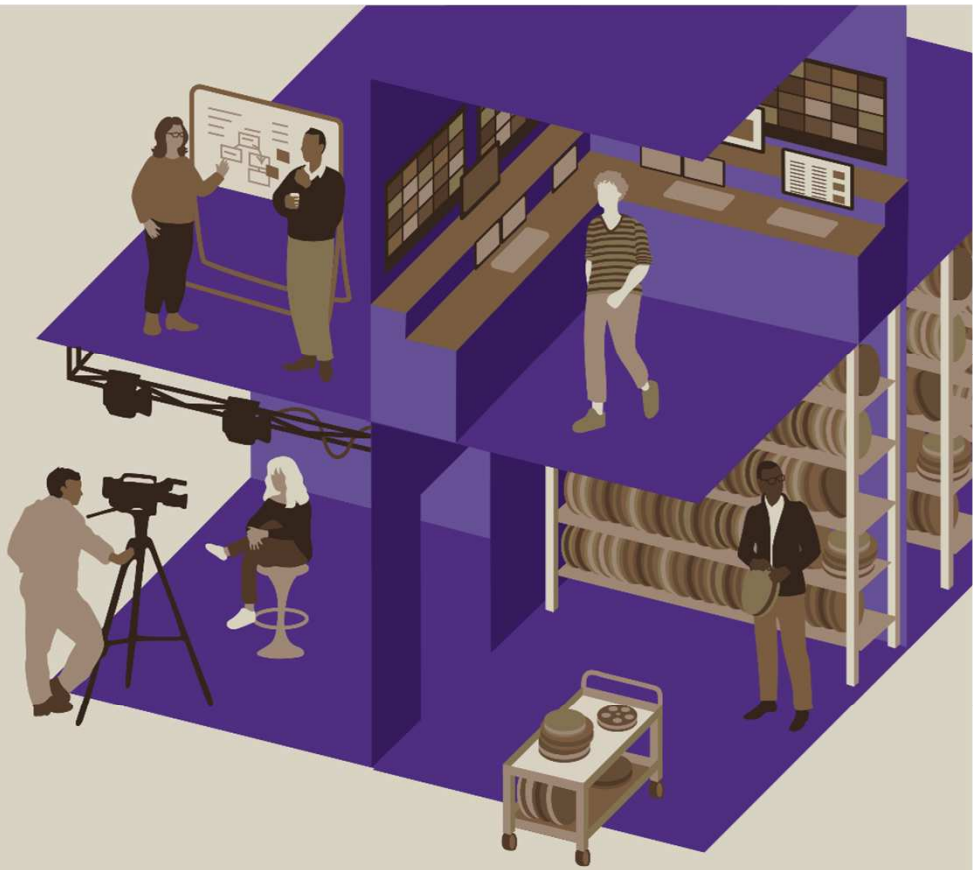
FRAME advanced

Tech 2026

15-19 JUNE



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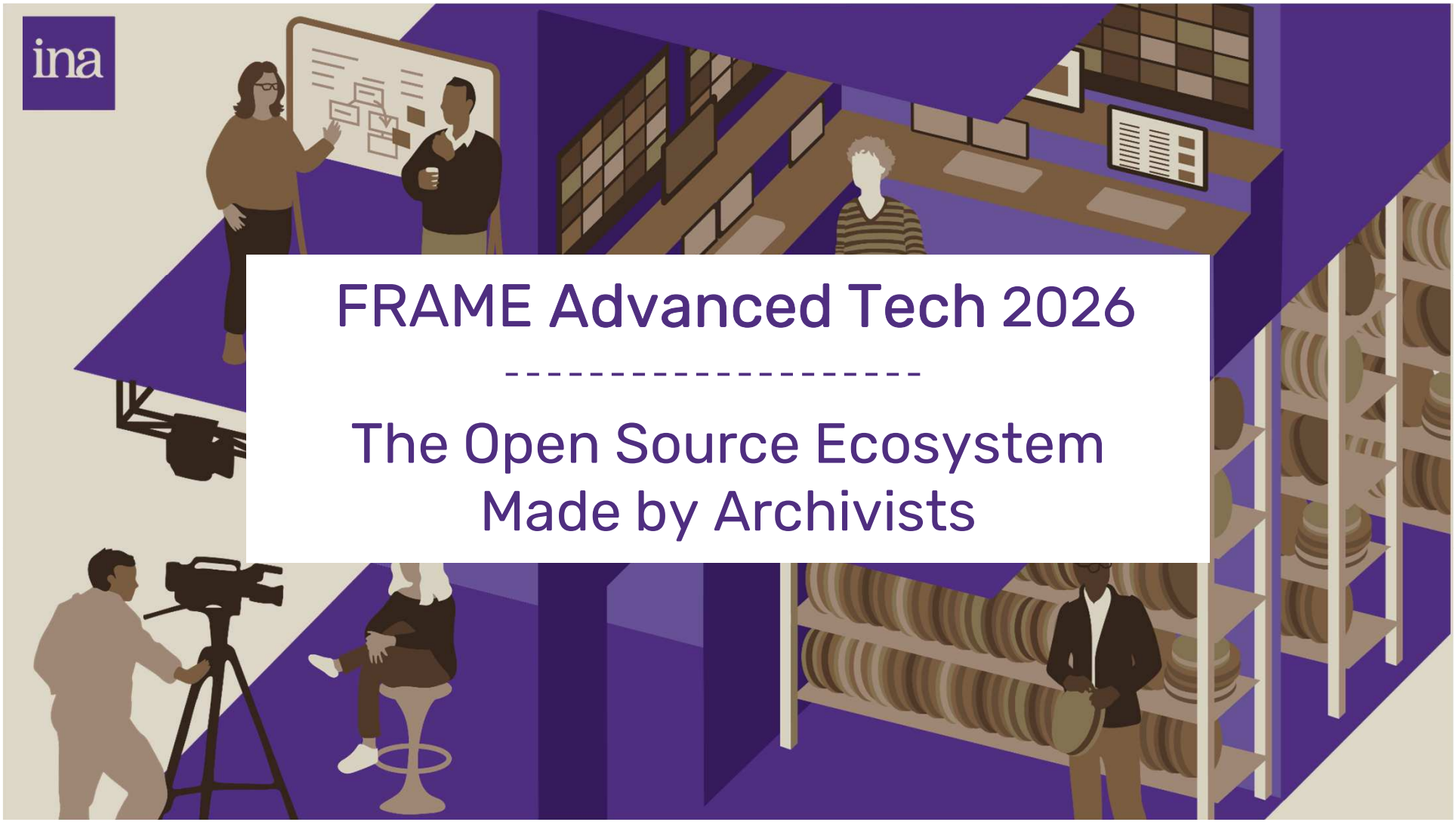
FIAT IFTA

EBU ACADEMY

Co-funded by the Creative Europe Programme of the European Union



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The Open Source Ecosystem Made by Archivists

What is MediaArea

Open source software company focused on digital media analysis.

Not a single entity, but a group of independent developers.

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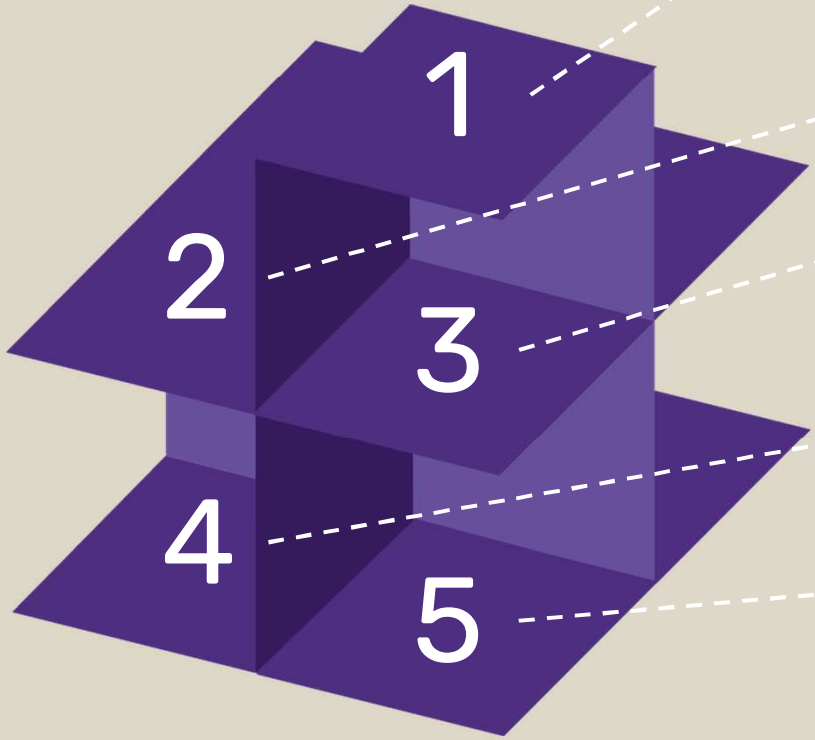

Why QC is important?

Why open source?

MediaInfo

MediaConch

QCTools and more

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Why quality control is important?

Why quality control is important?

If you don’t handle that now,
content is definitely partially lost.

Why quality control is important?

Your digital copy provider is available now
In the future, your content provider may have disappeared, trashed content…

The original tape is still there, but for how long?
The original tape is still there, but for how long?
Or your tape becomes no more readable.

Why quality control is important?

Easier to catch quality issues and fix them now than later.

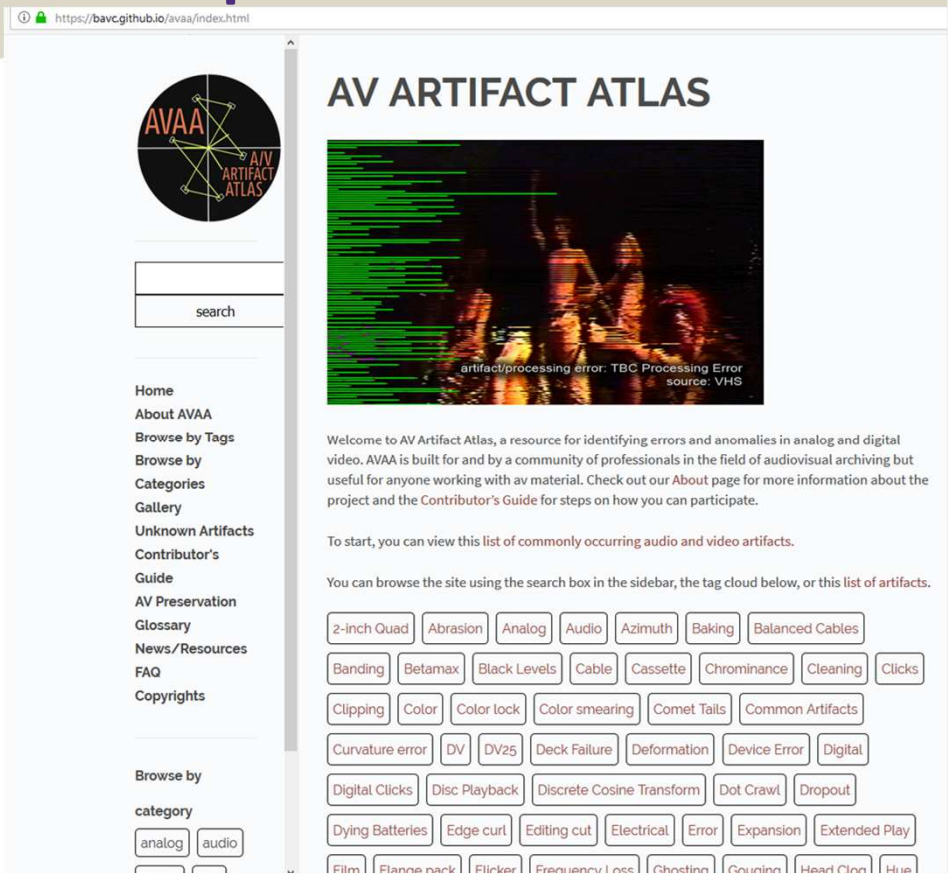
When someone else discovers quality issues, it may be too late.

Why quality control is important?

You are not alone

Example of online support:
AV Artifact Atlas, a resource for identifying errors and anomalies in analog and digital video. AVAA is built for and by a community of professionals in the field of audiovisual archiving but useful for anyone working with AVmaterial.

https://www.avartifactatlas.com



Why quality control is important?

You are not alone

Example of symposiums:
“No Time To Wait” symposiums are free events focused on open media, open standards, and digital audiovisual preservation.
Symposium program is made by archivists, who present how they work and the associated (open source) tools.

Past events:
https://www.youtube.com/@MediaAreaNet

Organization of symposiums has a cost.
- Hosting granted by a main sponsor
- Other archives or vendors may provide additional financial support

“No Time To Wait” 2026 will be at Filmoteka Narodowa – Instytut Audiowizualny (FINA)" in Warsaw on October 14-16.
Current main additional sponsor is Centre national de l’audiovisuel Luxembourg (CNA)
https://mediaarea.net/nttw10

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Why open source?

Why open source?

The archival domain

Relatively small market (niche)

Off-the-shelf products often focus on different use cases

Highly specialized demands

High potential for vendor dependence...

Why open source?

Why not Proprietary tools ?

Proprietary tools and formats are linked to one, and only one, vendor

If vendor disappears, it is impossible to get bug fixes
Without source code, you can not adapt yourself to new platforms: are you sure you'll be able to run the software in 100 years?
Vendor decides on the new features

Are you big enough for making the vendor develop your preferred feature?

Why open source?

The four freedoms of open source

Proprietary tools and formats are linked to one, and only one, vendor

- The freedom to run the program as you wish, for any purpose
- The freedom to study how the program works, and change it so it does your computing as you wish
- The freedom to redistribute copies
- The freedom to distribute copies of your modified versions to others

Why open source?

Reusability

Everyone can use everything

An example
FFmpeg: A complete, cross-platform solution to record, convert and analyze audio and video.

Adapted and reused in several MediaArea's open source tools
Sometimes tweaked

Why open source?

Open source does not mean not professional

Support contracts

Paid installation/integration

Hire developers

Why open source?

A real-world example

The lossless video codec FFV1
Austrian National Archive (Mediathek) wanted to do lossless digital video archiving
Not satisfied with existing products (Interoperability issues)
Found FFV1 in FFmpeg: Excellent codec, but we wanted/needed more...
Contacted and hired a FFV1 developer
Other parties involved for advices (pooled resources)
Budget calculated in reference to costs of proprietary alternatives
Now FFV1 version 3: faster and integrity-aware
So: other archives use FFV1, for free!

Why open source?

A real-world example

FFV1 version 3 is now a standard

FFV1 version 4 in progress:
float numbers, Bayer/RGGB…

Status:	Informational
More info:	Datatracker | IPR | Info page
Stream:	Internet Engineering Task Force (IETF)
RFC:	9043
Category:	Informational
Published:	August 2021
ISSN:	2070-1721
Authors:	M. Niedermayer D. Rice J. Martinez

RFC 9043
FFV1 Video Coding Format Versions 0, 1, and 3

Abstract

This document defines FFV1, a lossless, intra-frame video encoding format. FFV1 is designed to efficiently compress video data in a variety of pixel formats. Compared to uncompressed video, FFV1 offers storage compression, frame fixity, and self-description, which makes FFV1 useful as a preservation or intermediate video format.

Why open source?

Quality of tools

Chicken and egg: if everyone waits, nothing happens
We start with needs easy to handle and we create dedicated open source tools
Tools become bigger, step by step, when more people join

YOU can decide about participating in lowering the overall cost for archives.

Why open source?

Funding

Driven by user requests

Most of tools were funded after a need is detected by users

Why paying for something you don't control? (is your current choice future proof?)

Everyone (you included) can develop or sponsor a development
You can fork if you think you have a better idea than others

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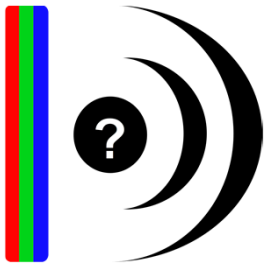
MediaInfo

MediaInfo

A technical information reporter

Convenient unified display of the most relevant technical and tag data for video and audio files.



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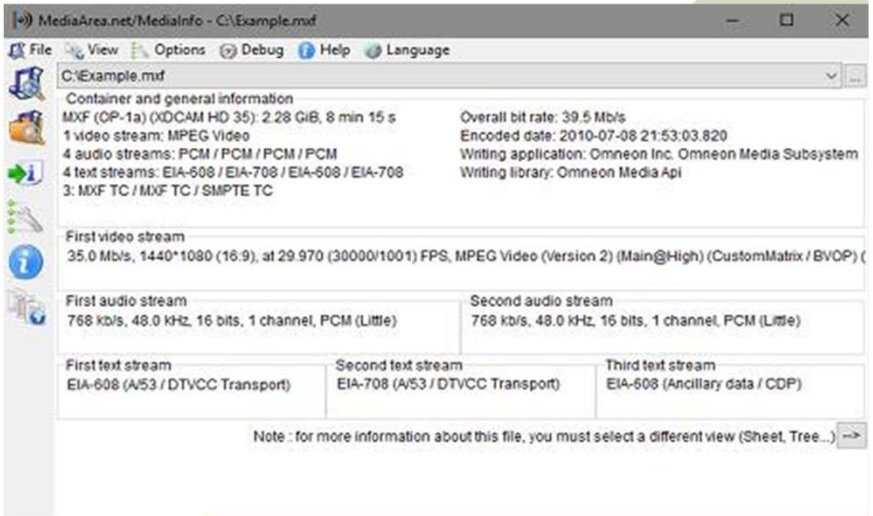
MediaInfo

A technical information reporter

Output: text, XML, HTML, PBCore, EBUCore…
Container: format, profile, commercial name of the format, duration, overall bit rate, writing application and library, title, author, director, album, track number, date, duration…
Video: format, codec id, aspect, frame rate, bitrate, color space, chroma subsampling, bit depth, scan type, scan order…
Audio: format, codec id, sample rate, channels, bit depth, language, bit rate…
Text: format, codec id, language of subtitle…
Chapters: count of chapters, list of chapters…



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MediaConch

MediaConch

A conformance checker

Implementation checker
Policy checker
Reporter

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MediaConch

Funding

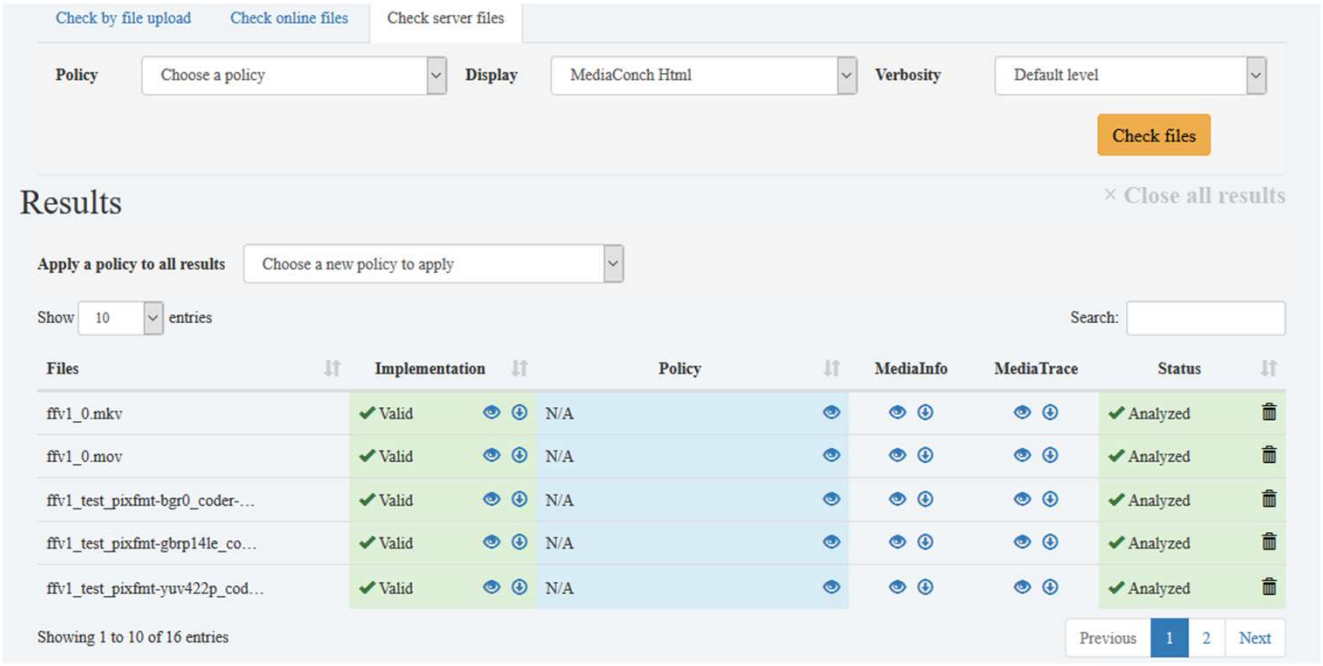
Initial development sponsored by European Union (PREFORMA project)

Focused on FFV1 and Matroska.

We added formats supported by MediaInfo to the policy checker.

MediaConch

Implementation and Policy reporter



MediaConch

Implementation and Policy reporter

Compared to a specification or compared to your policy

MediaConch Report

File: C:/temp/FFV1+PCM_WithChecksum_Untouched.mkv

MediaConch EBML Implementation Checker

Toggle all verbosity:

- **EBML-ELEM-START** Tests run: 1 | Results: ✓
- **EBML-VER-COH** Tests run: 1 | Results: ✓
- **EBML-DOCVER-COH** Tests run: 1 | Results: ✓
- **EBML-ELEMENT-VALID-PARENT** Tests run: 87 | Results: ✓
- **EBML-ELEMENT-NONMULTIPLES** Tests run: 70 | Results: ✓
- **EBML-ELEMENT-CONTAINS-MANDATES** Tests run: 43 | Results: ✓
- **EBML-ELEMENT-IN-SIZE-RANGE** Tests run: 43 | Results: ✓
- **EBML-VALID-MAXID** Tests run: 1 | Results: ✓
- **EBML-VALID-MAXSIZE** Tests run: 1 | Results: ✓
- **HEADER-ELEMENTS-WITHIN-IDLENGTH-LIMIT** Tests run: 1 | Results: ✓
- **ELEMENTS-WITHIN-MAXIDLENGTH** Tests run: 1 | Results: ✓
- **HEADER-ELEMENTS-WITHIN-MAXSIZELENGTH** Tests run: 1 | Results: ✓
- **ELEMENTS-WITHIN-MAXSIZELENGTH** Tests run: 1 | Results: ✓
- **MKV-SEEK-RESOLVE** Tests run: 4 | Results: ✓
- **EBML-CRC-FIRST** Tests run: 6 | Results: ✓
- **EBML-CRC-VALID** Tests run: 6 | Results: ✓
- **MKV-VALID-TRACKTYPE-VALUE** Tests run: 2 | Results: ✓
- **MKV-VALID-BOOLEANS** Tests run: 3 | Results: ✓

MediaConch FFV1 Implementation Checker

- **FFV1-SLICE-CRC-VALID** Tests run: 4 | Results: ✓

MediaConch PCM Implementation Checker

MediaConch Report

File: C:/temp/FFV1+PCM_WithChecksum_Untouched.mkv

Example MKV FFV1 digitization policy ✗ fail

Example of a digitization specification of analog SD video to FFV1 and Matroska.

Type: and | **Rules run:** 17 | **Fail count:** 5 | **Pass count:** 12

- **Is it Matroska?** ✓ pass
- **Matroska version 4 or greater?** ✓ pass
- **Unique ID is present?** ✓ pass
- **Is the video FFV1?** ✓ pass
- **FFV1 is version 3.4 or later?** ✓ pass
- **FFV1 is encoded in GOP size of 1?** ✗ fail
- **FFV1 uses slice crcs?** ✓ pass
- **Display Aspect Ratio is 4/3?** ✗ fail (Actual: 1.222)
- **Frame Rate is Constant?** ✓ pass
- **ColorSpace is YUV?** ✗ fail (Actual: RGB)
- **Chroma Subsampling is 4:2:2?** ✗ fail
- **Audio is PCM?** ✓ pass
- **Audio is 48000 Hz?** ✓ pass
- Is this NTSC or PAL SD? ✗ fail
- Bit Depth is 8 or 10? ✓ pass
- Audio is Stereo or Mono? ✓ pass
- Bit Depth is 16 or 24? ✓ pass

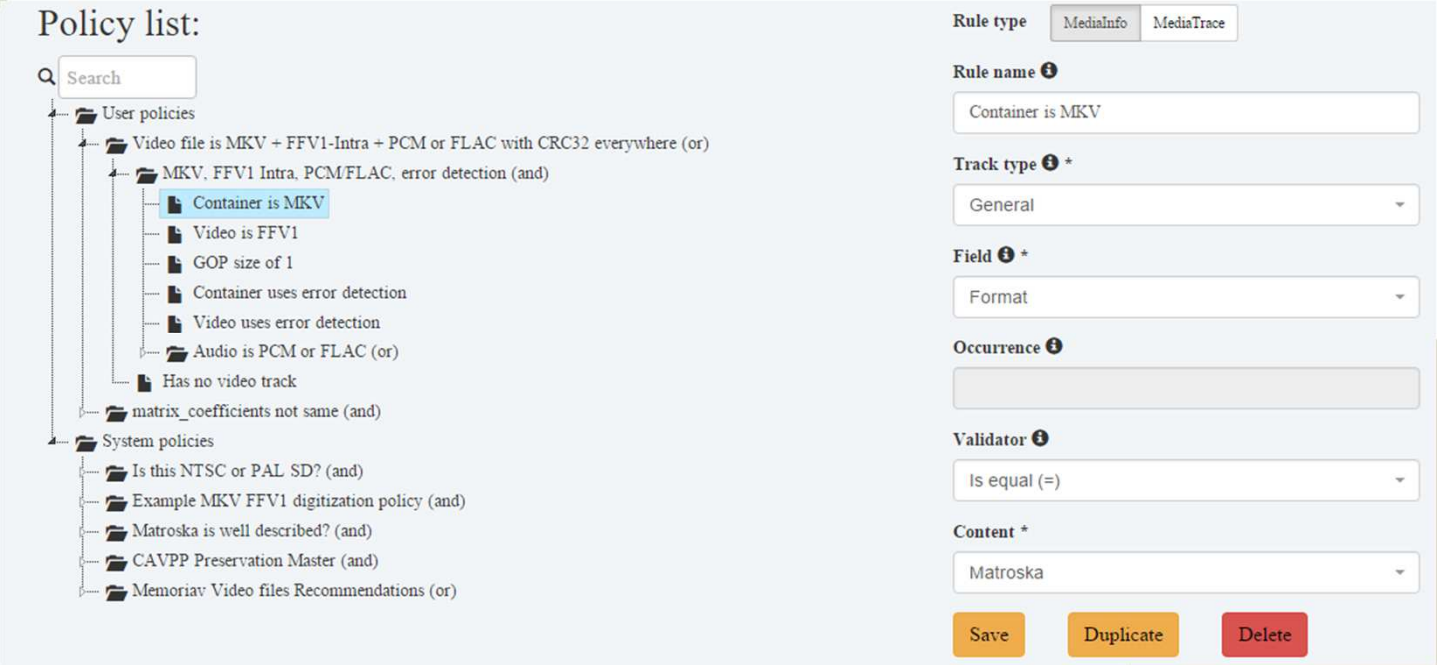
MediaConch

File inspection

Offset	Key	Value
0x00000000	EBML (30 bytes)	
0x0000001e	Segment (35726 bytes)	
0x0000001e	Header (12 bytes)	
0x0000002a	SeekHead (115 bytes)	
0x0000009d	Void (88 bytes)	
0x000000f5	Info (139 bytes)	
0x00000180	Tracks (112 bytes)	
0x00000180	Header (5 bytes)	
0x00000185	CRC-32 (6 bytes)	
0x0000018b	TrackEntry (101 bytes)	
0x0000018b	Header (2 bytes)	
0x0000018d	CRC-32 (6 bytes)	
0x00000193	TrackNumber - 1 (3 bytes)	
0x00000196	TrackType - 1 (3 bytes)	
0x00000199	CodecID - V_FFV1 (8 bytes)	
0x000001a1	TrackUID - 1 (4 bytes)	
0x000001a5	FlagLacing - 0 (3 bytes)	
0x000001a8	Language - und (7 bytes)	
0x000001af	DefaultDuration - 40000000 (8 bytes)	
0x000001b7	Video (12 bytes)	
0x000001c3	CodecPrivate (45 bytes)	
0x000001c3	Header (3 bytes)	
0x000001c6	version	3 (0x3)
0x000001c6	micro_version	4 (0x4)
0x000001c6	coder_type	0 (0x0)

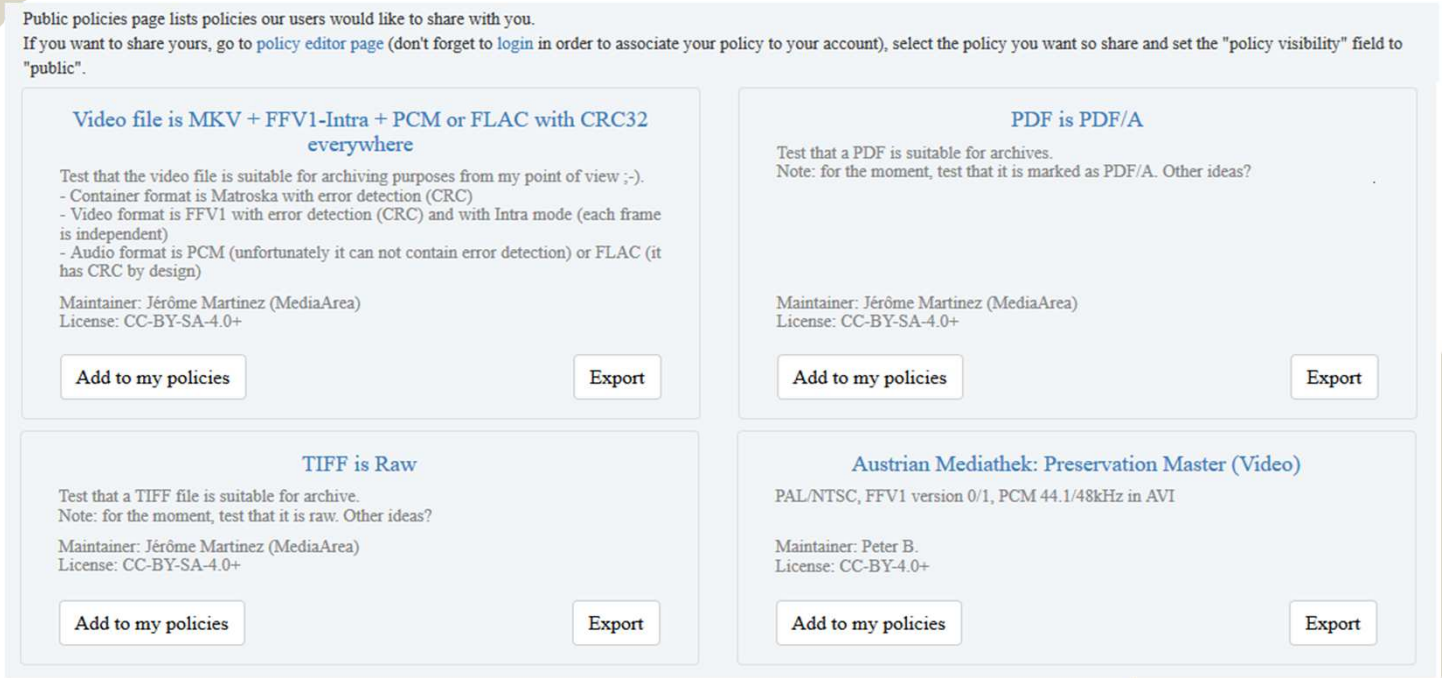
MediaConch

Policy editor



MediaConch

You are not alone



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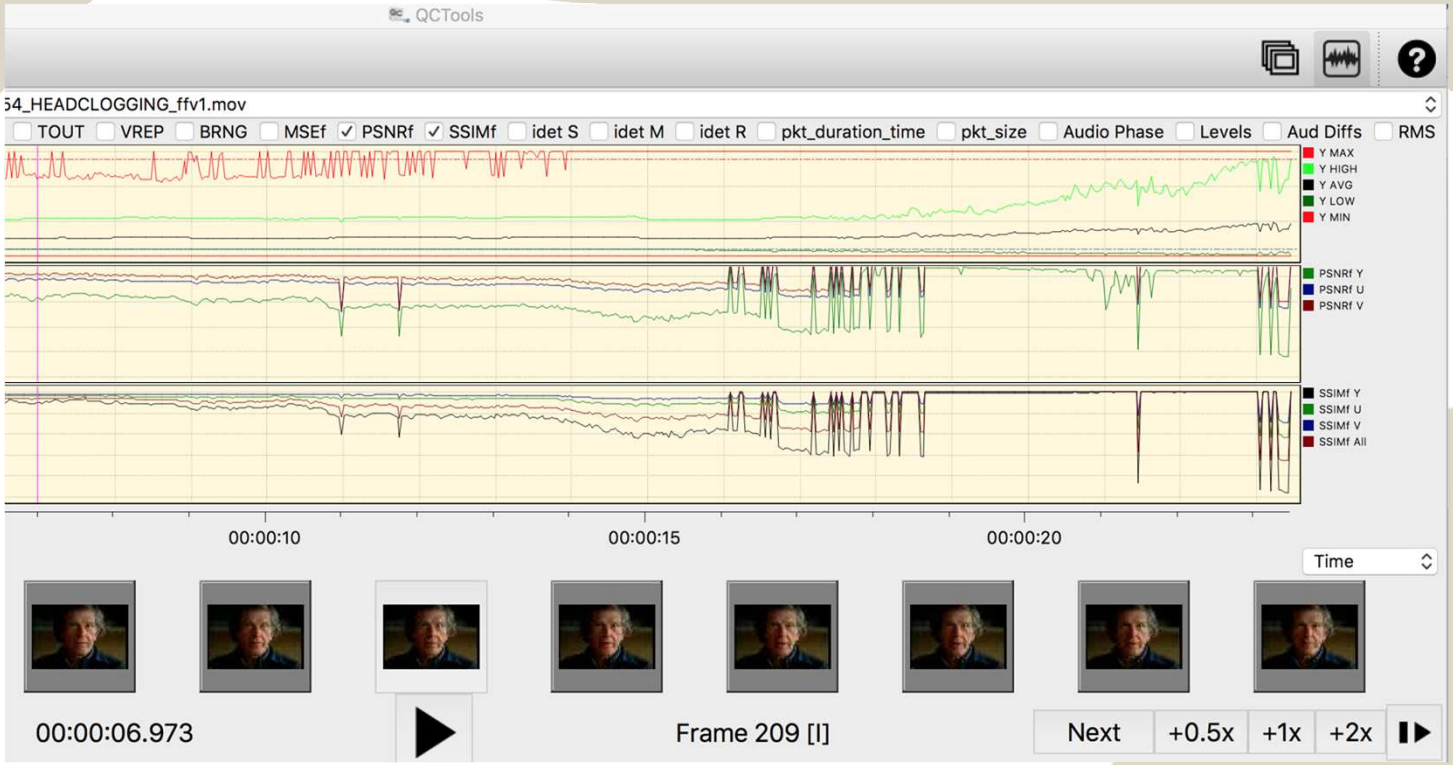
QCTools

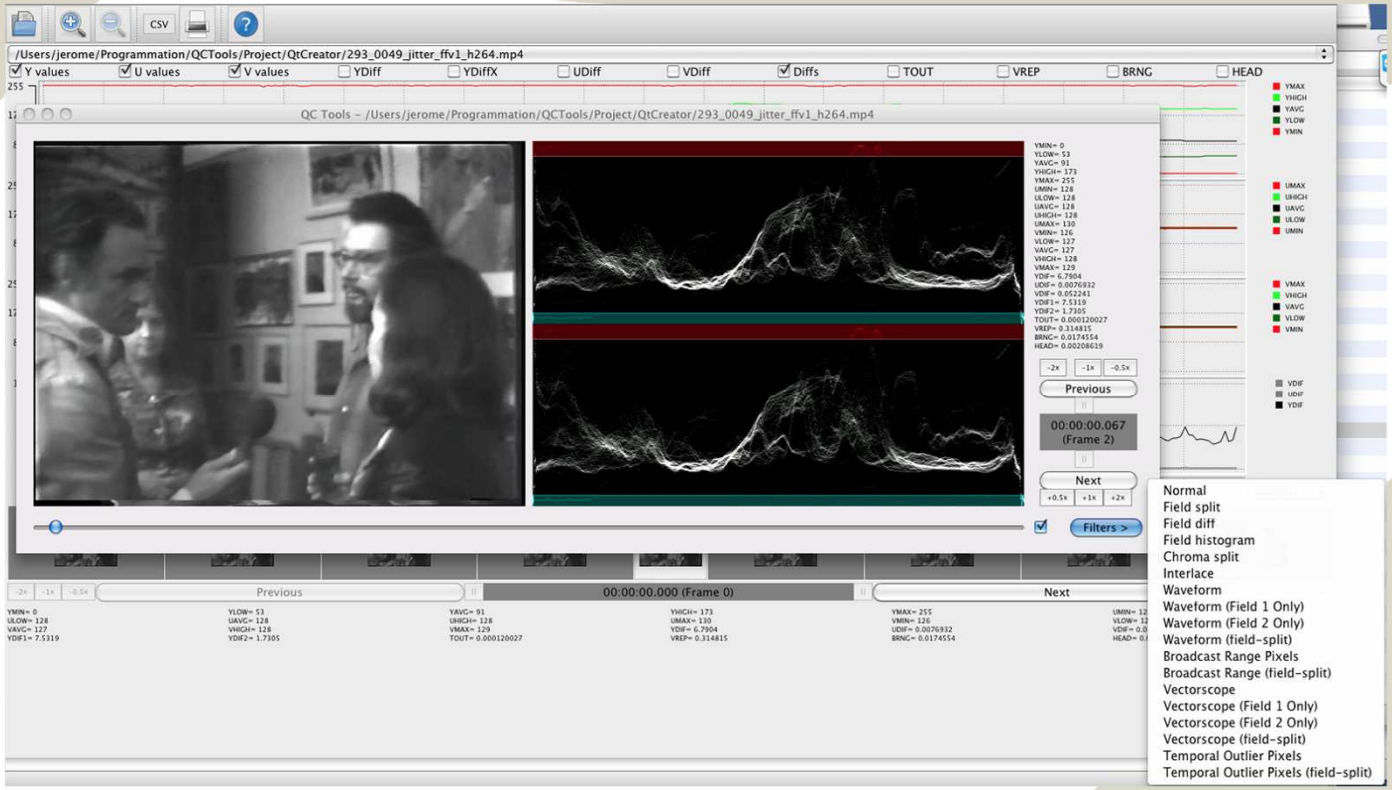
QCTools

Helps users analyze and understand their digitized video files through use of audiovisual analytics and filtering.

QCTools

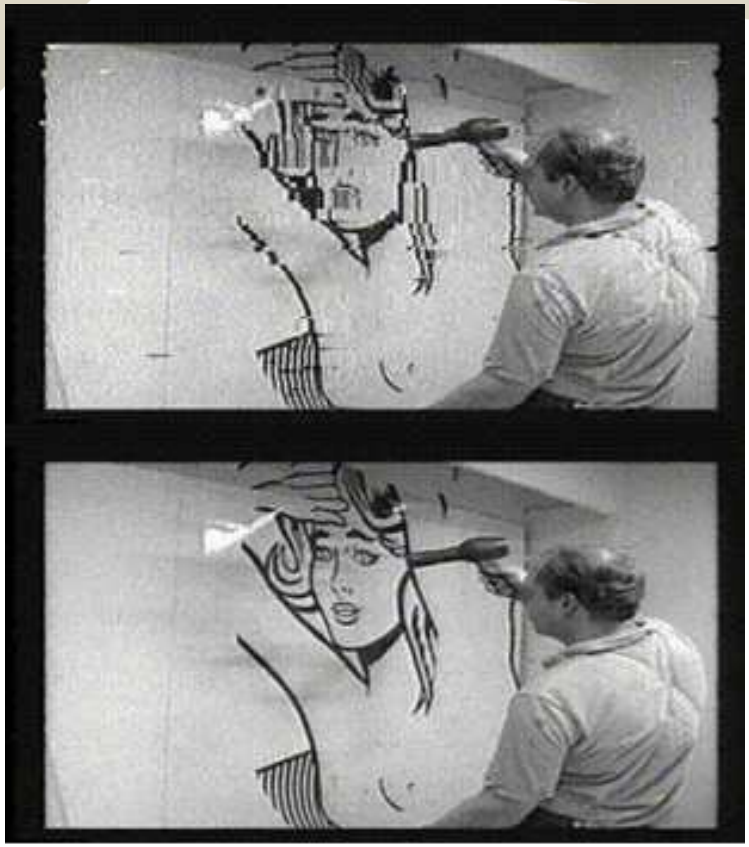

QCTools
54_HEADCLOGGING_ffv1.mov
TOUT
VREP
BRNG
MSEf
PSNRf
SSIMf
idet S
idet M
idet R
pkt_duration_time
pkt_size
Audio Phase
Levels
Aud Diffs
RMS
Y MAX
Y HIGH
Y AVG
Y LOW
Y MIN
PSNRf Y
PSNRf U
PSNRf V
SSIMf Y
SSIMf U
SSIMf V
SSIMf All
00:00:10
00:00:15
00:00:20
Time
00:00:06.973
Frame 209 [I]
Next
+0.5x
+1x
+2x

QCTools


/Users/jerome/Programmation/QCTools/Project/QtCreator/293_0049_jitter_ffv1_h264.mp4
Y values
U values
V values
YDiff
YDiffX
UDiff
VDiff
Diffs
TOUT
VREP
BRNG
HEAD
QC Tools – /Users/jerome/Programmation/QCTools/Project/QtCreator/293_0049_jitter_ffv1_h264.mp4
Previous
00:00:00.067
(Frame 2)
Next
Filters >
Previous
00:00:00.000 (Frame 0)
Next
Normal
Field split
Field diff
Field histogram
Chroma split
Interlace
Waveform
Waveform (Field 1 Only)
Waveform (Field 2 Only)
Waveform (field-split)
Broadcast Range Pixels
Broadcast Range (field-split)
Vectorscope
Vectorscope (Field 1 Only)
Vectorscope (Field 2 Only)
Vectorscope (field-split)
Temporal Outlier Pixels
Temporal Outlier Pixels (field-split)

QCTools

QCTools



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RAWcooked

RAWcooked

The issue

1 DPX/TIFF file per video frame
Not playable as is by several players (VLC...)
Huge size
So many DPX or TIFF format flavors
(interoperability issues)

And need of keeping all metadata

RAWcooked

The goal

1 file with all (video, audio, sidecar files)
Playable by a lot of players (MKV+FFV1+FLAC)
Size divided by 2
Reversible to source format if needed
Easy to use

RAWcooked

The solution

Easy: just a short command line
"rawcooked YourDirectoryName“

Store DPX/TIFF headers/footers in a specific Matroska attachment
Store other sidecar files as Matroksa attachments
Output is a single Matroska/FFV1/FLAC file

Encoding is reversible (bit-by-bit to original files)
"rawcooked YourMatroskaFileName.mkv"

RAWcooked

Long term sustainability

~50 RAWcooked sponsors
A niche market
No big company interested
The initial effort was not small
Each single entity needing that can not afford a full development
We needed to find a different development model

And more

RAWcooked

Long term sustainability

~50 RAWcooked sponsors
A different business model based on license key
We provide a key for other format flavors and features (temporary key possible)
1000 € for first flavor/feature
+ 500 € per additional flavor/feature
Except for GPU support (1000 €)
To be compared with storage cost saving (storage cost divided by 2)

And more

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BWF MetaEdit

BWF MetaEdit

Metadata edition

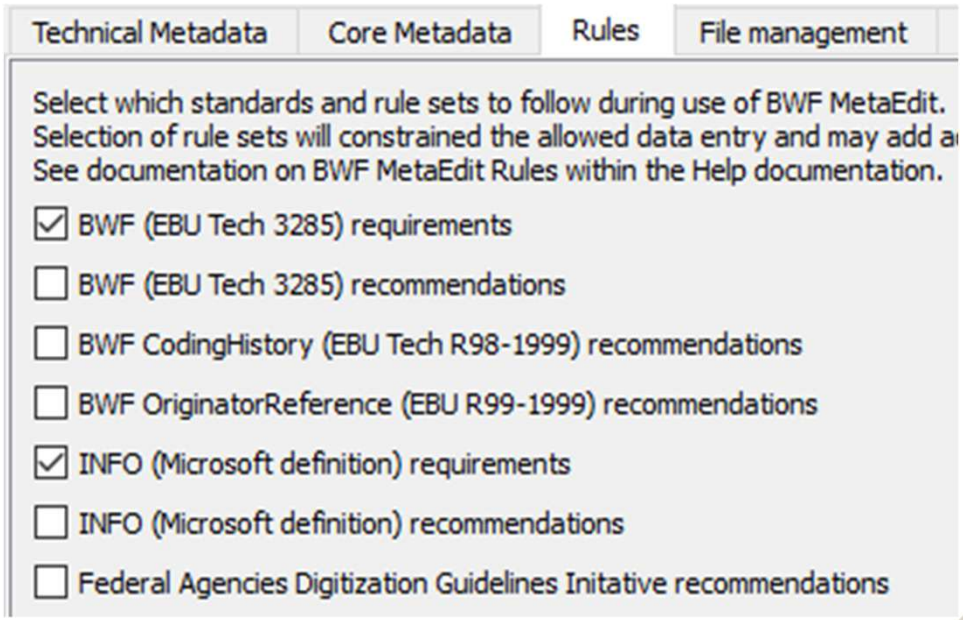
Library of Congress (USA) centralized the management.

Edition of WAV/BWF metadata for conforming to ther guidelines.

https://www.digitizationguidelines.gov/guidelines/digitize-embedding.html

BWF MetaEdit

Metadata edition



BWF MetaEdit

Open source! And versatile

Other entities needed metadata edition for other formats.

AVI MetaEdit and MOV MetaEdit are born.

Forks of BWF MetaEdit, same idea, same core source code.

Cheaper!

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DVRescue

DVRescue

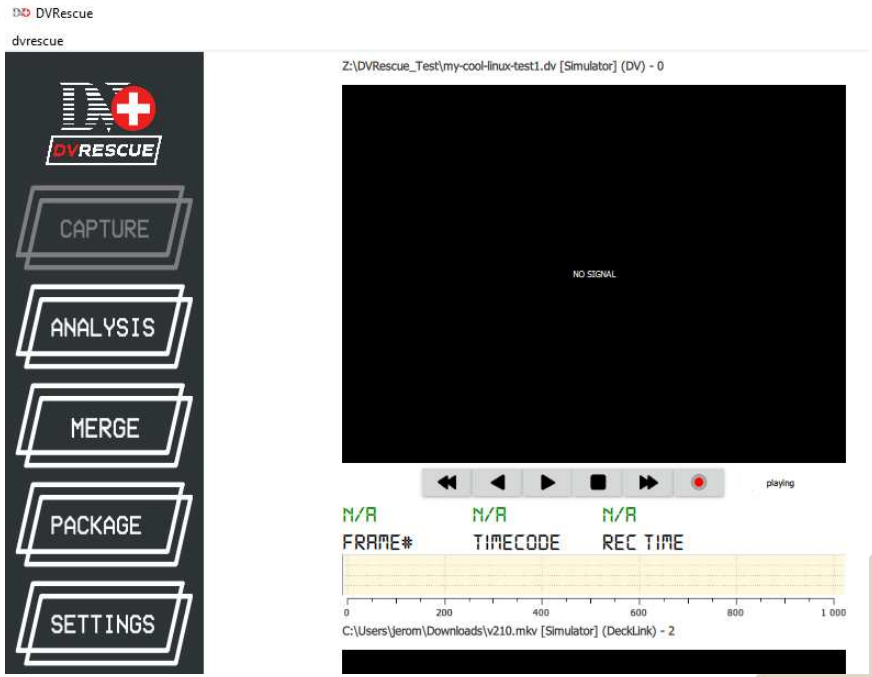
Improve DV dumps

DV format is complicated.
Lot of different vendors with specific issues.
National Endowment for the Humanities centralized the management.

Need to make capture easier

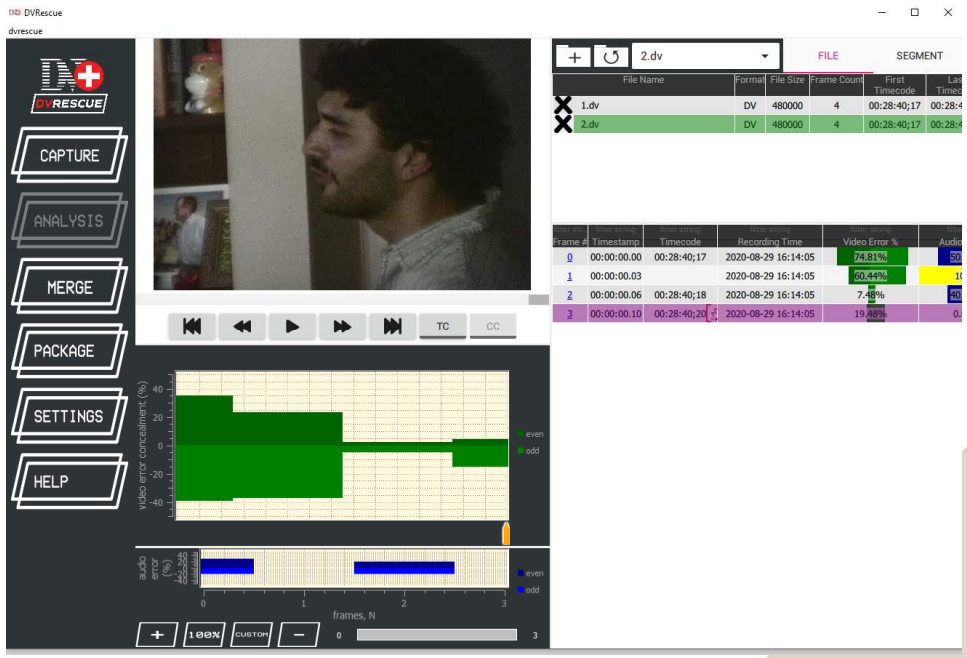
DVRescue

Improve DV dumps



DVRescue

Improve analyze



DVRescue

Optimize DV dumps

Now a tool for dumping DV from tape several times and peek the best dump.

Not by file… Not by frame… By macroblock.

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mkvnote

mkvnote

The issue to resolve

MKV is a container format.

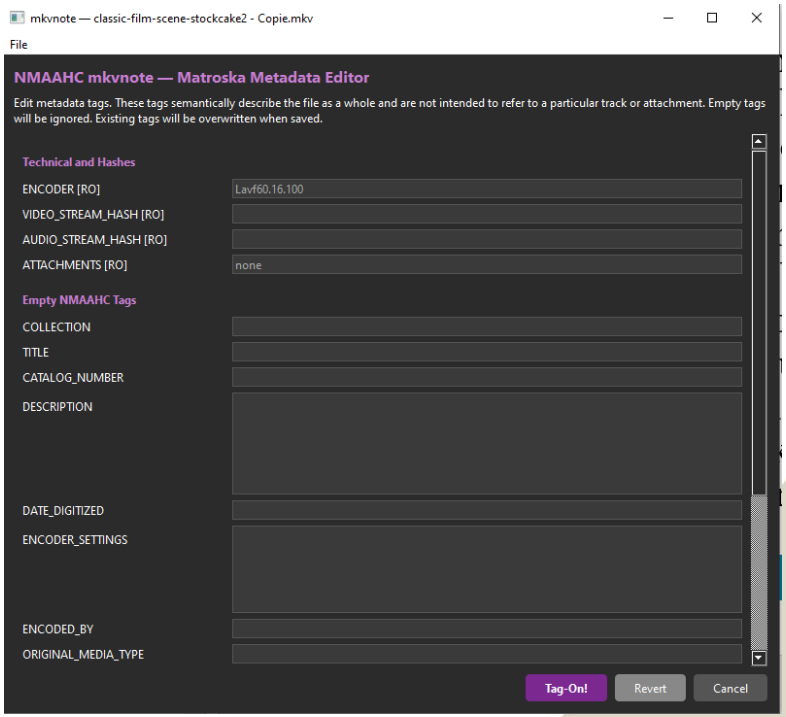
Lot of tools for editing MKV metadata.

But… Command line ☹.

Not everyone is able to use it.

mkvnote

The solution



mkvnote

A graphical interface easy to use

Smithsonian National Museum of African American History and Culture (NMAAHC)
needed something easier to manage.
And adapted to their needs.

We develop a dedicated tool for the graphical interface,
using existing open source command line tools.

Not so expensive.

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LeaveSD

LeaveSD

How to leave a proprietary format

STARDIVA® storage format based on NSV but with opaque metadata format and 8-ch single audio track for actually 8 independent mono content.

The old software version is not compatible with Windows 10+.
The new software version is super expensive.
Here is the trap!

Well… Let’s do some reverse engineering.

LeaveSD

How to leave a proprietary format

Funded by an anonymous sponsor.

Not happy with the monopoly from one vendor on the file format support.

But past is past, files are there, very important.

LeaveSD

How to leave a proprietary format

Sponsorship of reverse engineering.

Risky, maybe no outcome.

Based on standard formats (NSV container, AVC video, AAC audio).
But not standard.

LeaveSD

How to leave a proprietary format

It was long but we succeeded to decode the files.

We used several open source tools (FFmpeg, FAAD, mkvmerge)
and custom glue between them.

A couple of other users wanted to use it too.
But new version of the files are slightly different.
No budget, not supported ☹.
Maybe in the future, when there is budget.
Code is open source, available for everyone motivated.

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Wrap-up

Wrap-up

Don’t forget QC

Open source is another way to work

Archivists created an ecosystem for themselves.

You can improve tools or sponsor the improvements you need

Stay in touch

MediaArea: https://MediaArea.net, @MediaArea_net

Jérôme Martinez: jerome@MediaArea.net

Slides: https://MediaArea.net/Events