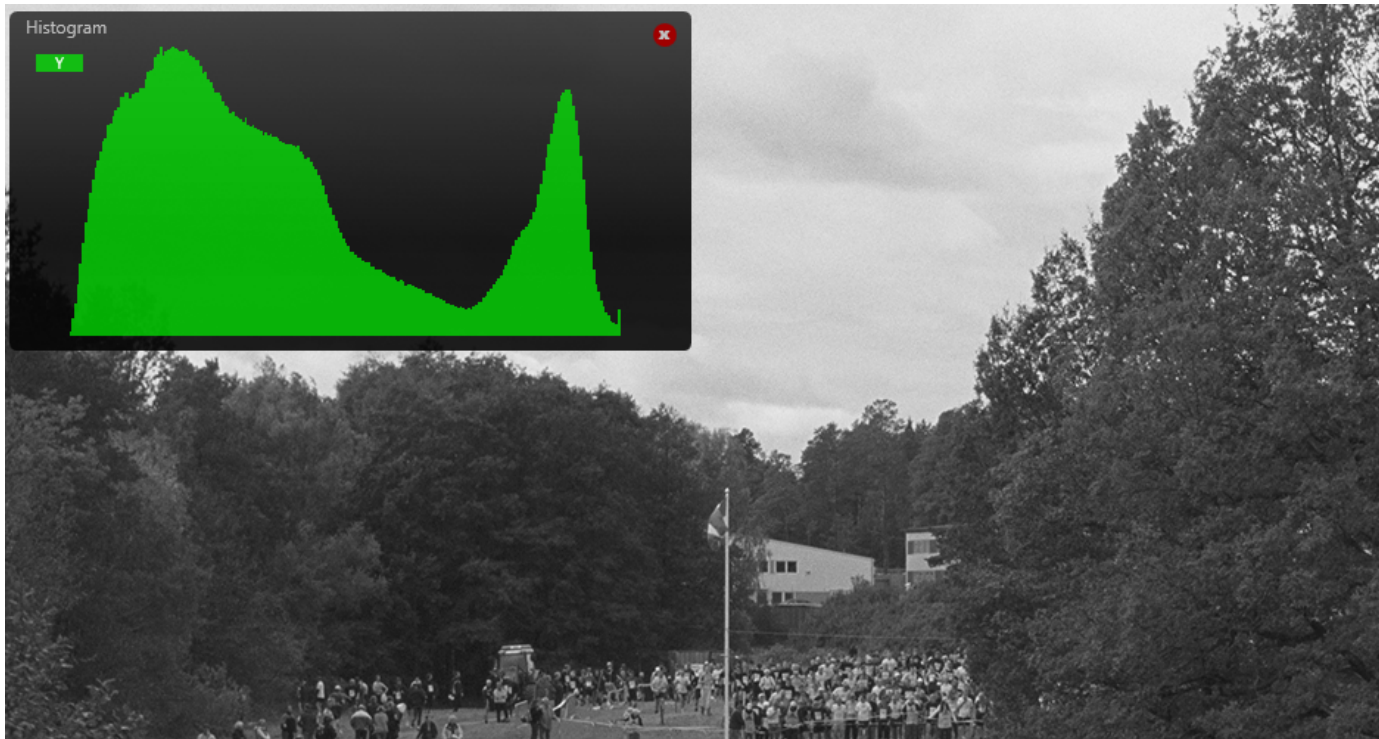


Comparing luminance histograms



Uncompressed image

Smooth curve without thin peaks



Compare it to the lungs of a heavy smoker

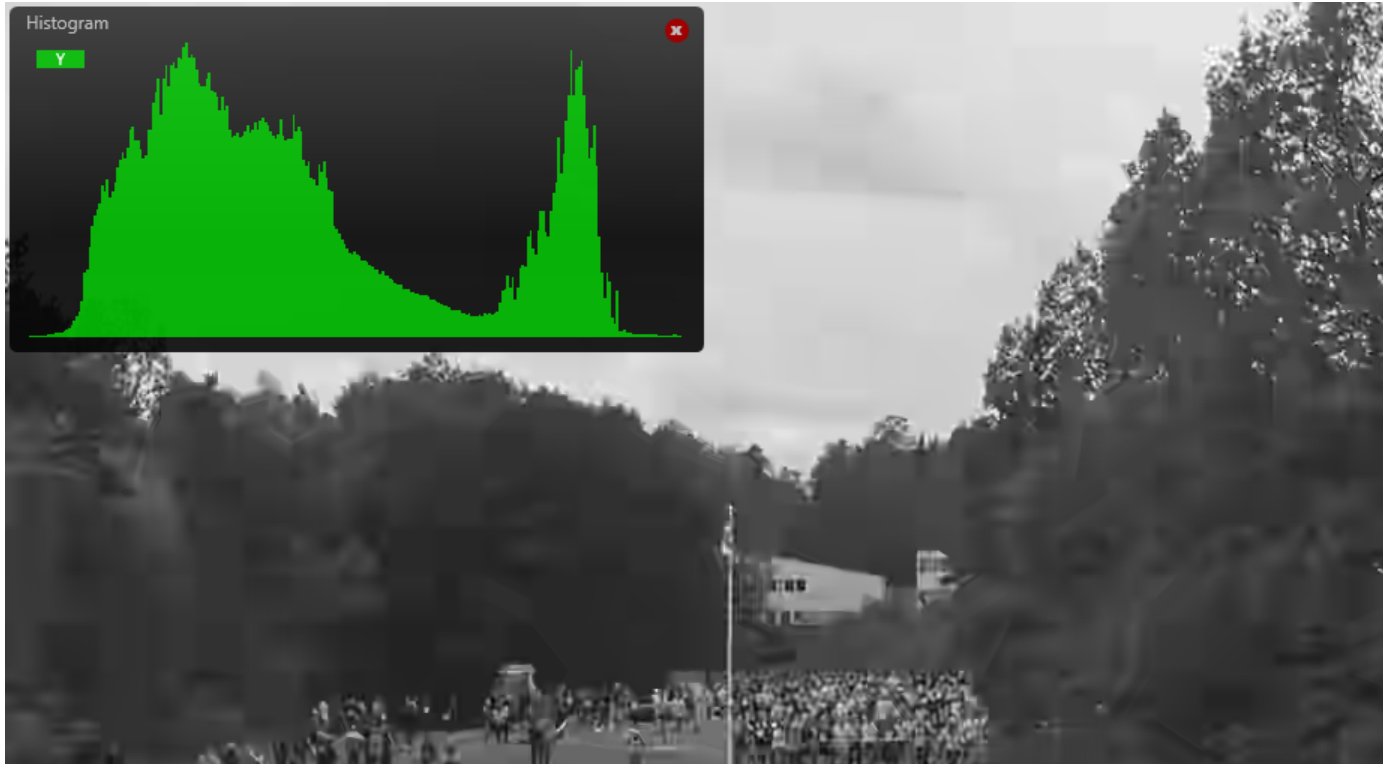
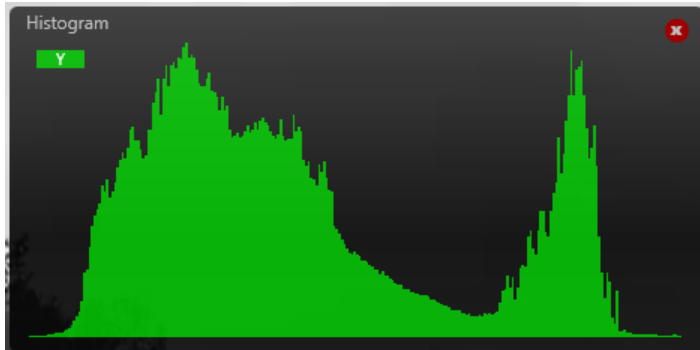


Compare it to heavily compressed image

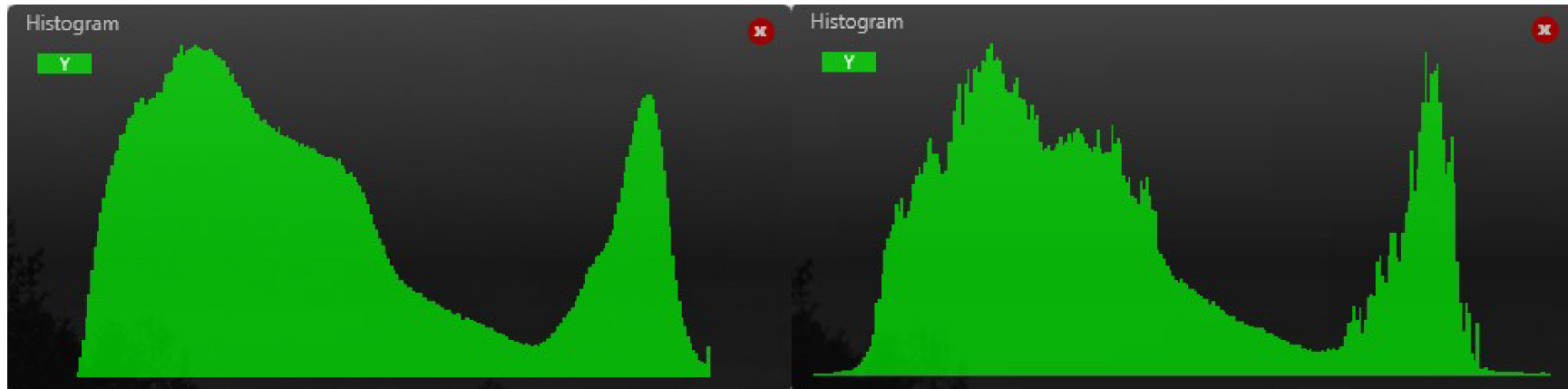


Heavily compressed image

Not that smooth plus a lot of thin peaks



Comparing luminance histograms



NDR – Number of Details Ratio



Concept	Calculate ration of number of details in the source and compressed videos
Formula	Elecard AVC Encoder with some modifications
Human perception	Close to VMAF, need to run more comparisons tests
Interpretation	Shows %% of details comparing with the “good” video. < 40% – bad < 50% – significant difference 70% – good enough 90% - almost the same

NDR metric against PSNR / SSIM / VMAF



NDR	PSNR	VMAF	SSIM
2.2%	27.2	34	0.82
30%	21	13	0.52
58%	27.5	75	0.82
69%	31	85	0.929
70%	32	87	0.94
87%	41	99	0.989
95%	48.4	99.9	0.998

NDR benefits



- Quality estimation is highly approximated to human perception
- No source/raw video is required
- Subsequent transcodings of the content is not an obstacle
- Videos with various video parameters delivered via various channels can be compared
- No access to end-user decoding device is required

Q&A



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Share your experience and
challenges with video quality
estimation!