Victor Steinberg, Roderick Snell

VideoQ Products & Technologies

Presentation

June 2024

www.videoq.com

About VideoQ

Customers & Partners

Company History

- Founded in 2005
- Formed by an Engineering Awards winning team sharing between them decades of global video technology.
- VideoQ is a renown player in calibration and benchmarking of Video Processors, Transcoders and Displays, providing tools and technologies instantly revealing artifacts, problems and deficiencies, thus raising the bar in productivity and video quality experience.
- VideoQ products and services cover all aspects of video processing and quality assurance - from visual picture quality estimation and quality control to fully automated processing, utilizing advanced VideoQ algorithms and robotic video quality analyzers, including latest UHD and HDR developments.

Operations

- Headquarters in CA, USA
- Software developers in Silicon Valley and worldwide
- Distributors and partners in several countries
- Sales & support offices in USA, UK

VideoQ Product Lines

VQL – Comprehensive Library of sophisticated test patterns

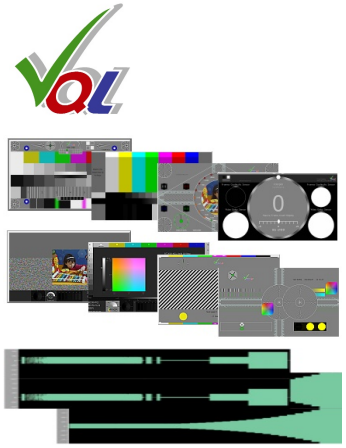
VQPT – Suite of Productivity Tools for cloud transcoding & streaming

VQV – Video Files Viewer-Analyzer

VQMP – Media Player-Analyzer

VQTS – Complete Video Quality Test Systems

VQDM – Video Latency & AV Sync Analyzer



1. VQL – Video and Audio Test Patterns Library

- VideoQ static and dynamic test patterns are available in a variety of video and audio formats, aspect ratios and frame rates, resolutions from 192x108 to 8K
- VQL files are designed to be compatible with all commonly used software or hardware codecs and media players
- All test patterns remain suitable for accurate measurements even after low bitrate coding, heavy scaling and/or cropping, color space and dynamic range conversion
- Full custom compressed and uncompressed test files and application-specific live video clips are available on request

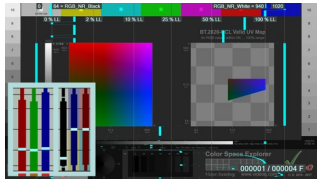
Learn more about **VQL** Test Patterns: www.videoq.com/vql.html

VideoQ Approach to Test Patterns Usage

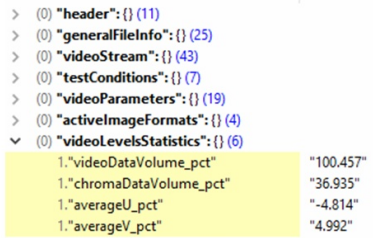
VideoQ approach combines “classic”, “digital” and “cloud” methodologies, sharing **same test patterns** and covering all **3 levels** of **video quality control**:

Instant visual-aural quality estimation

Objective measurements of video and audio parameters



Fully automated Quality Control

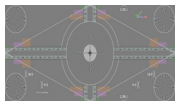


VideoQ Test Patterns by Categories

1. Color Space, Gradations and Linearity Tests – **GradTracker™** series,
   *including the widely used **VQCB Wonder Bars™** – **V**ideo**Q** **C**olor **B**ars suite*
   1.a Special **HDR** (High Dynamic Range) Tests, **HDR-PQ** and **HDR-HLG** versions

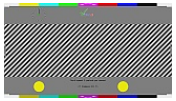


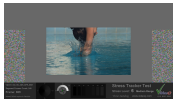
2. Geometry, Scaling, SR and Sharpness Tests – **ScalTracker™** series




3. Motion Portrayal Tests and AV Sync Tests – **ChronTracker™** series,
   checking AV Latency, Frames Continuity, De-Interlacing, and more


4. Compression Quality Tests – **StressTracker™** series





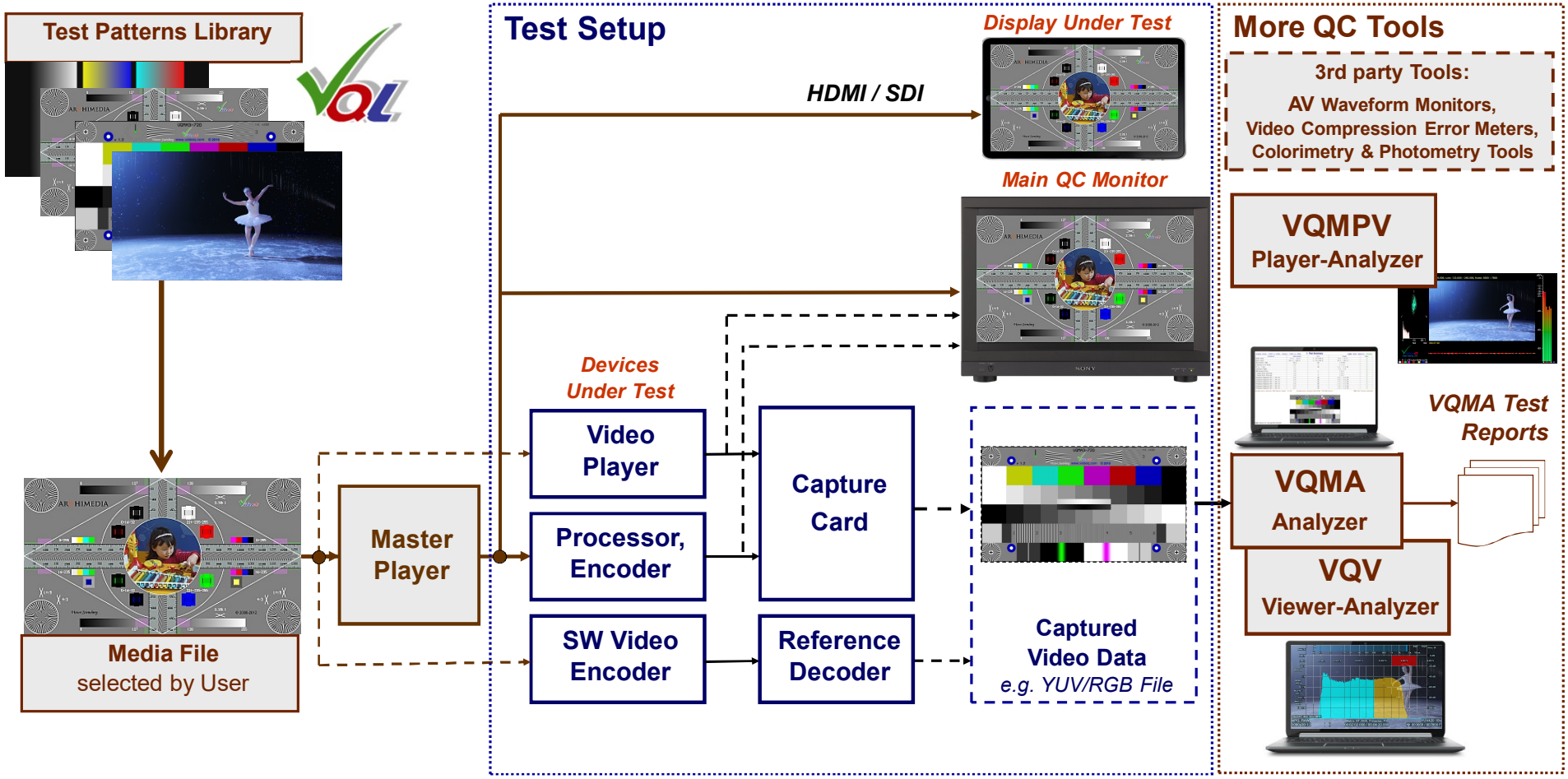
5. Static and Dynamic Multi-purpose Test Charts,
   *including widely used **VQCB**, **VQMA** and **VQMPC** tests*



6. Reference Live Clips in a variety of formats


7. Audio Tests

VQL Workflow Variants

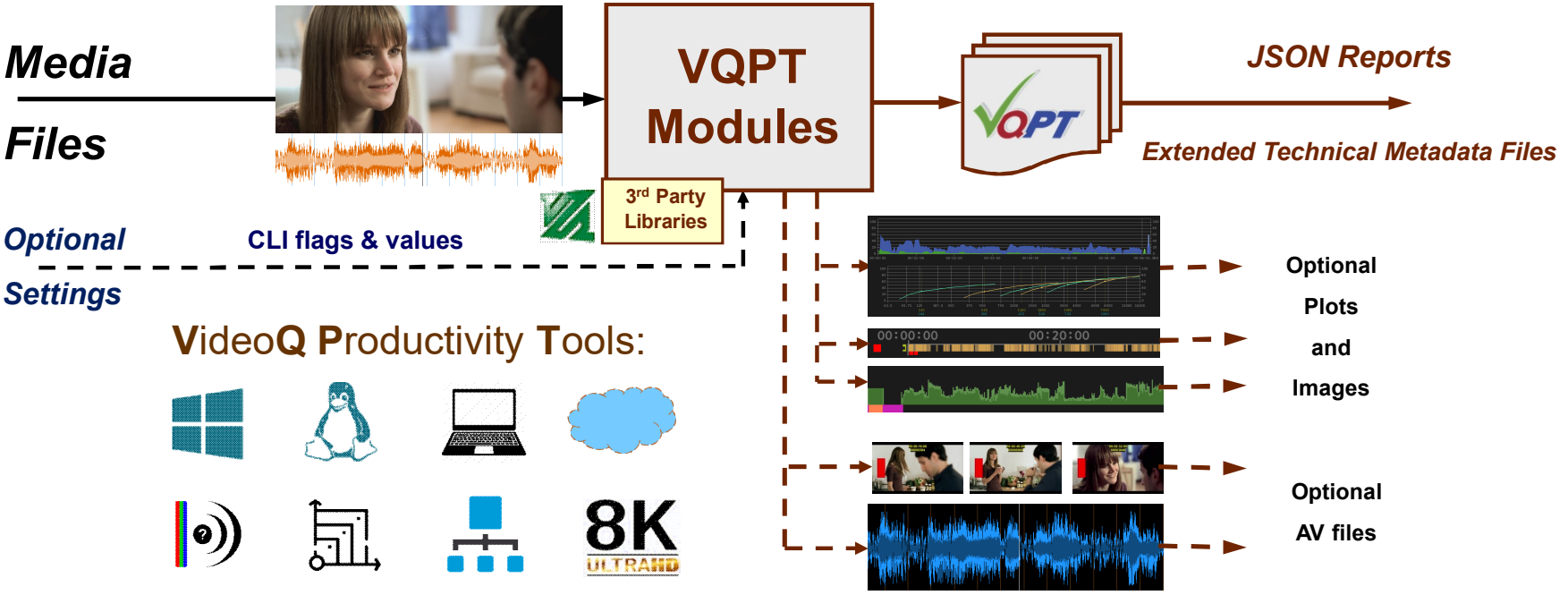


2. VideoQ Productivity Tools

VQPT is a suite of portable Windows/Linux CLI programs for on premises and cloud computing.

It can be used for production, post-production and distribution applications.

The program modules can be purchased and used separately or grouped for typical applications.



Learn more about **VQPT** suite: www.videoq.com/vqpt.html www.videoq.com/vqpt_packs.html

VQPT Packages

VQPT program modules can be used separately or grouped for the following typical applications:

Pack 1. Target Application: **Workflow Health Tests**

VQMINF – Media File Info Report Generator
VQCBA – VideoQ Color Bars Analyzer, companion program for **VQCB** test patterns — www.videoq.com/vqcba.html
VQCSA – Compression Stress Analyzer, companion program for **VQCST** test patterns
VQMA – Video Analyzer for objective video processing chain integrity tests — www.videoq.com/vqma.html

Pack 2. Target Application**: Encoding, Transcoding and CDN Optimization**

VQMINF – Media File Info Report Generator
VQBIF – BIF (Base Index Frames) Files Verifier
VQBLA – Bitrate Ladder Analyzer
VQCSA – Compression Stress Analyzer, companion program for **VQCST** test patterns
VQLPN – Audio Loudness Profiler and Normalizer — www.videoq.com/vqlpn.html
VQTSF – Transcoding Segments Finder

Pack 3. Target Application**: AV Content Analysis**

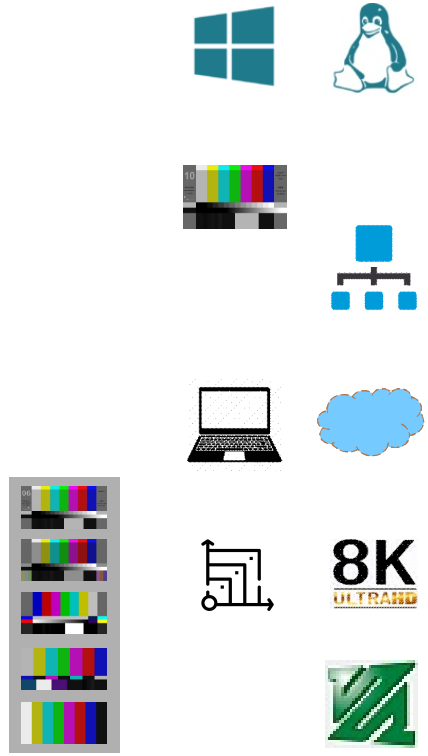
VQMINF – Media File Info Report Generator
VQCFA – Captions Files Analyzer
VQFP – Video Frames Profiler
VQLPC – Loudness Profiles Correlator, companion program for **VQLPN** module
VQLPN – Audio Loudness Profiler and Normalizer — www.videoq.com/vqlpn.html
VQPLA – Picture Levels Analyzer

Note that some modules are included in more than one pack, e.g., VQMINF is recommended for all three packages.

VQCBA – VideoQ Color Bars Analyzer Overview

Video**Q** **C**olor **B**ars **A**nalyzer:

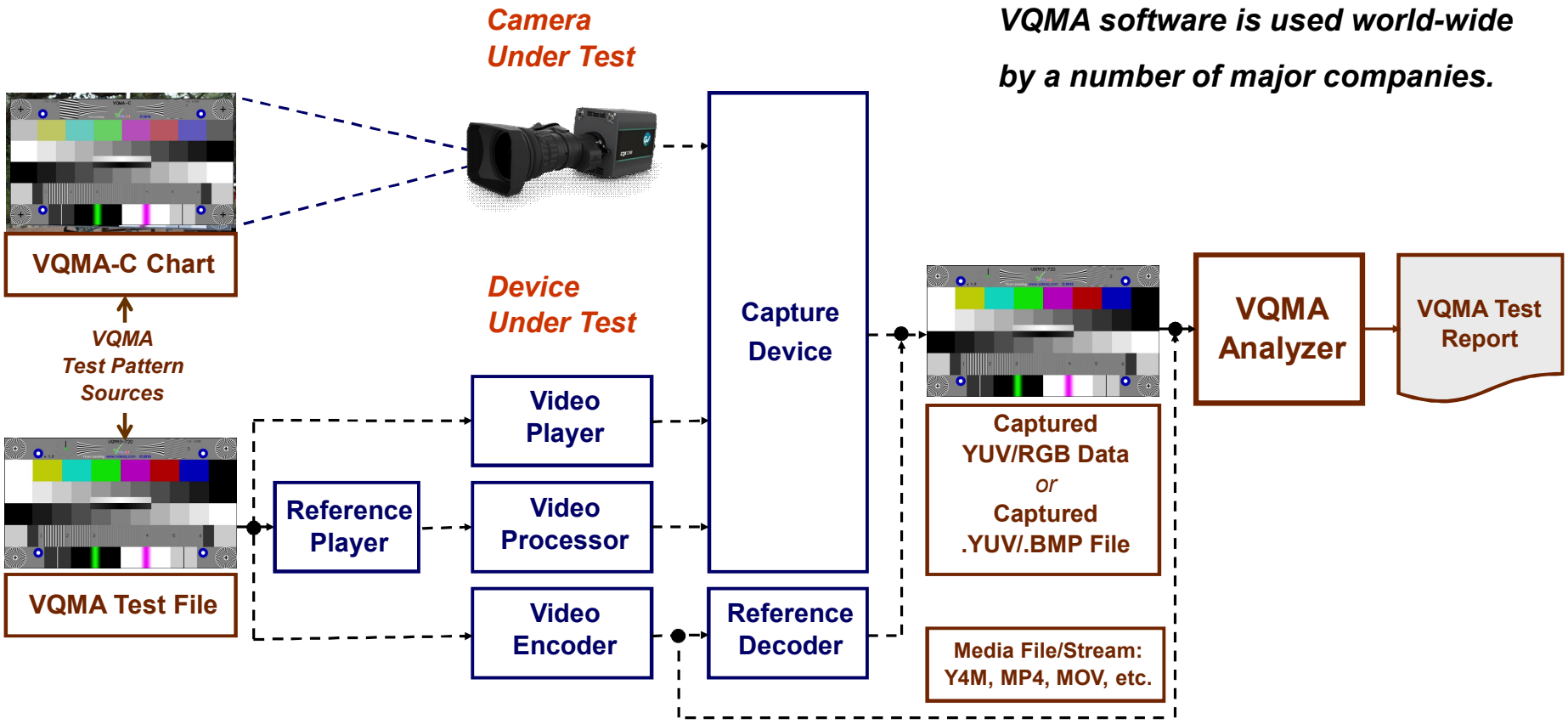
- **Applications**: Video production, post-production, transcoding, distribution
- **CLI program** for **on premise** and **cloud** tasks, **Windows** and **Linux** versions
- **Software module** of **V**ideo**Q** **P**roductivity **T**ools suite
- **Companion program** for **VQCB Wonder Bars™** Test Patterns Suite
- **Video workflow verification** tool for the 8K / 4K / 2K, HDR / SDR environment
- **Easy-to-use tool**, instantly revealing your video device / system / workflow **performance**
- **Unattended automated analysis tool**, suitable for **workstations** and **cloud computing**
- **VQCBA auto-detects** and **process 5 different types** of color bars tests
- **Frame sizes**: from **480x270** to **8K UHD**
- **Dynamic range formats**: **HDR-PQ**, **HDR-HLG**, and **SDR**
- **Variety** of **color spaces**, **containers** and **encoding formats**, supported by **ffmpeg**



Learn more about **VQCBA**: www.videoq.com/vqcba.html

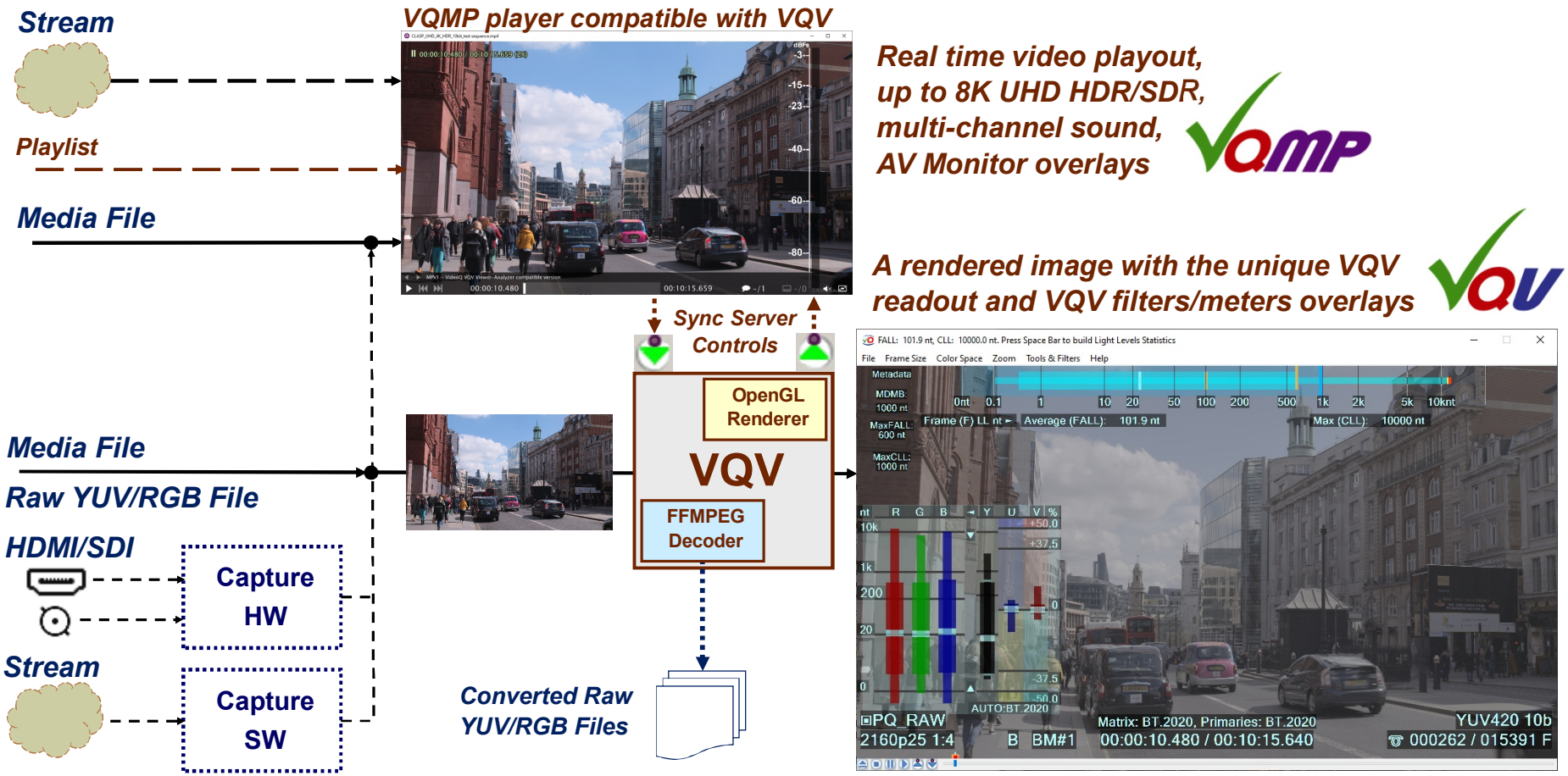
VQMA – Video Quality Software Analyzer

VQMA software is used world-wide by a number of major companies.



Learn more about **VQMA**: www.videoq.com/vqma.html

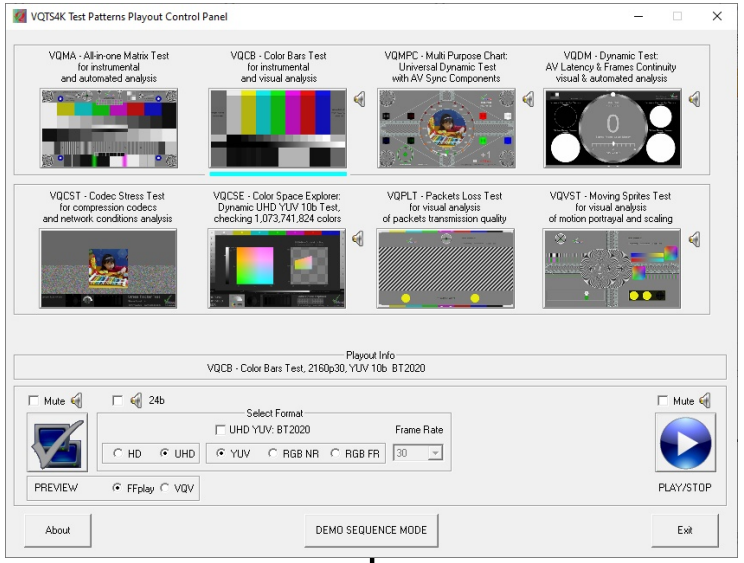
3. VQV and VQMP – General Concept



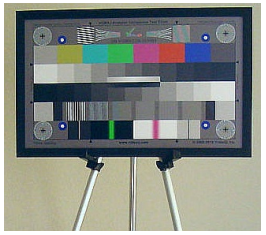
UHD HDR10 sample video – courtesy of newsbyte.co.uk

4. VQTS4K Top Level Block Diagram

Test Pattern Generator

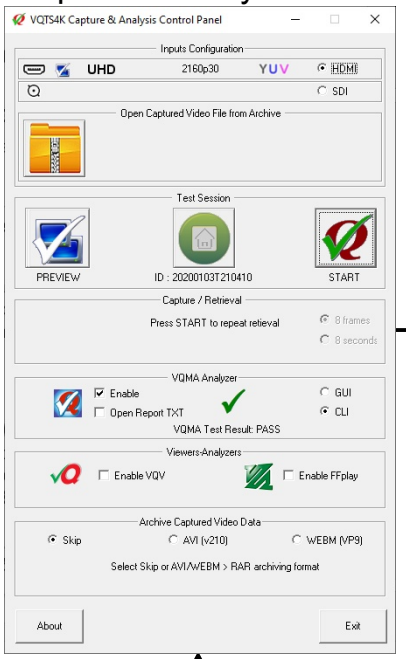


Camera
Test Chart Option

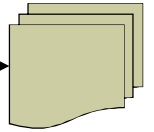


Network
Connectivity
Options

Capture & Analysis Tools



Test Samples
&
Test Reports



BMD Playout Card

HDMI or SDI

System Under Test

HDMI or SDI

BMD Capture Card

Learn more about **VQTS4K**: www.videoq.com/vqts4K.html

Appendix

More Info and Examples

www.videoq.com

VideoQ Philosophy of Media Data Processing

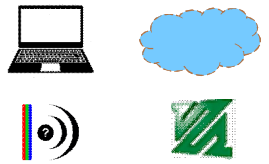
1. Modern cloud-based environment requires **fully automated modular tools** and a **smaller number of human operators** or **supervisors** should focus ***only*** on optional final checks and/or complicated cases.
2. And these operators must be equipped with appropriate **software tools and indicators** presenting all relevant parameters in a time-saving "easy to spot at a glance" way.
3. Automatically generated **Extended Technical Metadata** and **Reports** are must be and must cover:

Image aspect ratio, contrast, sharpness, sound loudness, noise and other unwanted components levels are among the most critical parameters affecting the subjective estimation of AV content quality.

4. Traditional professional image & sound QA/QC methodology, based on the usage of large number of high-grade video & audio monitors, etc. is no longer the answer, ***but we learn that QA/QC is still needed***.

The VideoQ **VQPT** (**V**ideo**Q** **P**roductivity **T**ools) modules answer the need for such automatic tools. Combination of VQPT suite modules with other VideoQ tools, such as **VQL** library of **test patterns** and **VQV** / **VQMP players-analyzers**, will result in further increase of workflow efficiency.

VideoQ tools handle various types of **files** and **streams**, on premises and in the cloud. They use **ffmpeg** libraries and support all common **containers**, **codecs** and **protocols**, such as: MP4, MOV, J2K, OGG, AC3, EAC3, AVC, HEVC, VP9, TCP, UDP, SRT, etc.



VideoQ Technologies and Media Ambits

What it is:

- [*me·dia am·bit*] noun: **Extended** technical and semantic **metadata** about moving images, sounds, and timed text; **embedded** in files or **externally centralized**
- Sentence example: Their system uses media ambits to automate ingest and delivery.
- Variations: Video Ambit, HDR Ambit, Audio Ambit, Timed Text Ambit, etc.

Ambit's Role for Automated and Automation-Assisted Workflows:

- Robot-assisted human decision-making **tools**
- Robots-learning-from-people **tools**
- **Ambits repositories** and **machine services** optimized for automation, web services, and directed acyclic workflows
- Automated and manual control of **optimized** video and audio processing/conversion
- Automated and manual **quality assurance** and **quality control** tools
- Measure, annotate and automatically **modify** files to match **target ambits**
- **Notify** machines, people and dashboards in **automated workflows**

Learn more about **Media Ambits**: http://www.videoq.com/Downloads/VideoQ_Media_Ambit_Presentation.pdf

HDR–SDR Conversion – Criteria for Success

The only criteria of success is a Happy Viewer and a visual impact of wonderful video images.
Modern HDR cameras and display screens are much better than their prior-art SDR counterparts.
However the content quality and its availability is dragging behind.

Important facts are:

- **SDR content** made via **HDR to SDR down-conversion** is significantly better than regular SDR content.
- **HDR content** made via **SDR to HDR up-conversion** is nearly as good as regular HDR content, but the **production cost** is order of magnitude **lower**.

There are only **two valid questions**:

1. Are **Video Data Levels** and **Light Levels** suitable for the **distribution context**, e.g. for **streams switching** and **adverts/captions insertion**?
2. Do the converted **images** *at the workflow output* **look good** to millions of viewers?

We **should not** compare **fundamentally different** video images of ***the same object***:

- Original HDR *(WCG)* or SDR image *(WCG UHD or NCG HD)*,
- Down-converted HDR to SDR image *(WCG UHD or NCG HD),*
- Up-converted SDR to HDR image *(WCG to WCG or NCG to WCG),*

Why? Because they belong to at least **three** quite different **workflows** and quite different **viewing conditions**.

VQC – VideoQ Dynamic Range and Color Space Converter

VQC is a **Windows/Linux CLI program** that reads a **media file** or **sequence** of **image files**, measures its video frames parameters, **converts** the content to the specified **dynamic range** and **color space** format, then creates a **Report** in **JSON** format and optionally plot the output LL profile in **PNG** format.

Supported input and output **dynamic range formats**:

- **SDR,**
- **HDR-PQ,**
- **HDR-HLG**

Supported **color primaries**:

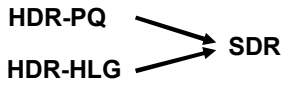
- **BT.709** *(aka NCG = Narrow Color Gamut)*,
- **BT.2020** *(aka WCG = Wide Color Gamut)*,
- **P3** (*(aka ECG = Expanded Color Gamut)*

Supported **frame sizes**:

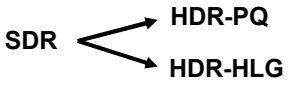
from **1920x1080** (HD)

to **8192x4096** (8K)

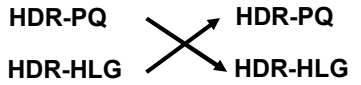
DR Down-conversion



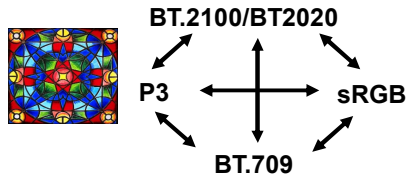
DR Up-conversion



DR Cross-conversion



And Color Space Conversion



Learn more about VQPT and VQC Colorator™ http://www.videoq.com/vqpt.html http://www.videoq.com/vqc.html

VQCB Test Pattern Usage Example 1

Hundreds of test sequences have been encoded and used in the consumer devices extensive lab testing.

20s long VQCB leader … **12min long feature film**

20s long **VQCB** test was used as a "**reference leader**" concatenated with the main 12min long movie.

VideoQ encoded this sequence in a variety of formats:

- Frame rates: from **23.976**fps to **120**fps
- Frame sizes and dynamic range versions: **HD** and **UHD**, **HDR10** and **SDR**, **8**bit, **10**bit and **12**bit
- Video codecs: **DoVi**, **H.265**, **VP9**, **AV1**, **VVC**
- Video bitrates: from **6**Mbps to **100**Mbps
- Audio codecs: **AC-3** 2.0 and 5.1, **Atmos** 5.1.4, **DTS-X** 7.1.4, **48**kHz, **96**kHz and **192**kHz sampling rates
- Audio bitrates: from **128**kbps to **1344**kbps

Special attention was given to the insertion of correct metadata and providing the specified bitrates.

Presence of **QR codes** in the VQCB leaders provided for easy handling and analysis of test results data.

VQCB Test Pattern Usage Example 2

VQCB test is included in 13s long "**reference leader**" concatenated with the main 5min long **test clip**.
The clip was specially created for **International Electrotechnical Commission** standard **IEC 62087-2**:
Audio, video, and related equipment - Determination of power consumption - Part 2: Signals and media.

All models of TV sets should be tested **worldwide** in accordance with the IEC 62087-2 standard**.**

IEC 3s Text Box + 10s VQCB = 13s leader

…

5min long special power consumption test clip

VideoQ encoded this sequence in a variety of formats:

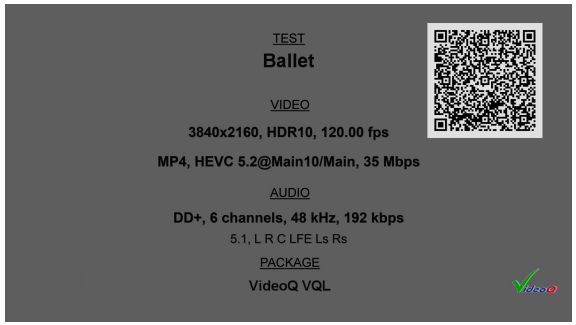
- Frame rates: from **23.976**fps to **59.94**fps
- Frame sizes and dynamic range versions: **UHD**, **HD**, and **SD**, **HDR10, HLG**, and **SDR**, **10**bit and **8**bit
- Video codec: **HEVC**
- Video bitrates: from **9.5**Mbps to **75**Mbps
- Audio codec: **AAC LC** 2.0, sampling rate **48**kHz
- Audio bitrate: **128**kbps

Live Test Clips Examples

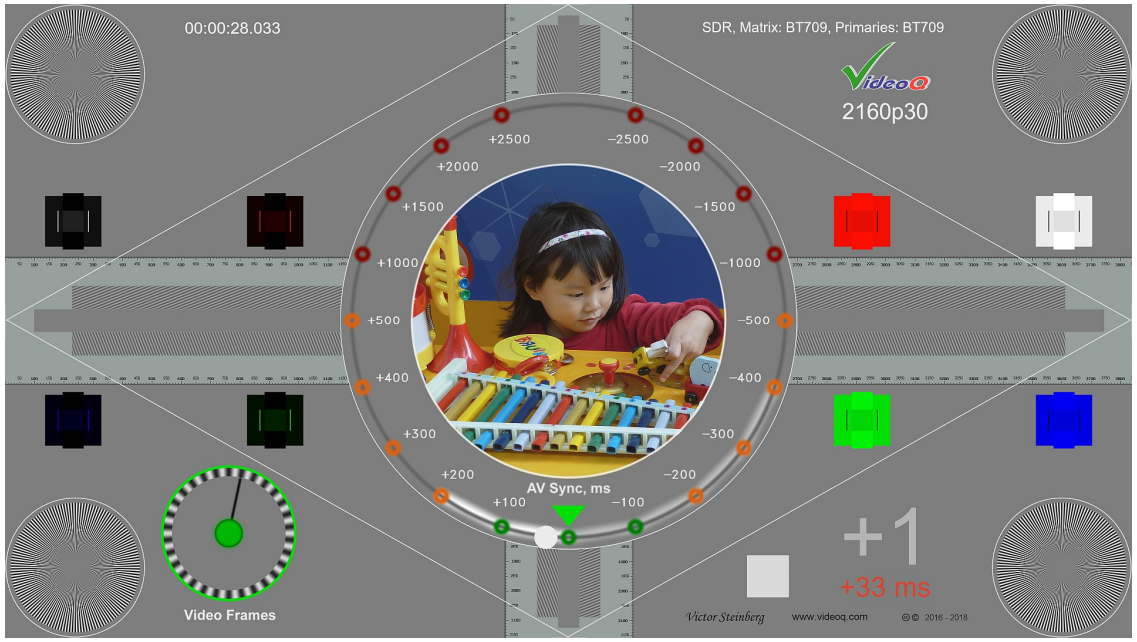
SFO: Aerial HD video, **high original frame rate**, decimated to various frame rates; the clip versions serve for frame rate conversion testing



Ballet: based on Netflix open content 'Nocturne' clip; **HDR** and **SDR** versions, variety of **frame sizes** (up to **4K**) and **frame rates** (up to **120fps**).
Each test clip starts with 20s long **VQCB** leader: text box with QR code, followed by VQCB test pattern, followed by test clip live content.



VQMPC – Dynamic Test Pattern with AV Sync Components



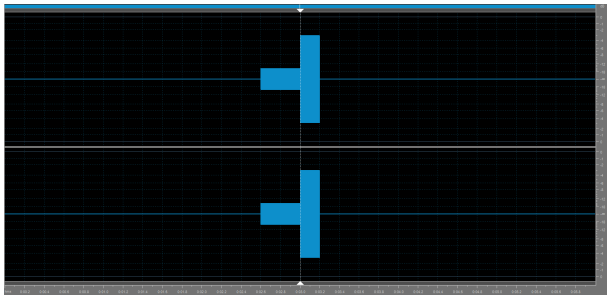
Set of test pattern video and audio files to check:

- Geometry and Aspect Ratio
- Video Levels and Color Rendition
- Scaling distortions or proof of no-scaling
- Frames continuity and AV Sync Errors
- Compression artifacts

Variety of video formats:

- Frame sizes from 720x480 to 8K
- Frame rates from 23.976 to 120.0 fps

AV Sync Reference: “Beep-bop” burst



Ideal tool for instant “at glance” video system performance estimation, e.g. for fast setup, functionality test and debugging

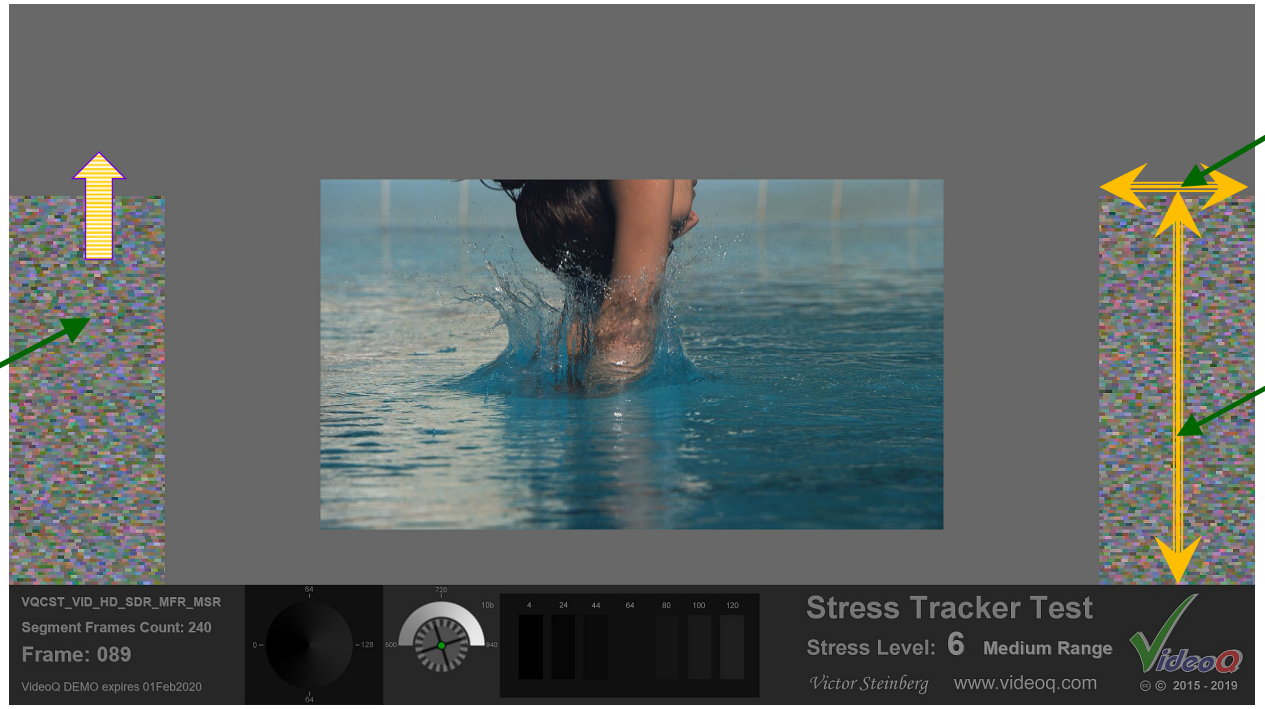
VQMPC test is used world-wide by a number of major companies.

Learn more about **VQMPC**: www.videoq.com/vqmpc.html

VQCST – Test Pattern for Compression Codecs

Stress Level
rising

Pseudo-random color shapes: ***calibrated and compliant*** stress source



Switchable **Stress Ranges**: Low, Medium, High

Variable **Stress Level**: from 0 to 9

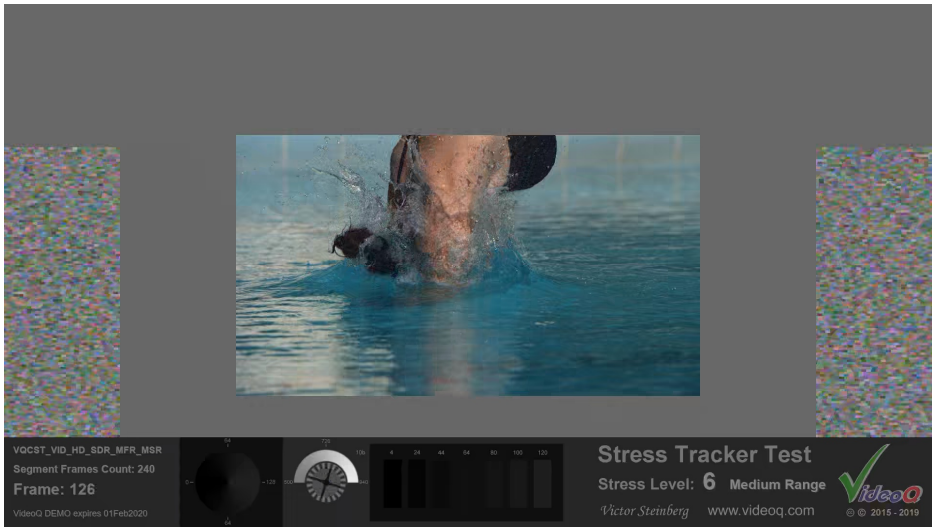
VQCST is a sequence of **10 Segments** (**10 Stress Levels**), each segment duration: 4.0, 4.8 or 5.0 seconds.
Total sequence duration is 40, 48 or 50 seconds, depending on the selected frame rate.
Stress Tracker ™ test is suitable for **subjective image quality estimation** in real time and for **automated measurement** of **Stress Response Profile**.

Learn more about **VQCST**: VideoQ_VQCST Training_Presentation

Compression Quality Test Examples

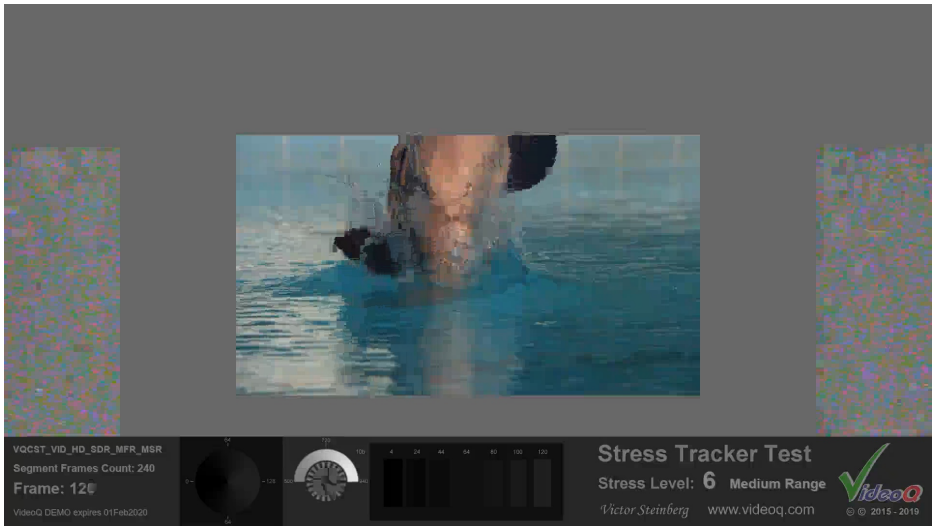
HD, 60fps (MFR), **HEVC 8Mbps**,
Medium Stress Range (MSR), Stress Level **6**

Noticeable compression artifacts

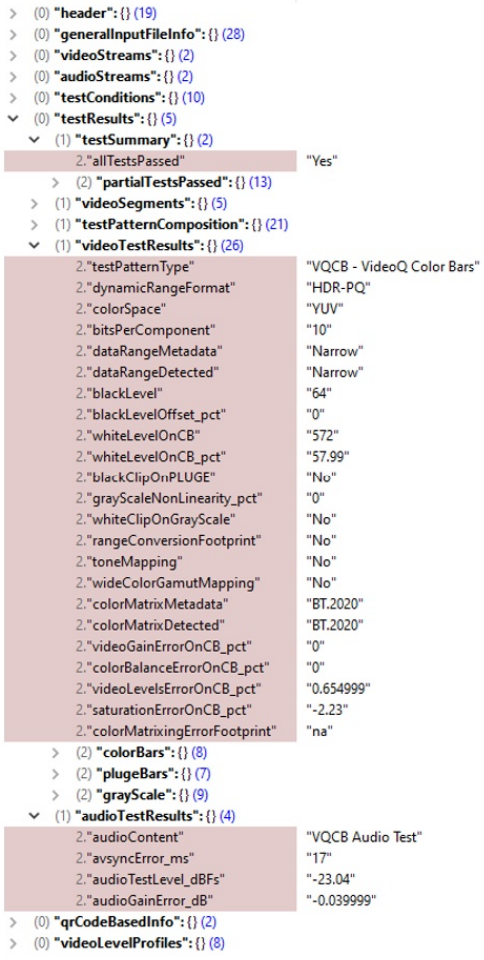


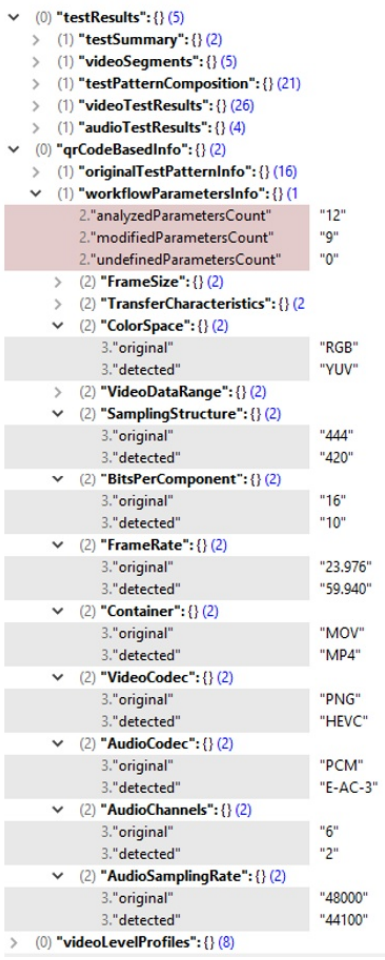
HD, 60fps (MFR), **AVC 2Mbps**,
Medium Stress Range (MSR), Stress Level **6**

Strong (annoying) compression artifacts

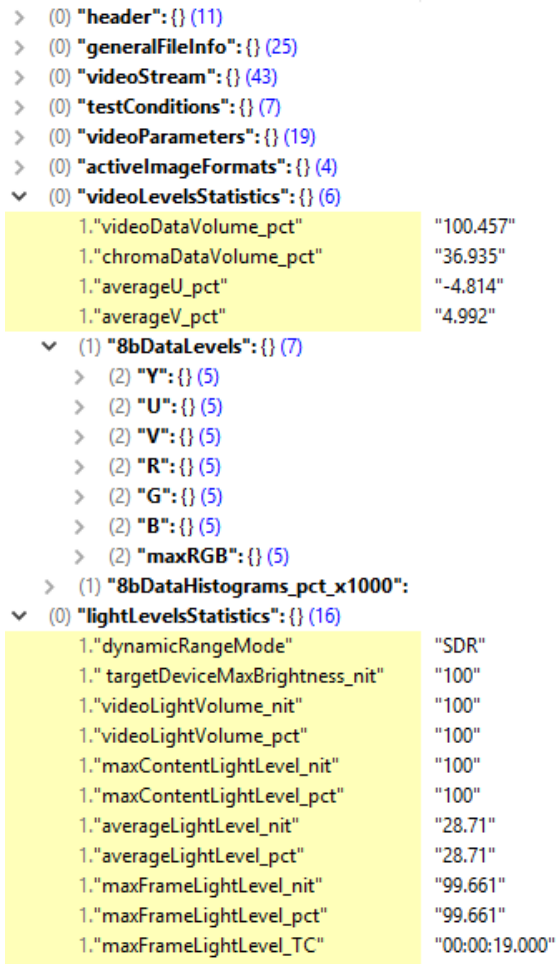


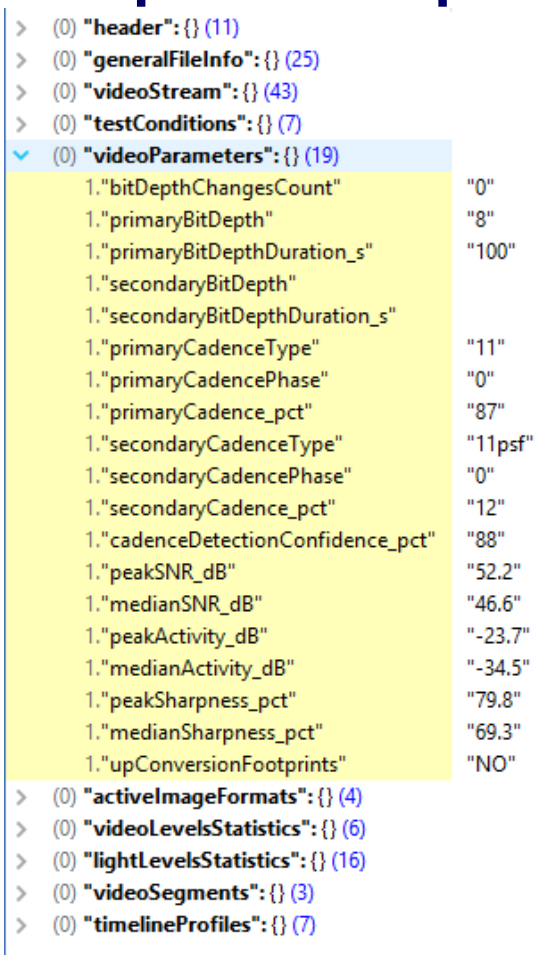
VQCBA – Color Bars Analyzer, JSON Report Example





VQFP – Video Frames Profiler, JSON Report Example





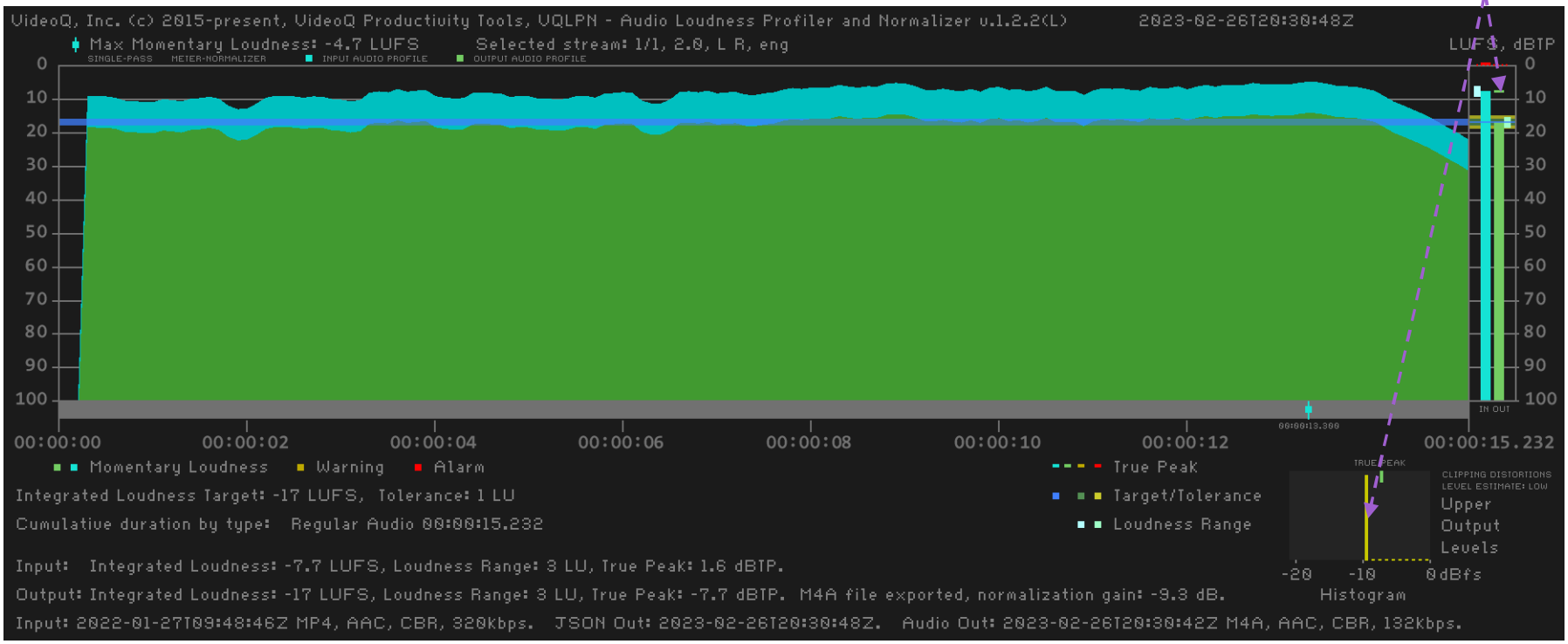
VQLPN – Loudness Profiler & Normalizer, Plot Example

- **Integrated Loudness** of this **extremely loud** clip after normalization is **exactly equal** to **-17 LUFS** (webcasting) target
- **Output True Peak** value looks **good**, but **Upper Levels Histogram** still shows **Low** level of possible **Clipping Distortions**

Conclusion: *The normalized clip is suitable for webcasting, probably with minor clipping distortions issues*

True Peak *level now* ***looks good****, but* ***Upper Levels Histogram*** *still shows possible problems*

Learn more about **VQLPN** module: www.videoq.com/Downloads/VideoQ_VQLPN_Training_Presentation_PPT.pdf



VQMA Test Pattern Composition

All-In-One: Single pattern allows **automatic measurement** of multiple **video workflow parameters**

Radial Plates x4 for visual estimation, camera shading and sharpness measurement

Test Components:

H Wedges
V Wedges — **0**

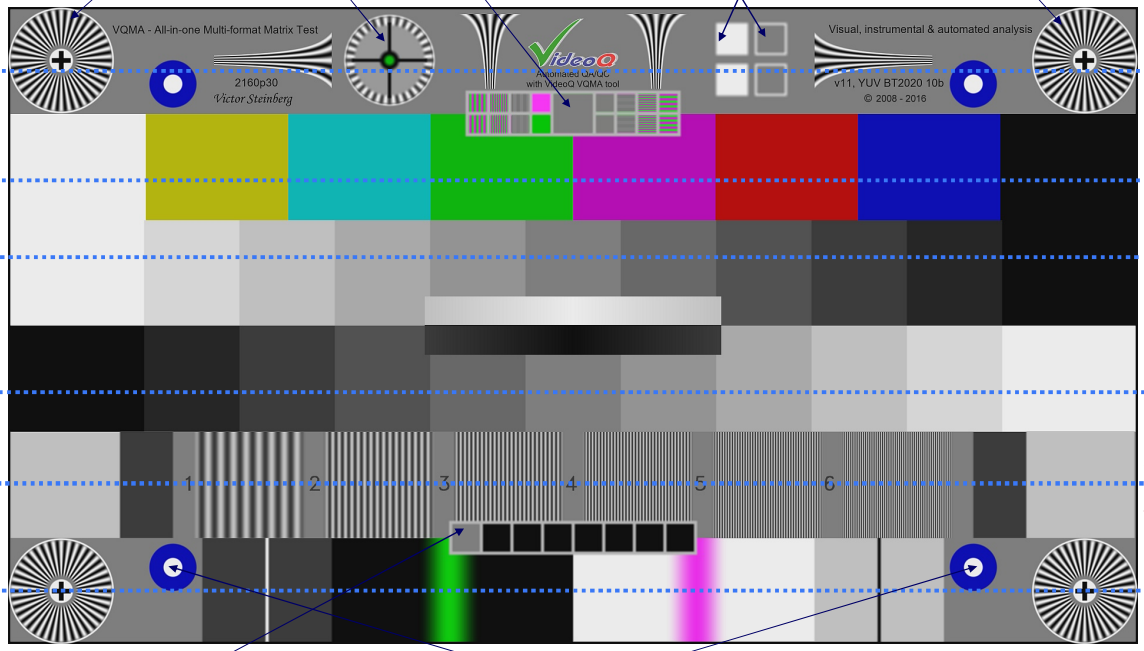
Color Bars — **1**

2

Grayscales x2,
Near-Whites,
Near-Blacks — **3**

Multi-Burst — **4**

Multi-pulses — **5**



Parameters:

Visual Estimation

YUV/RGB Levels,
Color Space Matrix

Black & White Levels,
RGB Balance,
Y Gamma,
Y Range Overload

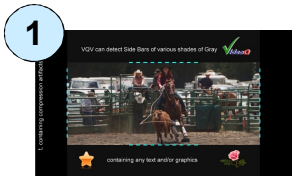
Frequency Response,
Aliasing Levels

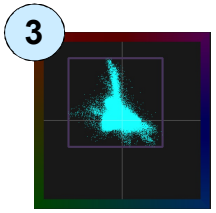
Y vs. UV Gain,
Needle pulse K-rating

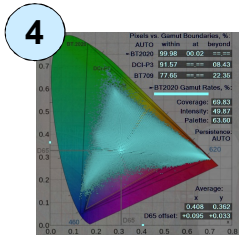
Learn more about **VQMA**: www.videoq.com/vqma.html

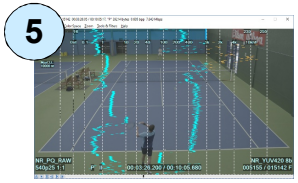
VQV – Video Viewer-Analyzer, Tools & Meters Overview

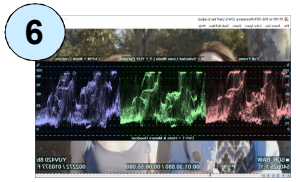
1. Active Image Size and Aspect Ratio Meter
2. Video Volume Meter – VV-Bars™
3. VectorScope
4. ChromaScope
5. RGB Frame Profile Monitor – FrameScope™
6. RGB/YUV Waveform Monitor
7. RGB/Light Levels Histograms
8. RGB/Light Levels Analyzer – L-Bar™
9. Bitrate Analyzer – C-Bar™
10. Noise Meter

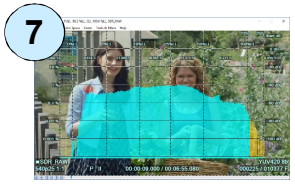


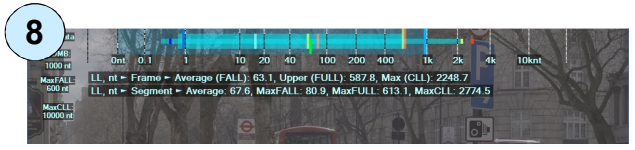










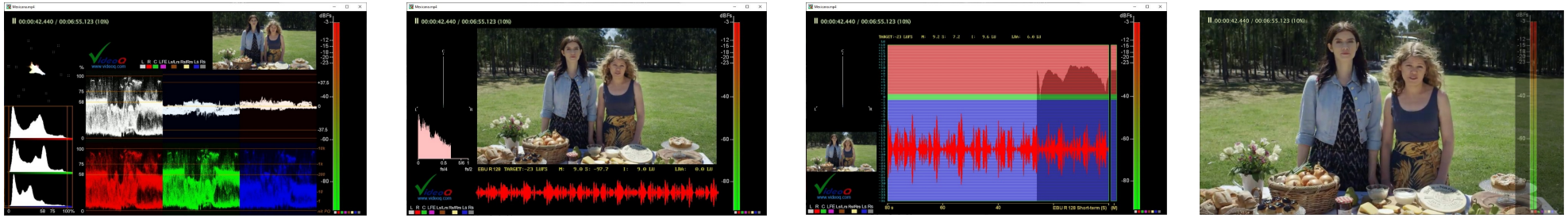


Learn more about **VQV**: www.videoq.com/vqv.html

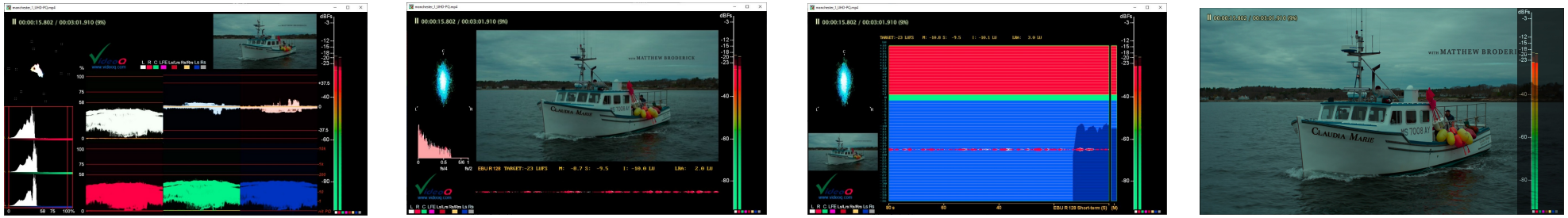
VQMP – Media Player-Analyzer, AV Monitor Modes

Mode 1 | Mode 2 | Mode 3 | Mode 4

SDR Content



HDR-PQ Content



Video tools: UV VectorScope, RGB Histograms, YUV Waveforms, RGB Waveforms

Audio tools: Level Meter, Waveforms, VectorScope, Frequency Spectrum, EBU R128 Loudness Monitor

Learn more about **VQMP**: www.videoq.com/vqmp.html