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Brenton Ough
Touchstream

Will Law
Akamai

11 DECEMBER 2025, 3 PM CET, 9 AM EDT - ONLINE WORKSHOP

SEE IT. SCORE IT. SWITCH IT! STANDARDS-BASED END-TO-END MEDIA QUALITY MONITORING

You will receive an email as soon as the on-demand version of the workshop is available

G&L SYSTEMHAUS NORSK touchstream Akamai

Agenda

MOTIVATION	THEORY & STANDARDS	ENCODER & PACKAGER	MONITORING	Q&A
Alexander Leschinsky G&L	Will Law Akamai	Adrian Roe Norsk / id3as	Brenton Ough Touchstream	all

You will receive an email as soon as the on-demand version of the workshop is available

Background: Motivation

Alexander Leschinsky (G&L)
2 min

Why this topic now?

Live streaming is unforgiving

Small hiccups early in the signal chain scale instantly

Bitrate ≠ quality: “network ok” doesn’t mean picture looks good

What ops teams need

End-to-end visibility

Shared signal for “how good it looks”, for all parts of redundant channels

Faster root-cause analysis

The gap we’re closing

The encoder already knows a lot about quality

Quality often needs to get “rediscovered” via extra decoding and tooling

Decisions get made blind or based on less relevant, but available metrics

Our approach

SEE IT

Surface quality where it already exists in the workflow

SCORE IT

Use standardized names for quality dimensions and attach values

SWITCH IT

Carry those metrics downstream and, eventually, let something switch based on them

Background: Theory

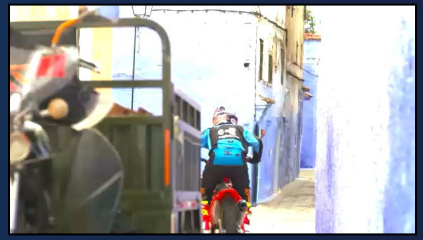
Will Law (Akamai)
10 min

Bitrate as a proxy for visual quality

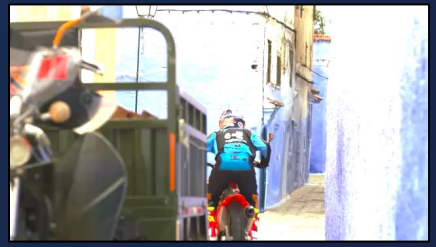
We constantly use bitrate as a proxy for the visual quality received by the end user, **but many times this is wrong**.

Perceived Visual Quality depends on

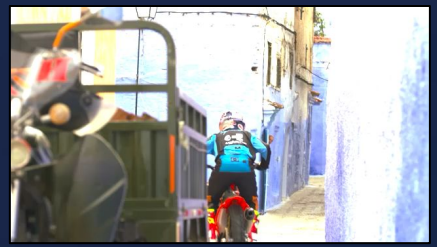
- CODEC being used
- Keyframe interval
- Encoding constraints (CRF vs QP, CBR vs VBR etc)
- Rendered size of the content
- Resolution of the display device
- Display capabilities of the device (HDR, HFR etc)
- Distance of the end-user from the screen.



500 kbps



1,000 kbps



2,000 kbps

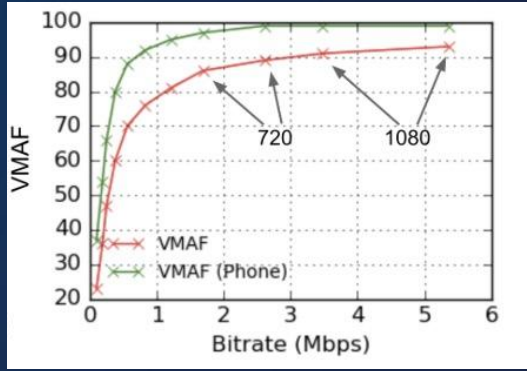
How do we measure Visual Quality?

PSNR - Peak Signal-to-Noise Ratio

SSIM - Structural Similarity Index

VMAF - Video Multimethod Assessment Fusion

and others …

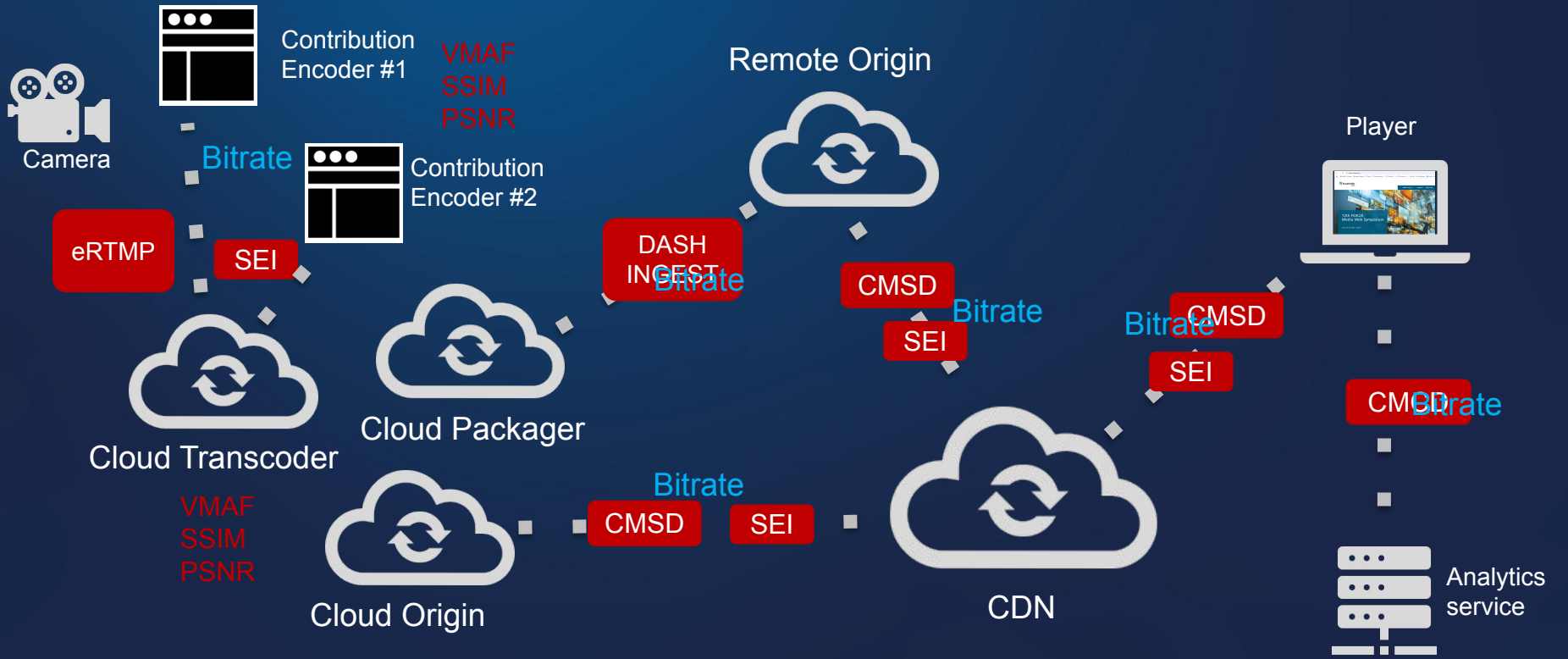


These are full-reference metrics, meaning that in order to generate them, you need a copy of the source from which they were encoded.

$$\mathrm{SSIM}(\mathbf{x},\mathbf{y}) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)\,(\sigma_x^2 + \sigma_y^2 + C_2)}.$$

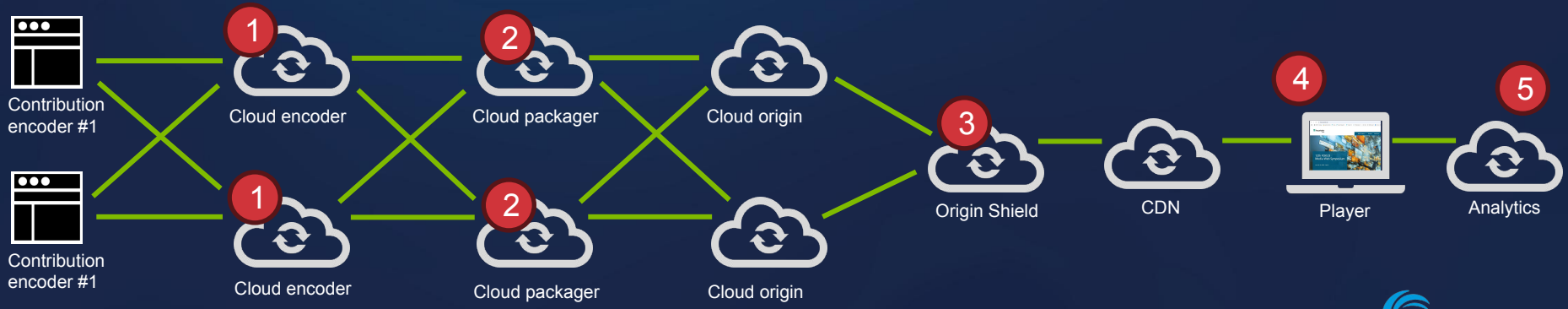
$$\begin{aligned} PSNR &= 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\ &= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\ &= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE). \end{aligned}$$

Which components have visibility into MQA?



Primary use-cases of MQA data

1. At the cloud encoder or packager - selecting between two contribution encoder sources
2. At a packager, to add enable quality-based switching data to be added to manifests
3. At the origin shield – selecting between two origin sources.
4. At a player – tracking the quality of what has been shown to the end user, especially across ad breaks
5. At an analytics provider – tracking the quality of what the end users have been shown, including ad breaks.



Transmission of Media Quality Assessment (MQA) data

October 2023: Dr. Urvashi Pal, submits patent for "Reference-based Video Quality Analysis-as-a-Service for OTT streaming", to the United States Patent & Trademark Office. Granted December 2025 as U.S. Patent No. 12,499,527. Usage for the media industry is royalty-free.

January 2025: A project of the QoE Working Group at SVTA

MQA = Media Quality Assessment (i.e video and audio)

The project proposes a standardized method for transmitting Media Quality Assessment (MQA) scores, such as VMAF, PSNR, and various proprietary metrics, using Common Media Server Data (CMSD) response headers as well as via SEI, eRTMP and DASH Live Ingest.

Q1 2026 – planned release of the guideline

Transmission via CMSD (request headers)

Description	Key Name	Type & Unit	Value Definition
MQA score	org.svta.mqa	Parameterized String or List of Parameterized Strings	A string defining the type of MQA metric being reported, along with one or more parameters. The allowed types are defined by the "Field name" column of Table 2.

Parameter Name	Parameter	Description
Value	v	Carries the numeric score associated with the metric. This parameter is required.
Temporal reference	tr	The offset in transmission unit count to which the current MQA data applies. A value of 1 indicates the prior unit.
Resolution reference	rr	The vertical pixel count of the reference resolution. Indicates that the MQA metric is computed relative to a reference (source) video that uses a different resolution than the encoded stream.
Scan Order Conversion Flag	sc	If present, this parameter indicates that the referenced format differs from the output of the encoder. For example, the encoder takes interlaced input and produces progressive output, in which case we assume the MQA metric is produced by incorporating the same conversion process.

Table of MQA metrics

#	Field name	Allowed values	Definition
1	VMAF	Integer [0..100]	The VMAF score for a standard profile, as defined by [6].
2	VMAFMobile	Integer [0..100]	The VMAF score for a mobile profile, as defined by [7].
3	VMAFUHD	Integer [0..100]	The VMAF score for a UHD profile, as defined by [8].
4	VMAFHD	Integer [0..100]	The VMAF score for an HD profile, as defined by [7].
5	PSNR	Integer [0..60]	The PSNR score for a standard profile, as defined by [9].
...	...	...	...
15	XVSbs	Integer [0..100]	IMAX proprietary VQA model - Banding Score
16	XVScvs	Integer [0..100]	IMAX proprietary VQA model - CVS
17	pVMAF	Integer [0..100]	Synamedia VQA model pVMAF [15] (open source for AVC, HEVC, and SVT-AV1)
18	MQCS	Integer [0..100]	The AWS Elemental media quality confidence score (MQCS) rating for the segment [20].
20	MQCS-SEQ	Integer [0..100]	AWS Elemental aggregate of MQCS ratings for all segments in the sequence [20].
21	MQCS-SEQ-TRACKS	String	AWS Elemental proprietary MQCS (Media Confidence Quality Score) sequence aggregate score per track type[20]. Indicates the aggregate of MQCS ratings for all segments in the media sequence number, by track type. Track type is communicated by using Tokens: v = Video a = Audio s = Subtitle m = Metadata

CMSD examples

org.svta.mqa="VMAF";v=81;
org.svta.mqa="VMAFMobile";v=83
org.svta.mqa=("PSNR";v=38 "PSNR";v=39 "PSNR";v=37)
org.svta.mqa="MQCS-SEQT";v=100;a=90;s=50;m=60
org.svta.mqa="MQCS-SEQ-TRACKS";v=98;a=88;s=45;m=70
org.svta.mqa="VMAF";v=81;rr=1080
org.svta.mqa="VMAF";v=81;sc=1
org.svta.mqa="MQA-VIDEO";v=90
org.svta.mqa="MQA-AUDIO";v=68

CMSD-Static:ot=v,sf=h,st=v,d=6006,org.svta.mqa="MQCS-SEQ-TRACKS";v=100
;a=90;s=50;m=60,br=1450,n="OriginA"

SEI transmission

MQA data may be embedded into H.264 or H.265 frames as SEI messages.

Encoded as a User Data Unregistered SEI message (payloadType == 5) with

`UUID f13425dd-c360-48c4-a166-72a32fc800b6`

The format of the user data payload is identical to the CMSD encoding (Structured Field Headers, ASCII encoding), with the key defining whether data applies to the frame or GOP:

f (frame) indicates per-frame data and must be given for every video frame if it is used.

p (previous GOP) must be given on an I frame and indicates aggregated media quality for the previous GOP

c (current GOP) must also be given on an I frame and indicates aggregated media quality for the current GOP

e (end of GOP) must occur on the last frame of a GOP and indicates aggregated media quality for that GOP.

Single type, per-frame data

`f="PSNR";v=47`

Multiple types, per-frame data

`f=("PSNR";v=47 "SSIM";v=84)`

Single type, aggregated for the previous GOP

`p="PSNR";v=47`

Multiple types, aggregated for the current GOP

`c=("PSNR";v=52 "SSIM";v=99)`

Transmission over DASH Live Ingest

For this contribution standard, we use CMCD (Common Media Client Data) request headers, which are sent as each segment is POSTed.

Structure is almost identical to CMSD syntax.

Examples:

```
CMCD-Static: org.svta.mqa="VMAF";v=81

CMCD-Static: org.svta.mqa="VMAFMobile";v=83

CMCD-Static: org.svta.mqa="MQCS";v=93

CMCD-Static: org.svta.mqa=("VMAF";v=81 "VMAF";v=81)

CMCD-Static: org.svta.mqa=("SSIM";v=83 "PSNR";v=38)

CMCD-Static: org.svta.mqa="MQCS-SEQ-TRACKS";v=100;a=90;s=50;m=60
```

How do we handle Low latency?

The challenge with using headers in Low latency environments is that the headers are sent before the segment has finished encoding. Therefore MQA metrics that apply to the GOP are not yet known.

To solve this problem, **we can send the data for segment N in segment N+1**. A special attribute is used with both CMSD and CMCD to signal the temporal offset of the data:

```
CMCD-Static: org.svta.mqa="VMAF";v=81;tr=1
```

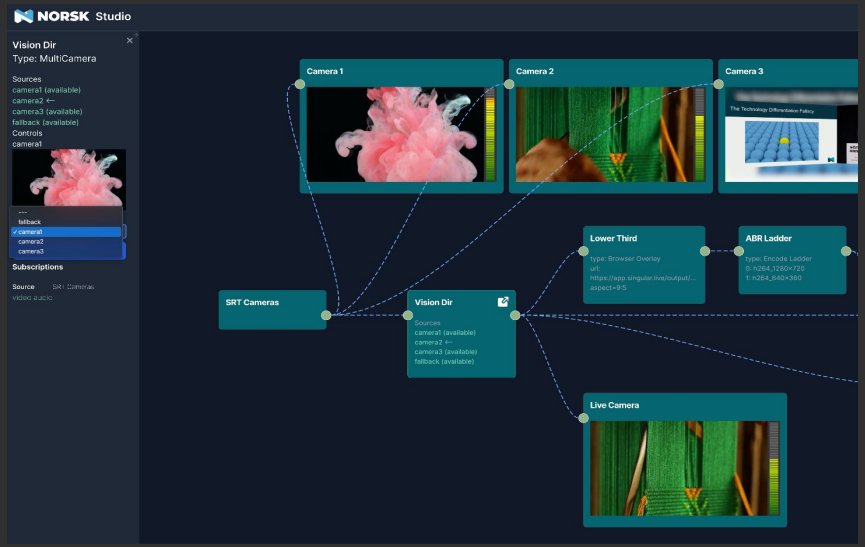
Encoder/Packager Instrumentation

Adrian Roe (Norsk by id3as)
10 min

Norsk Studio

Create live workflows in minutes

- No Code
- Design Visually
- Test and deploy instantly
- Cookie-cutter programmable deployment

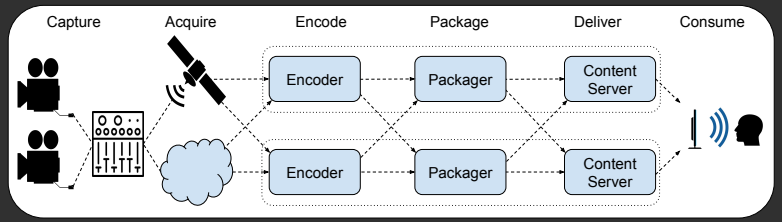


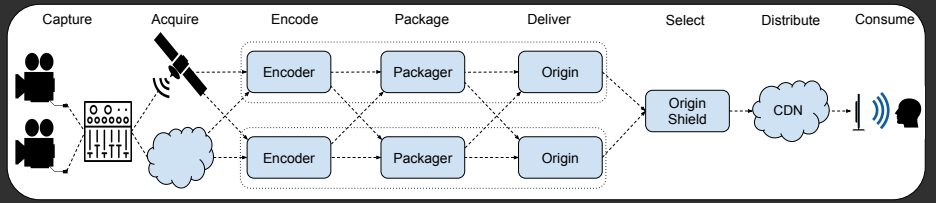
Good on a Bad Day

Is the only thing that matters!

High Availability Track Record
- Top picture is 12 years old!

CMSD-MQA
- Quality - not just availability
- Ad hoc => Standards based
- Quality assessment throughout

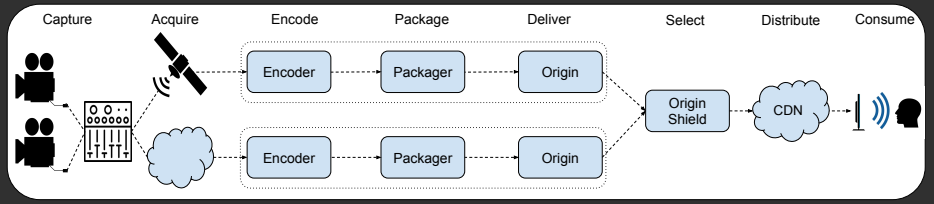




Good on a Bad Day

...In the Real World

- Reduce complexity
- Don’t solve the same problem twice



CMSD-MQA
Tracking Quality

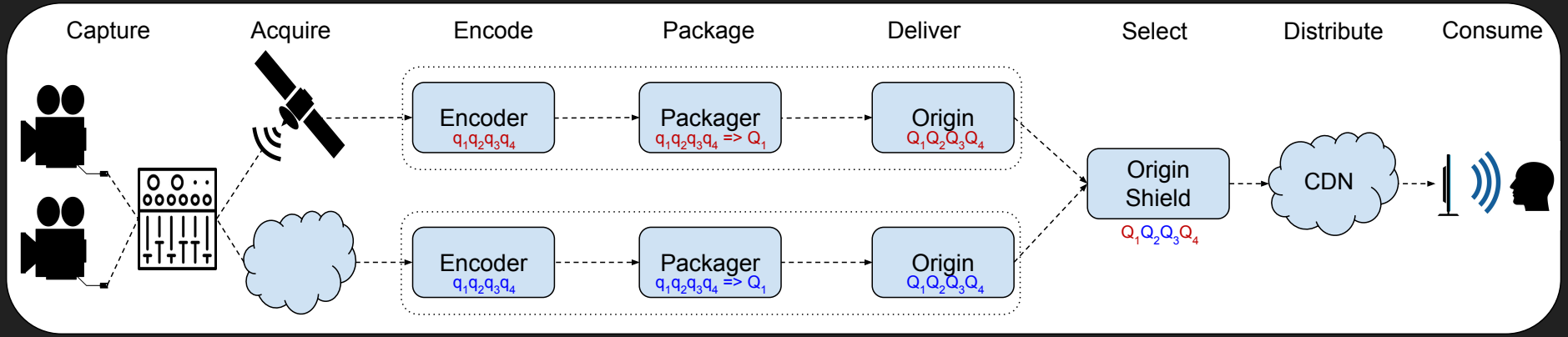
The encoder knows best!

- Tag quality (PSNR, SSIM...) to each frame
- Aggregate at the packager

Immediate big wins

- No need for all the probes when the media already knows how good it is!
- DRM keys not required
- Combine with CMCD for direct user experience data

Demo Topology



CMSD-MQA
Tagging Quality

Per Frame

- SEI message (e.g. in Transport Stream)
- eRTMP: AMF - onMetaData message

Per segment

- HTTP Headers (DASH, HLS)

Not just any old average

- Linear
- Logarithmic / geometric
- Defined per metric

Fidelity is Not Quality

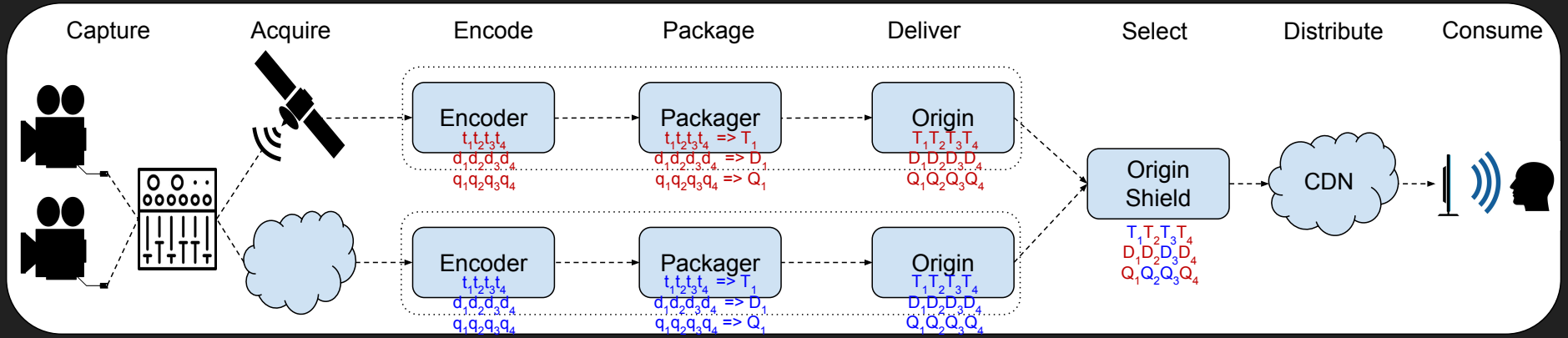
The Real World Strikes Again

- Pixelated nonsense is EASIER to encode than “real” content
- So typically has a higher PSNR / VMAF...

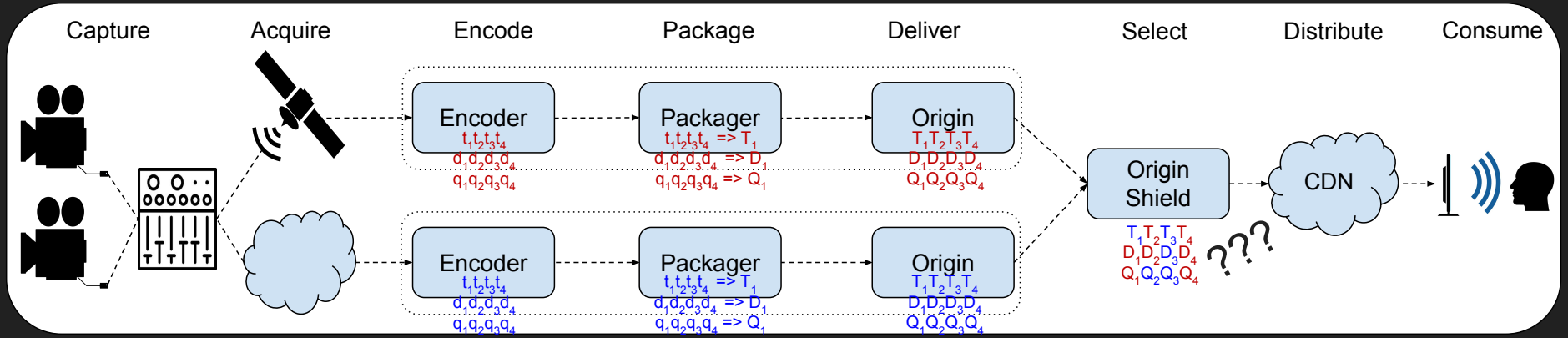
Filters to the Rescue

- TS score
- Decode score
- Audio (volume, clipping)
- Video (black / contrast / pixelation)

With Filters



Help!



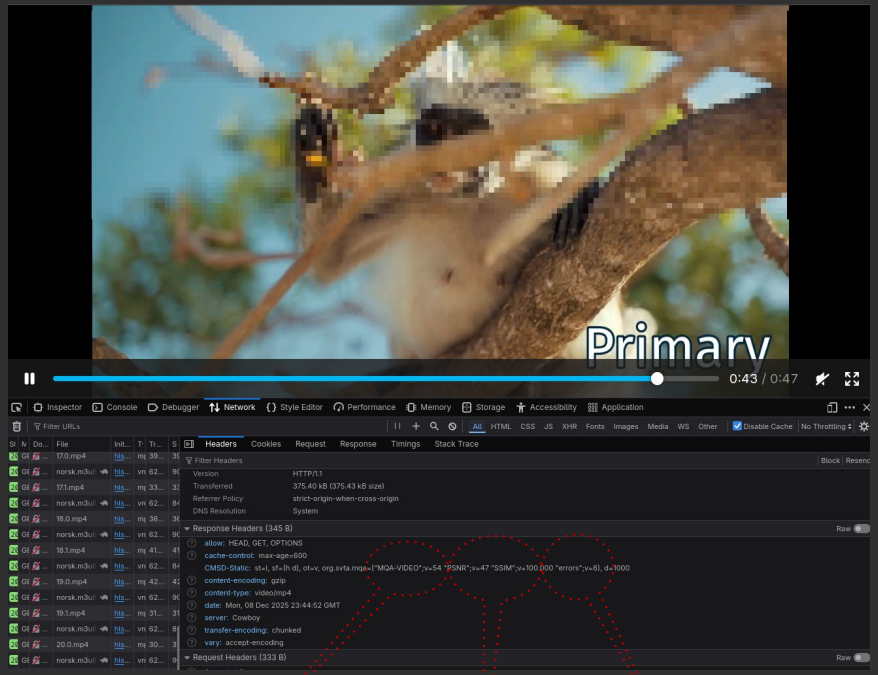
I now have 53 metrics I need to understand

Avoiding Metric Explosion

Standard “overall” quality
- MQA-AUDIO
- MQA-VIDEO

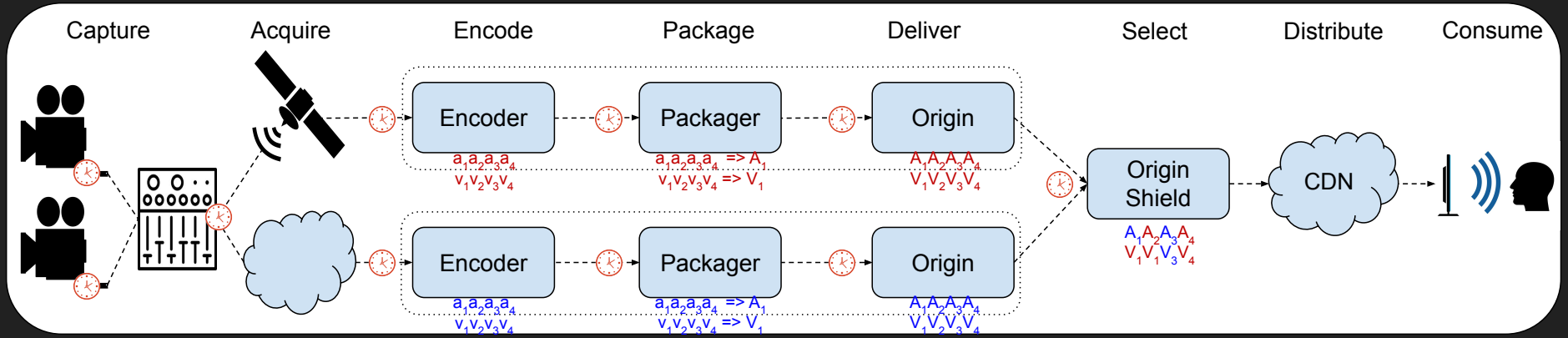
0 - 100
- Bigger is better
- Linear aggregation

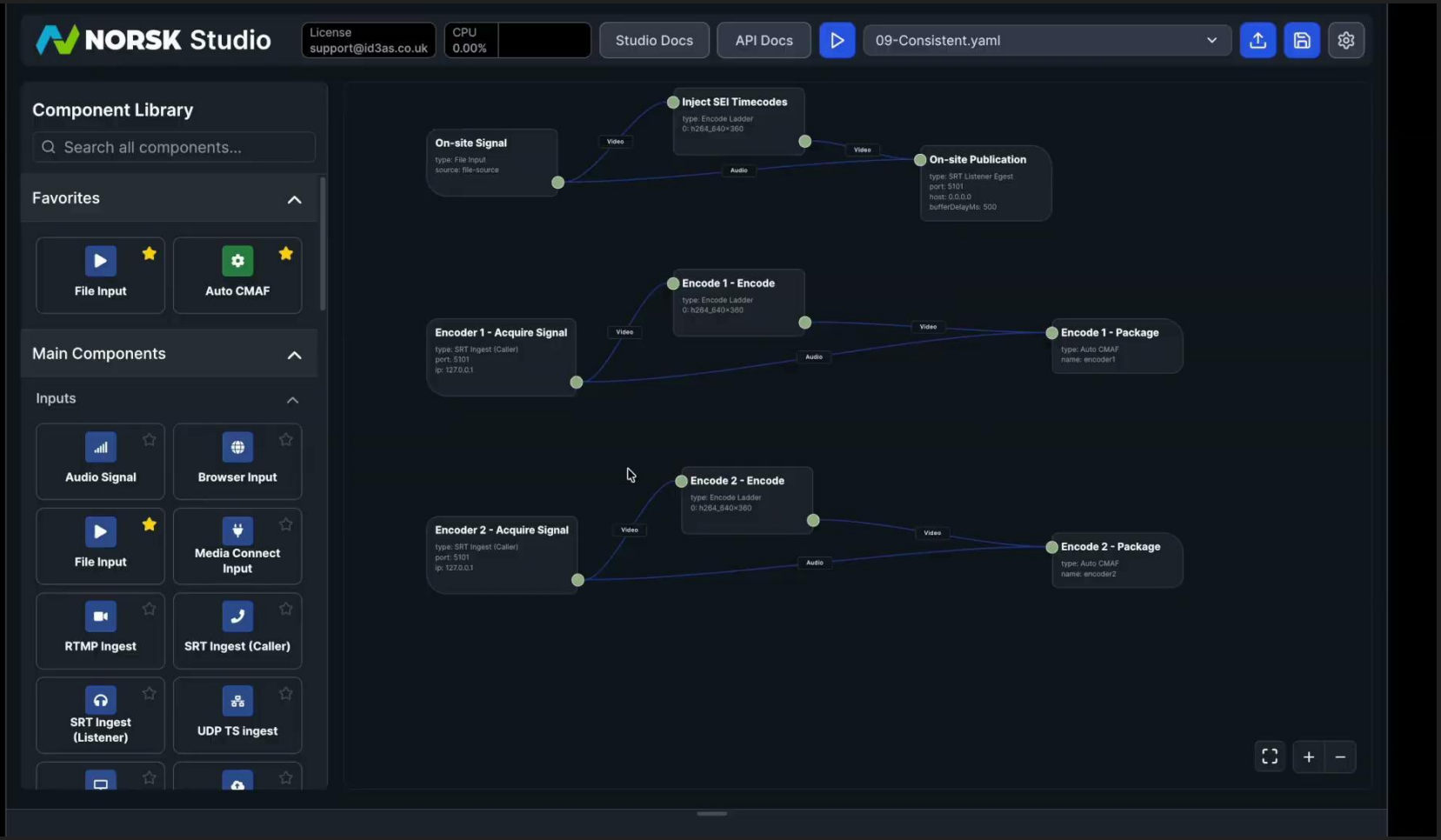
In Addition to the Detail
- Keep the granular information as well



When The Cure Is Worse Than The Disease

Consistent Segmentation



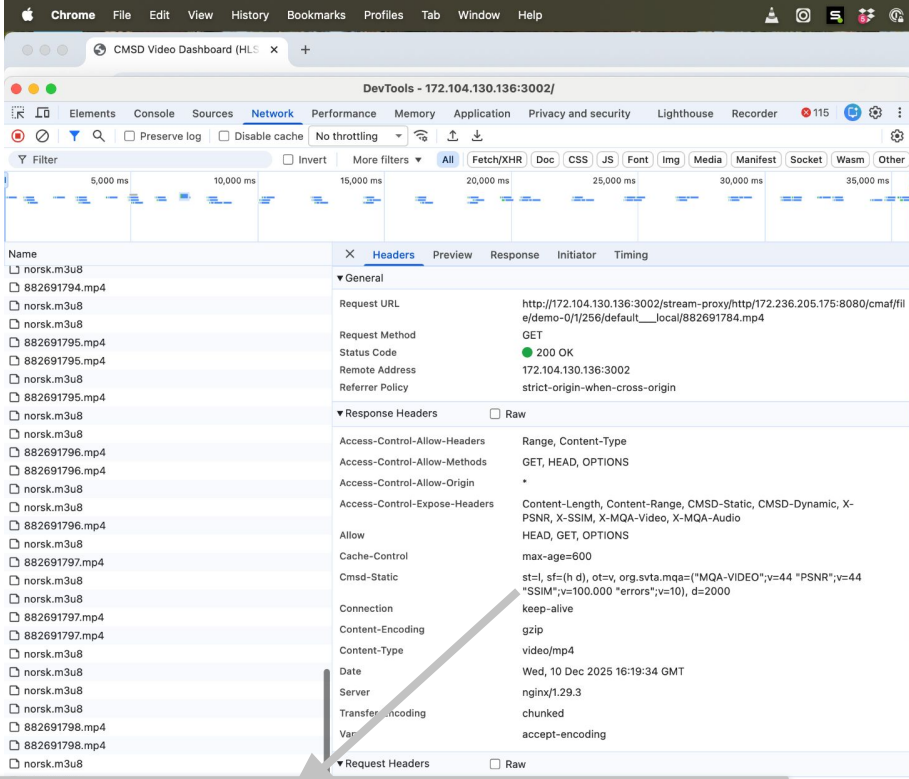

NORSK Studio
License
support@id3as.co.uk
CPU
0.00%
Studio Docs
API Docs
09-Consistent.yaml
Component Library
Search all components...
Favorites
File Input
Auto CMAF
Main Components
Inputs
Audio Signal
Browser Input
File Input
Media Connect Input
RTMP Ingest
SRT Ingest (Caller)
SRT Ingest (Listener)
UDP TS ingest
On-site Signal
type: File Input
source: file-source
Inject SEI Timecodes
type: Encode Ladder
0: h264_640×360
On-site Publication
type: SRT Listener Egest
port: 5101
host: 0.0.0.0
bufferDelayMs: 500
Video
Audio
Encoder 1 - Acquire Signal
type: SRT Ingest (Caller)
port: 5101
ip: 127.0.0.1
Encode 1 - Encode
type: Encode Ladder
0: h264_640×360
Encode 1 - Package
type: Auto CMAF
name: encoder1
Encoder 2 - Acquire Signal
type: SRT Ingest (Caller)
port: 5101
ip: 127.0.0.1
Encode 2 - Encode
type: Encode Ladder
0: h264_640×360
Encode 2 - Package
type: Auto CMAF
name: encoder2

Monitoring

Brenton Ough (Touchstream)
10 min

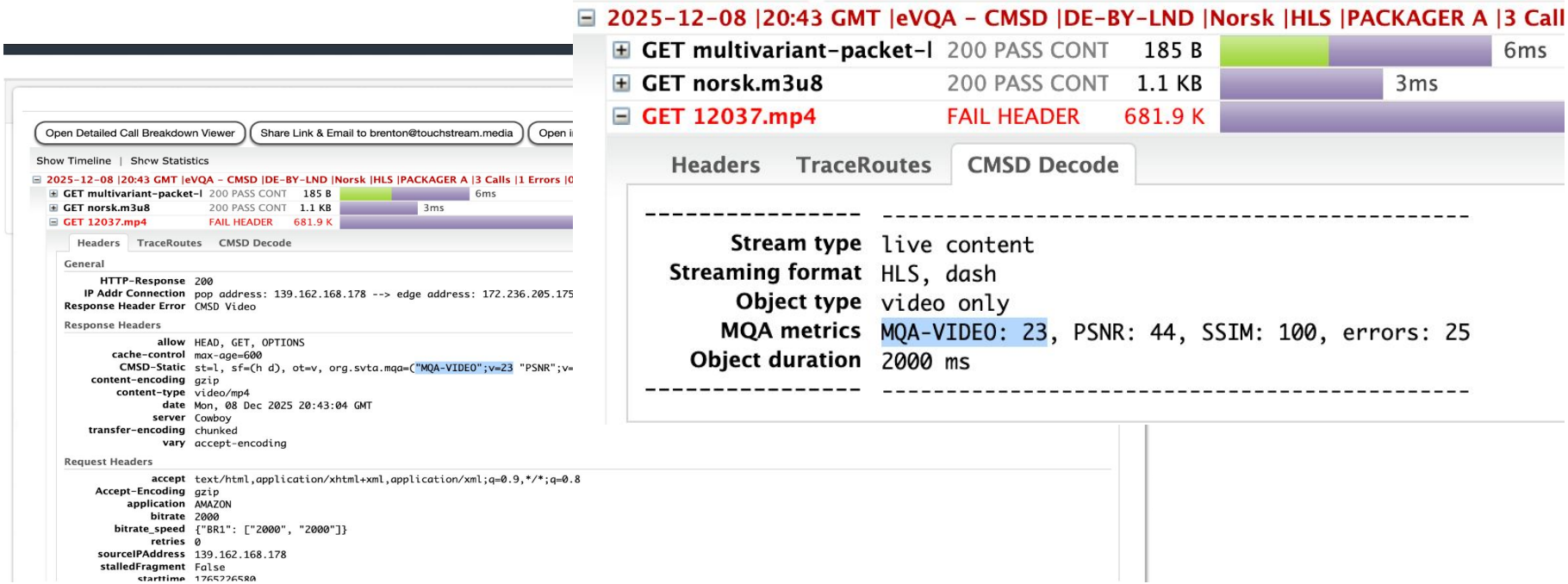
Data Sources

CMSD headers produced by encoder/packager and propagated forward in the delivery workflow



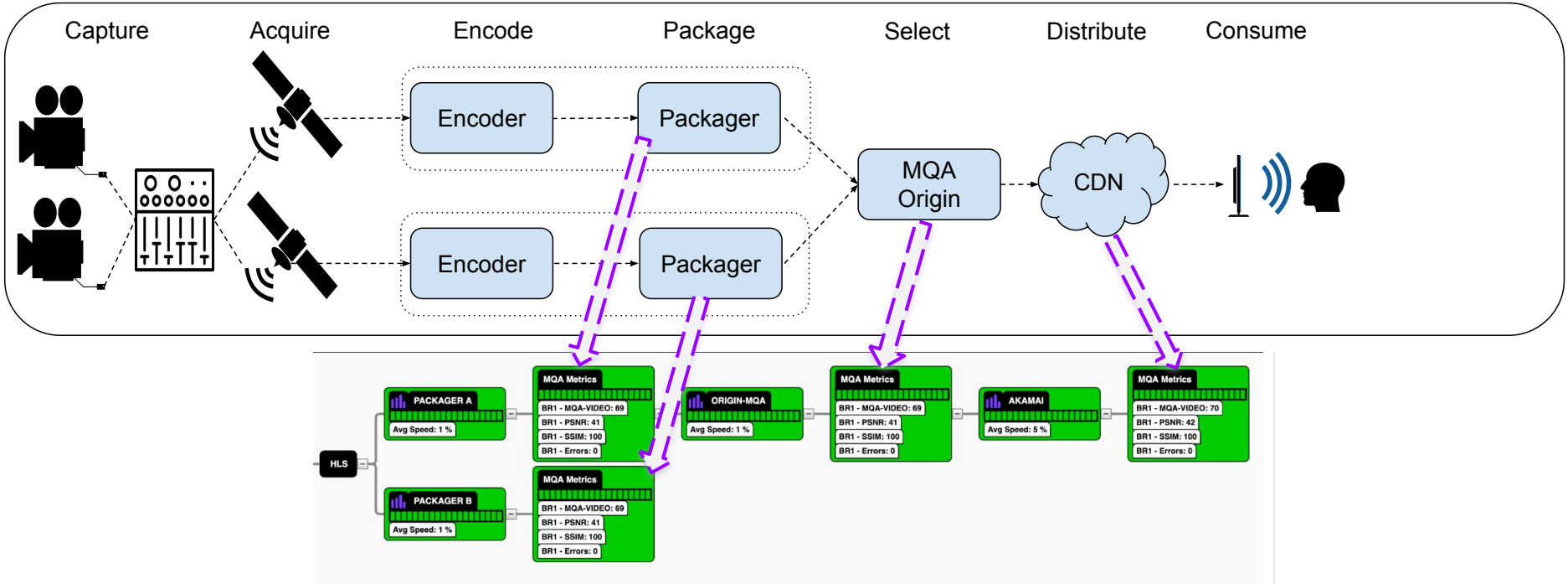
Cmsd-Static st=l, sf=(h d), ot=v, org.svta.mqa=("MQA-VIDEO";v=44 "PSNR";v=44 "SSIM";v=100.000 "errors";v=10), d=2000

Dashboards - Headers



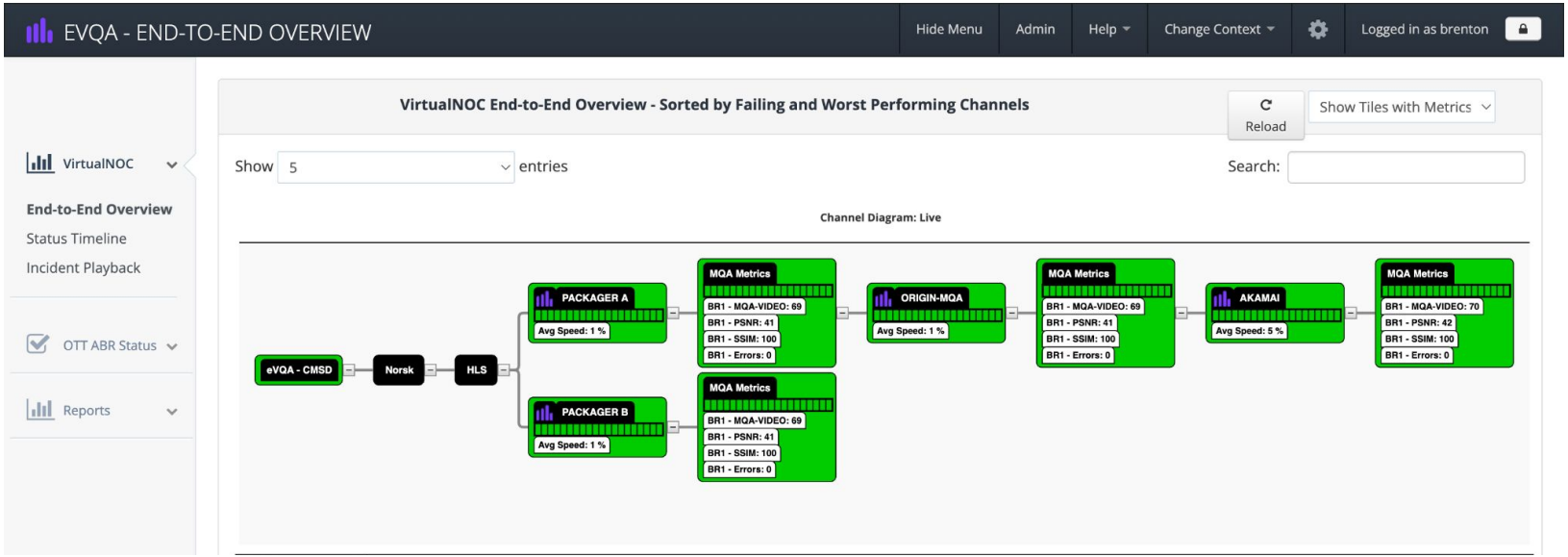
Data Capture

Collect CMSD data from as many points along the delivery workflow as possible



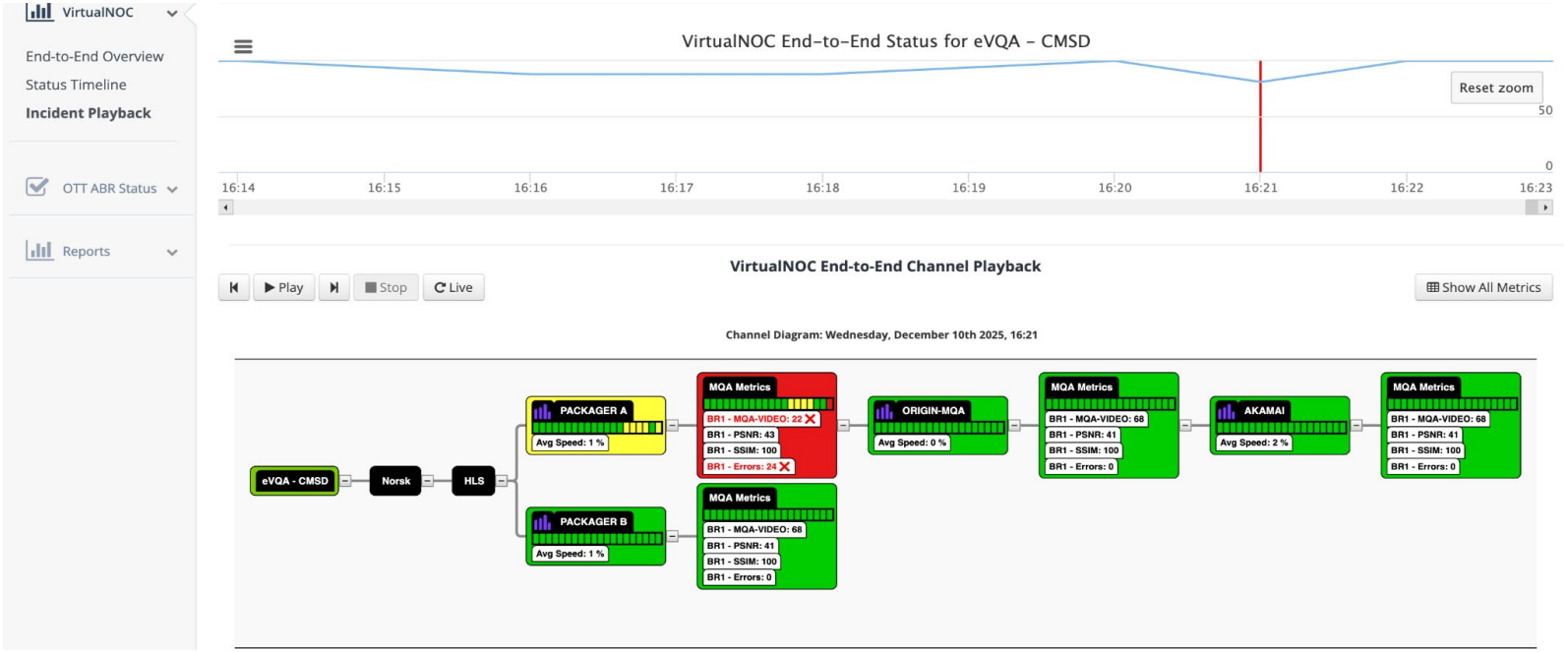
Presentation - Live

Dashboards for visualising video workflow with CMSD-MQA status

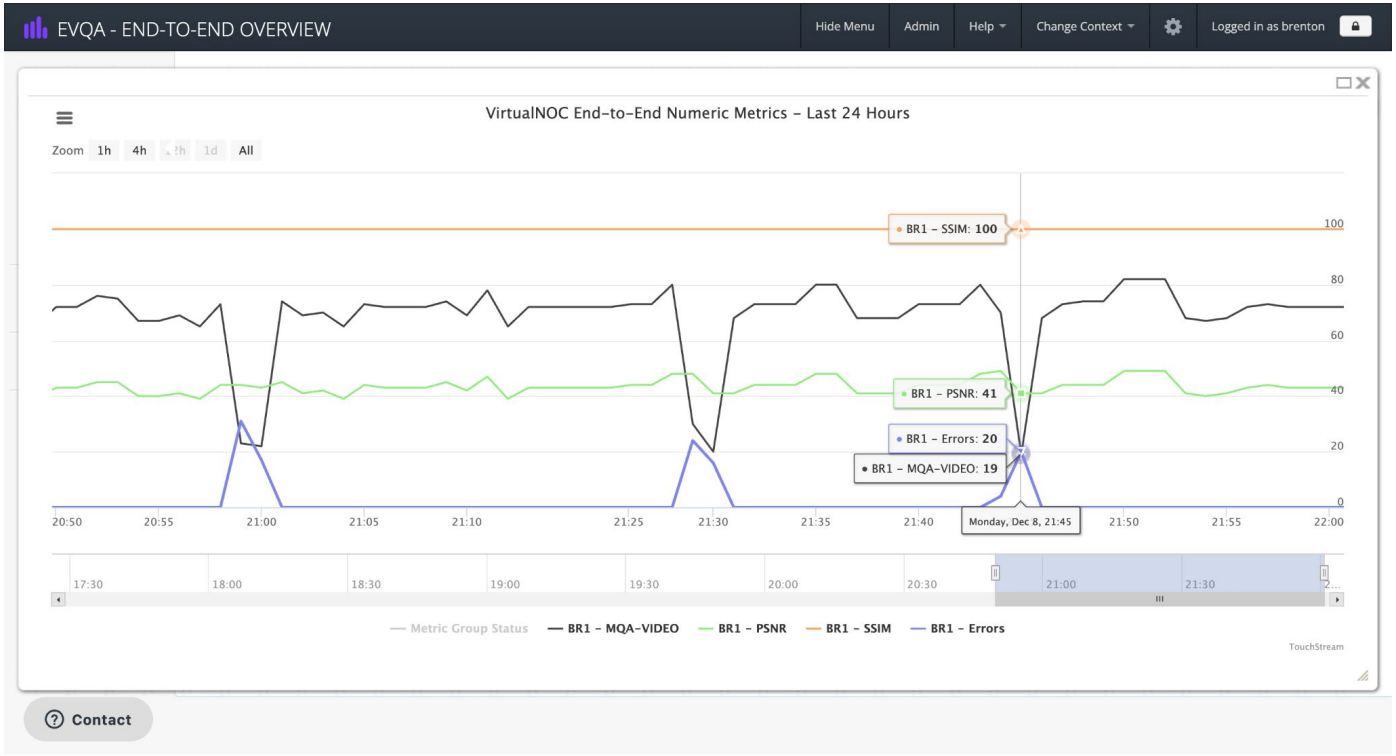


Presentation - Over Time

Dashboards for visualising CMSD-MQA over time

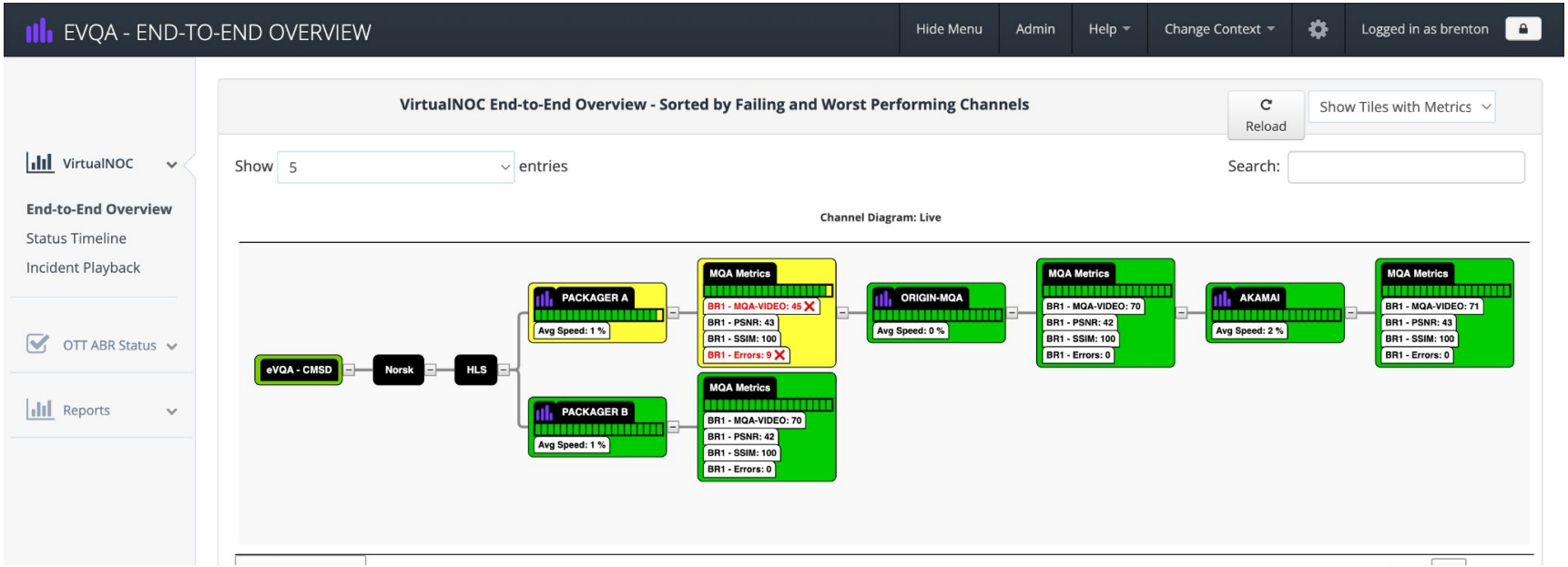


Dashboards - KPIs over time



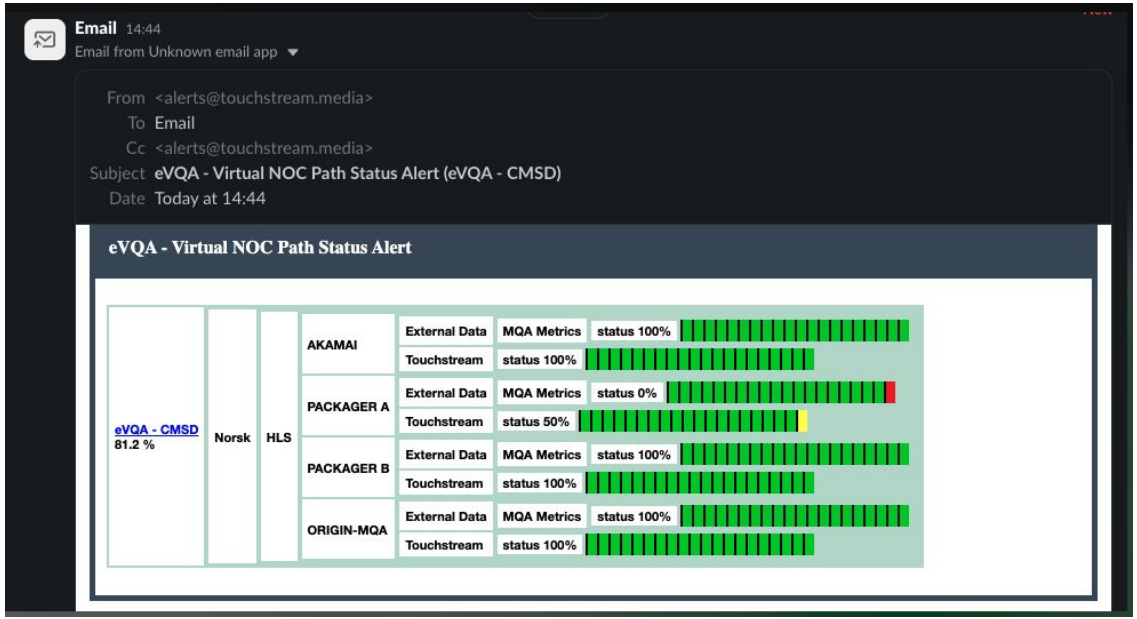
Alerting - Dashboard

Threshold-based alerts for quality degradation and loss of redundancy



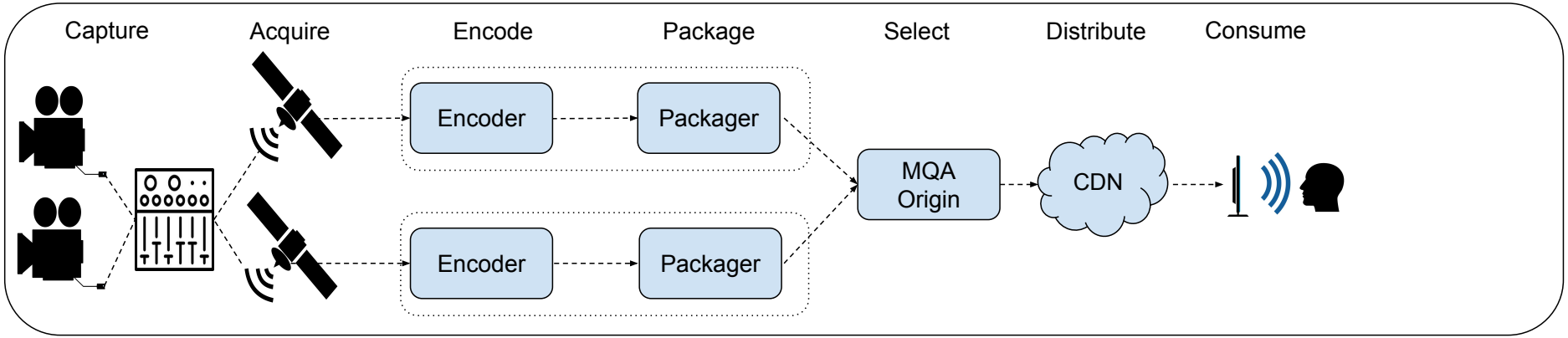
Alerting - Slack/Email

Threshold-based alerts for quality degradation and loss of redundancy

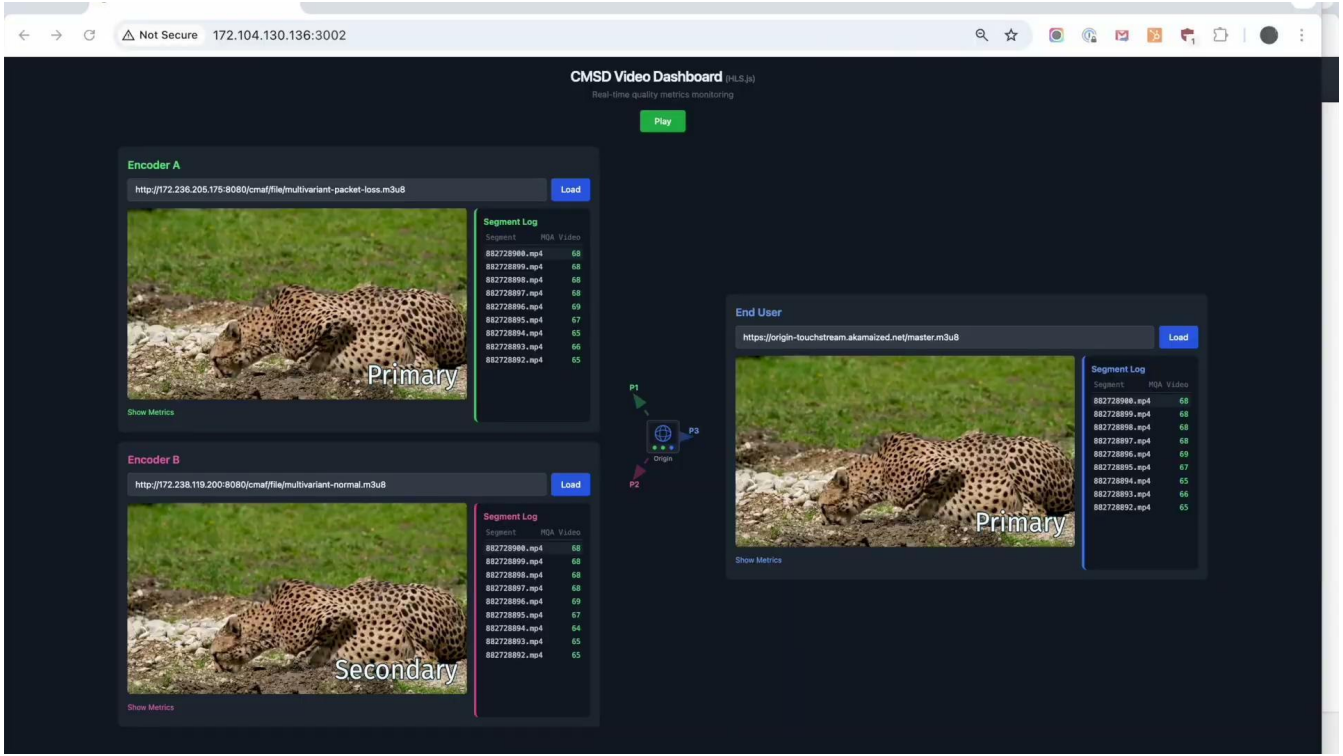


Demonstration Setup

- Live side-by-side encoding A & B
- Inject packet loss in A
- Failover triggered at MQA-Origin by highest CMSD-MQA score



Demonstration



Q&A

#1 How much latency is there while the algorithm selects the best start bit rate?

#2 What does “prefetching” mean for the player; is it supposed to reduce latency?

Will

#3 Would like to better understand how far upstream for live content signals can be monitored, analyzed, and switched, and what the limitations are in terms of ingest protocols and underlying video codecs.

Adrian

#4 Keen to know more on MQAS on akamaized fairplay, mpegdash live linear streams

Will

#5 Which standard set of data are defined to be requested by CDN supplier in RFP?

Alex

#6 What can be done to compare pre- and post-encoder broadcast quality according to globally established standards (excellent / very good / good / poor)?

Adrian

#7 How can post-encoder video quality be compared to the quality viewed by the end user on the client?

Brenton

#8 Are there are any other than from ide3as onprem encoders present, supporting CMSD-MQA?

#9 Are there are any proxies/packagers known, that can enrich encoders quality metrics? (if encoder can not enrich it).

#10 I could see live tracking of VMAF, in Touchstream Dashboard, is that possible to check VMAF of VOD Contents at large, lets say 100 contents ?

#11 Can you please mention again which vendors support CMSD today?

#12 I imagine that trending reports of the past performance could then be used for Ops to plan for discovered periods of problems such as spring & fall sun outage times

G & L

Thank you!

If today's session gave you new perspectives for your streaming setup,
or you have any questions, we're happy to continue the conversation!
Reach out to: contact@gl-systemhaus.de

For questions directed to **Touchstream**, **Norsk** or **Akamai**, please contact:

Touchstream: info@touchstream.media
Norsk: info@norsk.video
Akamai: info@akamai.com