File formats for audiovisual preservation: How to choose?

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1 Abstract:

Every memory institution dealing with audiovisual material must face these questions sooner or later:

- Which file format shall we store our collection in?
- Which video container?
- Which video codec?
- Lossy or lossless encoding?
- Which format can still be read in the future?
- Which file formats are already part of our digital archive?
- Should we replace them, or can we keep them?

No matter whom you ask, you will get different answers. The answers might be correct, but they they might not be the right solution for your use-cases.

There is no evergreen format. There is no one-size-fits-all solution.

This talk addresses what to look out for when choosing a file format: Now and in the future.

2 Introduction

Which properties should an archivist look out for when choosing a format for long-term preservation of audiovisual materials?

When asking other professionals in that domain, they often refer to a format which is promoted and supported as industry standard. Or one is simply choosing to use what others are using for the job.

Today we are living in a time where technology is becoming more and more complex, more intransparent. Especially digital video is a challenge for preservation, since it combines all things to be considered for preserving images, audio and metadata. Additionally, audiovisual material requires vast amounts of storage capacity and data bandwidth. Non-trivial, even with today's existing hardware.

2.1 Different institutions, different use-cases

In difference to digital audio formats, there is currently no "one size fits all" format to be used for digital video. Before we continue, it is important that the reader is aware that there are different use-cases and needs of professional institutions dealing with audiovisual material.

The main ones are:

- production
- broadcast
- preservation

Production and broadcast institutions have their own collections, but their priority are things like retrieval, archive-to-air times and editing. Preservation of their material might of course be in their interest, but it is not their main objective. This should be kept in mind, as it means that solutions designed for production or broadcasting, might not necessarily be the best choice for preservation.

In this paper, we will focus on the use-cases and needs of professional preservation of audiovisual material. Mainly video, but the basic principles can be applied to film and possibly other media types, too.

2.2 Video on tape: An endangered species

In comparison to many other formats that we archivists try to preserve, video is a different challenge on its own:

- Very short market relevance time, compared to other media, such as audio or film for example.
- Therefore:
  - Replayers discontinued
  - Lack of spare parts and service manuals

    - Even for mainstream formats (e.g. VHS)
- Video professionals mainly in broadcast
- Film is very different than video
- Electric tape layout complex to understand
- and many more...

This mostly applies to analogue video, but also to digital video formats stored on tape, such as DigiBeta or DV for example.

2.3 Digital video primer

Digital video always consists of at least 3 different entities. Let's call this the "digital video trinity":

- Video codec
- Audio codec
- Container

For proper preservation purposes, it is also important to consider a fourth entity:

- Metadata

Metadata is very important for proper long-term preservation. Even if it the metadata is just text, it makes a big difference for accessing and using that data, in which way it is digitally stored. An important decision for storing metadata is whether it is to be stored directly inside a media file (=embedded), or in separate files next to the media files (=sidecar).

It may seem more convenient and "cleaner" to embed the metadata, but there are pros and cons of both methods.

Embedding the metadata into the mediafile adds additional complexity, and limits the number of applications that will be able to properly read or write certain metadata, which also increases dependence on certain implementations of hardware/software - as well as the codecs/containers eventually supporting storing the metadata properly.

Sidecar files often allow easier, technology-neutral access of metadata, but may seem more inconvenient if an application does not automatically support reading them. See the chapter "Try before you buy" for more information and practical tests.

This article will not go into details about pros/cons of metadata formats, because that would justify another paper on its own.

The video container format is often what users see as the file ending of a video file. Popular examples for video container formats are "AVI", "MOV", "MKV", "MXF" or nowadays more and more "MP4".

Unfortunately, it has become very common to use the name of the container only as answer to the question "which format?". This leads to a lot of uncertainty, confusion and misunderstandings when speaking about video formats, because it's actually necessary to always consider all three components when speaking about "a video format": Videocodec, audiocodec and container.

For example the most popular and commonly agreed upon format for archiving audio is often called "WAV" - or "Wave File". Yet, "WAV" is merely the container - and the actual audio codec is "Linear PCM uncompressed". The audio codec inside a WAV could also be something different. Even "MP3" as codec in WAV is legal, according to the container specification.

Using uncompressed PCM as audio codec is perfectly possible and well supported in almost all digital video containers. Therefore, this article will only focus on the remaining 2 entities which are most unclear - and also have the most impact for preservation:

- Video codec
- Container

3 Defining technology-neutral properties for long-term preservation

Technology will always change.

This has a direct effect on availability, support and sustainability of tools to handle collection's contents. At the end of the day, one must make a choice for technology being available to them today - but one day this technology will be outdated or unavailable. Therefore, it is a good idea to define a list of property-requirements that a format for storing ones collection must have. Independent of which technology provides it.

This makes it possible to apply the same set of requirements whenever a new technology, a new format must be chosen to migrate to. Since there is no evergreen format, migration to a yet-unknown format in the future will be necessary one day.

By defining a proper set of preservation format requirements, obstacles for migrating to future formats can greatly be reduced.

Take written text for example: The "technology" being used over ages changed dramatically.

- Carving in bones, stone, wood, etc.
- Drawing on stone, papyrus, wood, paper, leather, etc.
- And many more...

Yet, the required properties for sustaining the content stayed the same:

- Visually perceivable contrast to store and retrieve the information
- Means of understanding the visual content: symbols / language

These requirements could then also be applied to digital technolog: From basic text files to more complex digital document formats.

This approach of defining the needs for long-term preservation in a technology-neutral way, allows to use this set of properties as demands that shall be met when choosing a format for archiving ones content. The example of written text was chosen to illustrate that this principle can also be applied to other media as well. Not only formats for audiovisual media.

4 Property list

The properties listed in this chapter are based on a list of desired format and technology properties for digitizing and preserving video material. This list was put together by technicians at the "Österreichische Mediathek" [1] , Austria's national audio/video archive.

Their motivation and necessity for writing such a list came up in 2009 as a result of the evaluation phase when considering buying a system for bulk-digitization of their video collection [2]. After talking to, and questioning many other memory institutions as well as broadcasting archives, it turned out that there was no commonly agreed upon method - or formats - for preserving video in digital form.

In order to make it easier to apply and use this list, it is here split into 2 different categories:

1. **Significant properties**

   These are the properties which are considered significant in order to maintain the actual content as accurately as possible in a technical way.

2. **Preservation-improving properties**

   These are properties that increase the chances for long-term preservation. Some of these properties are there to avoid unnecessary issues that may cause additional efforts or problems when dealing with a format in the future. Such as dealing with format obsolescence or future mass migration.

4.1 Significant properties

- No digital loss
- Resolution independent
- Aspect ratio preserving
- Colors as native as possible

4.2 Preservation-improving properties

- Handleable data amount
- Non-proprietary
- Hardware independent
- Avoiding unnecessary complexity

5 Properties in detail

5.1 Significant properties

5.1.1 No digital loss

With analogue material, even high-quality copies were a degradation compared to the original. One of the major benefits of digitization is the fact that the content can be copied infinitely without any loss. In the audio domain for example, it is already common to record and edit recordings in a digitally lossless way. Non-professional, consumer devices use lossy compression for recording in order to save space. Yet, in professional environments it would be considered inacceptable to record or edit audio material using lossy formats, such as MP3 or MP4, for example. Regardless how good it may sound to the listener.

For audio material archiving, it is therefore mentioned as requirement in the technical guidelines of "IASA-TC03" [3, p.8], that only uncompressed data, or lossless compression is acceptable for proper long-term preservation.

For digital video materialthe situation is currently far from perfect:

The ones who started dealing with preservation of digital video material were mostly broadcast and production. The reason for that is, that they simply have way larger budgets than preservation archives. Therefore, the market focused on delivering solutions tailored towards the needs of their main customers.

As stated above, preservation-needs of broadcast/production are not necessarily the same preservation-needs of archives. Since the data size of digital video is still non-trivial to handle - even by current technology - it became common to use lossy compression formats.

To give you a better understanding of the data sizes to consider when dealing with digital video, here are a few examples:

PAL Standard Definition (SD):

- 720 x 576 pixels resolution
- 25 frames per second (fps)
- 8 bits-per-component YUV
- 4:2:2 chroma subsampling (=16 bits per pixel)

= 720 * 576 * 25 * 16 / 8 / 1024 / 1024 = 19,77 MB per second

= 1,186 GB per minute

PAL High Definition (Full HD):

- 1920 x 1080 pixels resolution
- 25 frames per second (fps)
- 8 bits-per-component YUV
- 4:2:2 chroma subsampling (=16 bits per pixel)

= 1920 * 1080 * 25 * 16 / 8 / 1024 / 1024 = 98,88 MB per second

= 5,8 GB per minute

These are only illustrative data rates for the image data only.

Assuming SDI standard for audio as example, with 48 kHz and 24 bits resolution, that is another 8,2 MB per minute to add for each audio channel present.

One must also consider that additional space might be required for audio tracks, higher framerate (e.g. 50fps), less chroma-subsampling (e.g. 4:4:4) and higher bits-per-component (bpc) sample depth. For film at resolutions of 2k at 14bpc and more, you can imagine the impacts not only on storage, but also CPU processing and network performance requirements.

5.1.2 Resolution independent

Although there are are numerous standard resolutions common for certain video formats, it is desirable to have a preservation format that is able to store arbitrary resolutions. This makes it possible to store any material as natively as possible without the need to resample the image data.

It also allows for using the same format for future resolutions not common at the day of choosing the format. In practice there are cases where the video format definition is not limited to certain resolutions, but the actual implementation of a hardware or software might be.

5.1.3 Aspect ratio preserving

Every image has a so called "aspect ratio". This is the ratio of its width to its height. There are different aspect ratios to consider when dealing with video:

SAR: Storage Aspect Ratio

The aspect ratio of the image actually stored per image.
Example: 720 x 576 pixels for SD PAL.

PAR: Pixel Aspect Ratio

The aspect ratio of the pixels of the display unit.
Example: Computer screens have square pixels, whereas analogue TVs often had rectangular pixels.

DAR: Display Aspect Ratio

This is the most popular - and most important aspect ratio for the viewer. It defines in which aspect ratio the final image is to be displayed.
Common DAR for video are "4:3" or "16:9" for example.

There are technial relations between all 3 of these aspect ratios. The image of audiovisual recordings is not always stored in the same aspect ratio as it is to be displayed in. It is best practice to store the image as natively as it was on the source.

For example, when recording 16:9 on a DigiBeta, it is stored anamorphic.

This means, that the SAR is 720x576 (=5:4 ratio), but the DAR is to be 16:9. Therefore in this example the image captured correctly "as-is", would be 5:4 aspect ratio - and therefore distorted / squished to the user's eye.

By the way, also 4:3 material is actually stored in 5:4 SAR. This is less visible distortion, but it originates from the non-square pixels of CRT screens.

This must be considered by an archivist when choosing how to capture and preserve their collection.

A recording system or file format for digital video must therefore be able to capture the original SAR without any interference or "correction", while being able to resize the material later on to its proper DAR for research and access copies, for example.

5.1.4 Colors as native as possible

When dealing with images - especially color images - there are different things to watch out for in order to avoid silent modification of the actual color information.

For video colors, important factors are:

Colorspace

Analogue CRTs, as well as PC screens and digital TVs display color dots in Red Green Blue: RGB

This color model is the most native for electronic equipment to record and display.

Yet, for legacy reasons related to introducing color later onto the black-and-white TV infrastructure in the past, a more complex color model was introduced:

Most analogue video - and for legacy and compression reasons even digital video - is a color space commonly referred to as "YUV".

Actually, there are slight differences between the analogue version and the digital one (YCbCr), but important to note here is that it is fundamentally different to RGB

Chroma subsampling

Also originating from the early days of color television being backwards compatible with black-and-white, a form of analogue signal compression was used.

This form of compression is called "subsampling" and is based on the fact that our human perception can be tricked by using full resolution for black-and-white, but less resolution for the color information.

It is usually written in the following form:

- 4:4:4
- 4:2:2
- 4:2:0
- etc...

The important reason to mention it here is, that not all audiovisual media, signal chains or file formats, use and support the same subsampling.

For example, analogue video on VHS is "4:2:2", default on DVD or digital television is "4:2:0" - and Digital Video tapes (DV) for example are "4:1:0".

Please refer to the “Chroma Subsampling” article on Wikipedia [4] for additional information on this topic.

Knowing that almost any video is silently and automatically cross-converted between the colorspace and subsampling in which it is stored, it is still important to consider these properties when choosing a file format to store the material in. As original and as close to the source as possible.

5.2 Preservation-improving properties

5.2.1 Handleable data amount

Given the huge amounts of data size of audiovisual material, even if it is just video and not even film, several entities of an institution's workflow must be considered.

There is no sense in choosing a format that one cannot handle given the current technology- and/or budget-limitations.

The main entities to be considered are:

- storage size
- network speed
- disk speed
- data bus speed (RAM, etc)

When talking about digital video preservation formats, the most prominent factor mentioned are often the storage costs.

Although storage size is one of the most noticeable cost factors, it is also important to consider the impact of these data sizes on other infrastructure requirements within an institution, too.

Even if a regular office-grade PC is able to playback video with Full-HD resolution smoothly in realtime over a limited bandwidth, such as an Internet connection for example, the same hardware might stutter when trying to play the same video in an uncompressed format.

Therefore, one might want to go through the following checklist:

- How much storage space is needed for 1 copy?
- Plus: At least 1 backup?
- How much data throughput (MB/s) is required for smooth real-time playback?
- Which network speed do I need for this (1GB, 10GB, etc)?
- Do I have enough free network bandwidth for storing daily ingest + backups?
- How many concurrent users do I have, accessing the material in-house?

NOTE: One very important aspect though is, that one must not forget that preservation properties and quality should not suffer. Even if this means additional costs. It is also so, that the most expensive factor in digitization are staff costs. Therefore, it is desirable to do the ingest work only once and as good as possible.

A very common misconception is to use high-quality lossy compression, although this is, again referring to TC03 guidelines for audio, not recommended for long-term preservation.

Regardless if it might look "good enough" for now:

Looking at video encodings done in the recent past of only a few years ago on today's equipment, one can immediately see the impact of the choice for smaller size back then. Even though it was the best available technical solution existing back then.

On the other hand, using lossless compression formats the gain in size due to compression might allow smaller storage (or more backups), as well as using existing network infrastructure for the same amount of playback hours and concurrent users.

5.2.2 Open Source / Non proprietary

The common status quo: proprietary

At the time of this writing, the default of implementations available for dealing with audiovisual material are proprietary.

This means that an end-user does not get information about the inner workings of the equipment they use and require for handling their own material. If one is using proprietary technology or formats, there is a great dependence on the good-will and market interests of that manufacturer.

This might often not really be noticeable until one wants a feature which has too little market-relevance, one wants to migrate to another technology - or another product from another vendor. Or simply the original manufacturer goes out of business.

Such a dependency is called "vendor lock-in".

Although vendor lock-in is not a new concept at all, the nature of older technology - even electromechanical - allowed users to use, reverse-engineer and modify such equipment in ways that did not need the explicit aid or consensus of the original manufacturer.

This is very different with digital technology and modern electronics:

In the past, skilled engineers employed in archives were able to understand and even fix problems, by applying common-sense and their electromechanical understanding of things. Nowadays, try to find out why a digital video works in one application, and fails to render correctly in another. As we can see in practice as well as in other areas of preservation, archivists need to be able to maintain their equipment independent of whether a certain technology or format is still actively available on the market. Just take a look at what is necessary and current practice for keeping old equipment alive and working for reproduction of media such as audio tapes, vinyl records or film - to mention just a few prominent ones.

In the past it was common for professional equipment to come with so called "Service Manuals". These included schematics and often detailed information about the machines themselves, as well as how to modify, adapt and repair them. Taking a look at all fields of long-term preservation, in order to preserve and access old material, archivists are still "hacking" together clever solutions to challenging problems on a daily basis. With great success.

The same requirements and necessities are to be applied to electronic and digital equipment.

For some reason, it has become increasingly common by vendors to reduce and withhold technical information from their customers. Up to a point where they become even unfriendly if one asks them for specification or implementation details necessary to access or migrate collection material. Choice for technology used in archives is getting increasingly linked to the product market lifetime: An average of 3 to 5 years. I hope that the reader will agree that memory institutions define "long-term" as a much more longer period that that.

It is therefore obvious, that this dependency must be kept as little as possible by archives in order to be able to fulfill their task of proper long-term preservation.

A practical solution: Free and Open Source

Imagine one could archive not only existing equipment, such as replayers for example, but also the schematics and building components required to use, study, share and improve their equipment as it fits ones needs.

For software, this is possible already today.

The license definition of "Free and Open Source Software" (FOSS) states that certain conditions must be provided to the end-user at all times [16].

This is defined by the rights to:

- use
- study
- share

- improve

Every computer program is built out of its "source code”. This source code is nothing else than just written text, interpreted by a computer. Having a copy of the source code of the tools used to create or open digital formats, makes it possible for developers to adapt it to any future technology. Even if not known yet.

This is the equivalent to what has always been done in the past to make content stored on outdated technologies available until today. Therefore, using FOSS for preservation purposes, counteracts issues such as format obsolescence or vendor dependency.

Not by chance, but by license definition.

It should be noted that a misconception currently common is to mistake "Free and Open Source Software" with "Freeware". Although it is often so, that many Open Source programs are freely (gratis) available, this is not mandatory. Therefore Open Source is not the opposite of "commercial", but merely the opposite of proprietary, closed source.

The quality of any software application (FOSS or proprietary) is independent of its price and license - but in case of Open Source, the end user is in control.

Although archives are most often not equipped with IT development staff, FOSS still enables institutions and individuals to combine their resources and have software tailored to their needs. Without the necessity to reinvent the wheel or start from scratch, because it is very likely that other existing FOSS code can be based on, or simply incorporated in their new solution.

In recent years, special tools for needs of archivists dealing with digital video have been released as Free Software/Open Source.

These were often using existing code from other software projects, or adding new features that had too little market-relevance, but are invaluable for archiving.

Some popular examples are:

- QCTools: Digital quality control (QC) for recorded analogue video tapes [6].
  Originally funded by Bay Area Video Coalition.
- MediaInfo: A tool for displaying of the most relevant technical and tag data for video and audio files [7].
  Funded by several audiovisual institutions and archives – as well as the European Broadcasting Union (EBU).
- FFV1: A lossless video compression codec [8].
- Ffmpeg/Libav/FFmbc: Complete, cross-platform solutions to record, convert and stream audio and video [9,10] – as well as a “version customized for broadcast and professional usage” [11].
- MediaConch: Implementation checker, policy checker, & reporter for Matroska, FFV1 & PCM [12].
  Originally funded by European Union project “PREFORMA” [13].

It is even so, that hardware that can be run with FOSS rather than its proprietary firmware can be used (a) longer than its original intended market-lifetime, and (b) can be adapted to future conditions, or use-cases it was never designed for.

A popular example from a completely different domain would be the wireless router "WRT54GL" from Linksys [5]: It is the only router which is still available on the market for more than 12 years. This is due to the fact that it can be run on a FOSS firmware.

As these real-world examples show, especially memory institutions can profit from Free and Open Source solutions.

So, using FOSS has the following benefits by license-definition:

1. No vendor lock-in.
2. No black-box technology.
3. Ability to use/study/share/improve their tools.
4. Independence of market interests.
5. No format obsolescence.
6. Future proof by archiving the source code.

If an existing FOSS application does not fit their needs, they have the option to hire developers - and even pool ressources with others to save money.

5.2.3 Hardware independent

Basically, the reasons for trying to avoid hardware dependency are similar, but not the same, as to the ones avoiding manufacturer dependency, mentioned above.

It is still common for manufacturers to offer archiving systems that use certain hardware to generate the actual codec bits stored in the video files. This sometimes leads to the case where one requires certain hardware to be able to decode the video files properly. Even if the format of choice is considered to be an official Standard (like ISO, SMPTE, etc), the actual implementation (in this case in hardware) might create files which render differently - or not at all - on other systems.

This is not something evil that vendors do, but everyone makes mistakes - and you would not want to be relying solely on a piece of market-niche hardware which is usually very expensive, and secondly hard to get or impossible to fix a few years after you bought the system.

In order to spare yourself this trouble, it is better to avoid hardware dependency wherever possible.

5.2.4 Avoiding unnecessary complexity

There is a nice definition of a so called "Minimalistic Data Format” [14] for file formats:

- As simple as possible.
- As complicated as necessary.

Applying these criteria to a digital file format greatly reduce the possible problems. It is actually quite obvious, and analoguous to experiences seen with older media.

Take an old telephone aparatus for example, and compare it to a modern smartphone: Which one lasts longer - and is easier to understand, use or repair?

Of course the old telephone cannot perform a fraction of the functionalities a smartphone does, but it does one thing - and it does it well.

Applying this principle to digital file formats (of any kind) increases your chances of preserving the actual contents.

Trying to create a "Jack of all trades" might in the end lead to a "Master of none".

And with digital formats, this is the number one cause for interoperability issues, because everyone just implements a subset of the whole set of possibilities a format can offer - and therefore creating incompatible files.

For long-term preservation, the principle of "As simple as possible - and as complicated as necessary" has proven to be even more important in the ever increasing complexity and feature-war of file formats.

6 Try before you buy

6.1 Concept

Regardless which software or hardware solution one is choosing, it is good practice to "try before you buy". Even if a file format is an official standard (e.g. defined by DIN, ISO, SMPTE, etc) - there are still variations in the actual implementations. These variations differ from implementation to implementation and often cause interoperability issues.

As mentioned above, the more complex a format specification is, the more "interpretation variations" may exist.

A rule of thumb is:

1. The smaller the userbase, the smaller the market.
2. The smaller the market, the smaller the number of different manufacturers providing a certain technology.
3. Only the popular use-cases are stable, due to less interest in testing/maintaining the other cases.

Professional video and film is a very special domain, often associated with high costs, due to it being a niche market. In order to avoid interoperability issues, or migration problems later on, it can save you a lot of time, nerves - and money - to perform the following tests before you agree to any file format technology. Yet, FOSS allows to go beyond black-box testing, since detected issues can often be fixed, rather than being forced to use workarounds.

The following prerequisites apply to all tests mentioned here:

- Only use hardware/applications *not* originating from the same manufacturer.
- Due to above explained reasons, use FOSS and Open Hardware for testing wherever possible.

6.2 Testset

Before you can begin testing, ask to get representative example copies in the format to be tested.

These files must have been created using the tools you are planning to use to create your preservation archive master files.

6.2.1 Playback on other equipment/appliction:

Can the video be played back properly on equipment or software applications from other manufacturers?

6.2.2 Hardware dependency:

Is proprietary hardware required to properly play it back (e.g. decoder card)?

The general aspects of hardware dependency were already addressed in the previous chapter. For encoding/decoding of digital video it is sometimes necessary to make use of specialized chip-implementations to perform the actions in real-time. Yet, one can simply try to convert the files to another format which can be played back.

If dealing with a lossless format, one can use the method of framemd5 check [15] to verify that the audio/video data was converted bit-proof from format A to format B.

If performance does not allow playback of the archive master format, it is also possible to use another, less ressource demanding codec as target format for the test.

6.2.3 Access metadata:

Which metadata can you access/extract using applications from other manufacturers?

Try to read and interpret the metadata provided in the given format. It does not really matter whether the metadata is embedded or sidecar, yet the challenges and troubles to expect with embedded metadata are far greater. Please keep in mind the machine-readability of the metadata. You might be misled by just looking at the metadata, because machines handle it differently than humans. If possible, try to access and match the metadata from the sample source to another target format and see if it works.

6.2.4 Transcode to lossless/uncompressed:

Can you transcode the file to lossless/uncompressed encoding using Free Software / Open Source tools?

If this works flawlessly, you can archive the FOSS tools (and its source code) you've used in your tests. As explained above, this greatly improves the chances of being able to get out of this format in the future. It also increases your chances of being able to perform a fully-automated mass-transcoding for other use cases, such as access copies on the web, for example.

6.2.5 Audio/video synchronicity:

In all your tests, observe if the audio still matches up with the video - throughout the duration of the sample.

Therefore it is good to have samples of a longer duration, since some A/V sync issues only become apparent after a while, due to sync-errors adding up.

If audio/video stay perfectly in sync for the whole duration, perform the same test on a transcoded copy of your sample.

6.2.6 Format specification and details:

Try to get the format specification and/or source code of the implementation.

Ask the manufacturer for a copy of the format specification that they used. Even if the format is an open standard, there might be multiple revisions - and not all specifications are freely available. These specification papers (e.g. ISO) often cost a few hundred Euros per paper.

Additionally, ask them which parts of the standard they have implemented. It is often so, that only a subset of features are relevant for a certain product.

You will in the reaction of the manufacturer if they are willing to cooperate with you in your interest of preservation. If they are reluctant on handing you information that is relevant for you to do your job, your chances are that it will not be better once you are more depending on their implementation.

If possible, try to get a copy of the source code used for the actual implementation you are going to use.

Although FOSS should be preferred (due to reasons mentioned in great detail in the above chapter), it is still possible to get source code from proprietary vendors under non-disclosure agreements.

Having the source code greatly improves your chances to be able to open the format in the future.

6.2.7 Lossless editing:

Can you edit and export the file in applications from other manufacturers - without any digital loss?

Many applications used even in professional studios are performing silent conversions to the audiovisual data in the background.

Try if you are able to load the sample file in a video editing suite, and export an excerpt without any modification to the actual audiovisual data.

If it is not possible to verify losslessness of this process, you cannot be sure what was changed - and if there are generation loss issues to be expected.

7 Conclusion

For additional information, one might also consider reading the following two articles which were written based on practical experiences with digitizing, preserving and handling digital video at the Österreichische Mediathek:

- The archivist's video codec and container FAQ [17]
- Comparing video codecs and containers for archives [18]

There is no silver bullet for choosing the right file formats for preserving audiovisual material in digital form.

Yet, I hope that this paper provides you with information to understand a bit more what to look out for - and hopefully be able to ask the right questions to your suppliers.

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