Issue 4, December 2013

AV INSIDER

Film, Files, Formats, and the Future

Open-Source Digitisation
at the Austrian Mediathek

Codecs and Wrappers
for Scanned Films

New Training Method
Preservation Case Studies for Archives

In the Picture
Danish Film Institute

Video Compression Facts
What Experts Say

Small Gauge Film to HD
Findings and Challenges

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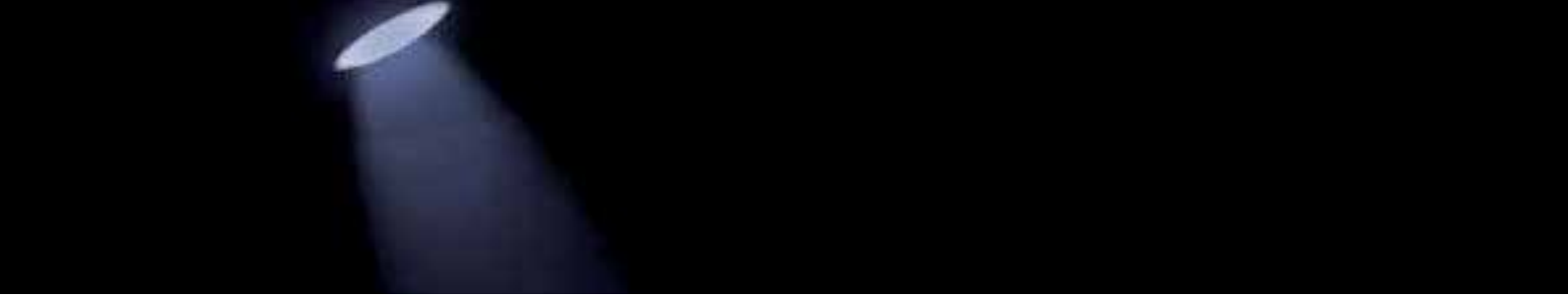

In this Issue

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PrestoCentre
The PrestoCentre Foundation is a membership-driven organization that brings together a global community of stakeholders in audiovisual digitization and digital preservation to share, work and learn. Using free tools and simple strategies we save you money and time, whilst improving long-term access to audiovisual collections. PrestoCentre works with experts, researchers, services providers and technology vendors, advocates, businesses, public services, educational organizations and professional associations to enhance the audiovisual sector's ability to provide long-term access to cultural heritage.

Membership is open for organizations across all user communities of practice, including broadcast archives, sound and film archives, national libraries and archives, regional archives, subject-specific archives and special collections, museums, educational institutions, corporate archives, production companies and studios, filmmakers and independent producers, research organizations, commercial providers, as well as funding bodies, standards organizations, and other organizations concerned with audiovisual archiving.

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One Format Does Not Fit All

Encoding covers a lot of ground, from compression to how to archive born-digital content. A great deal can be said about what makes one format preferable to another, and about the general risks and characteristics of files. File formats have got so complicated (powerful, the developers would say) that people started to call them wrappers, to emphasise that the file can hold many things: video, multiple channels of audio, subtitles, time code, other metadata. You won't find straight answers in this issue of AV Insider. But you will be able to learn from the various experiences of your colleague PrestoCentre members. A lot of emphasis will be on film as there are many complexities about film. There is no standard for the digitisation of film for preservation, because film is many things. Whether film needs digitisation for preservation is also hotly debated. Then again, film in broadcast archives will never be used without digitisation. And older broadcasters have a lot of film. The Presto 2002 survey of 10 major European broadcasters found that one-third of their television archives were on film, not videotape.
This issue of AV Insider covers technical guidelines and examples of good practice from both Memoriav (Switzerland) and the Institute for Sound and Vision (Netherlands). They have both looked at many options and have shared their findings. Lene Halvor Petersen of the Danish Film Institute tells about the differences between film and broadcast archives. And there are deep dives into file format specifications for film heritage, open source digitisation, and best practices for dealing with compressed video.

So, how should your collection be encoded for preservation? What file format(s) should you use? And what standards should you follow? Here in PrestoCentre we think we do understand about the preservation of audiovisual content, and the use of digital audiovisual content with particular reference to the Internet and 'new media'. As a 'way in' to the huge amount of information already present in the online PrestoCentre Library, we have recently created some basic questions and answers, available at www.prestocentre.org/answers/frequently-asked-questions. These really are frequently asked questions, but the list certainly doesn't cover everything. Detailed discussion of the answers is supported by a dedicated online forum. You can also leave your comments or contribute your questions and answers that you think are both frequent and within the powers of the PrestoCentre.

All that remains for me to do is to wish all members an enjoyable reading and a very good start of the new year!

Jan Müller
President, PrestoCentre Foundation

David Pfluger has a PhD in chemistry and since his graduation has been working in the field of cinema post-production and motion picture and video conservation. He was involved in several scientific projects exploring the properties of analogue audiovisual media during transfer to digital. Since 2004, he has been part of the film and video competence network of Memoriav. As a Super8 filmmaker, he has a special interest in the characteristics and conservation of small gauge film formats.

Digitisation of Small Gauge Film to HD

Discovering Characteristics of a 16mm Reversal Material Transfer to High Definition

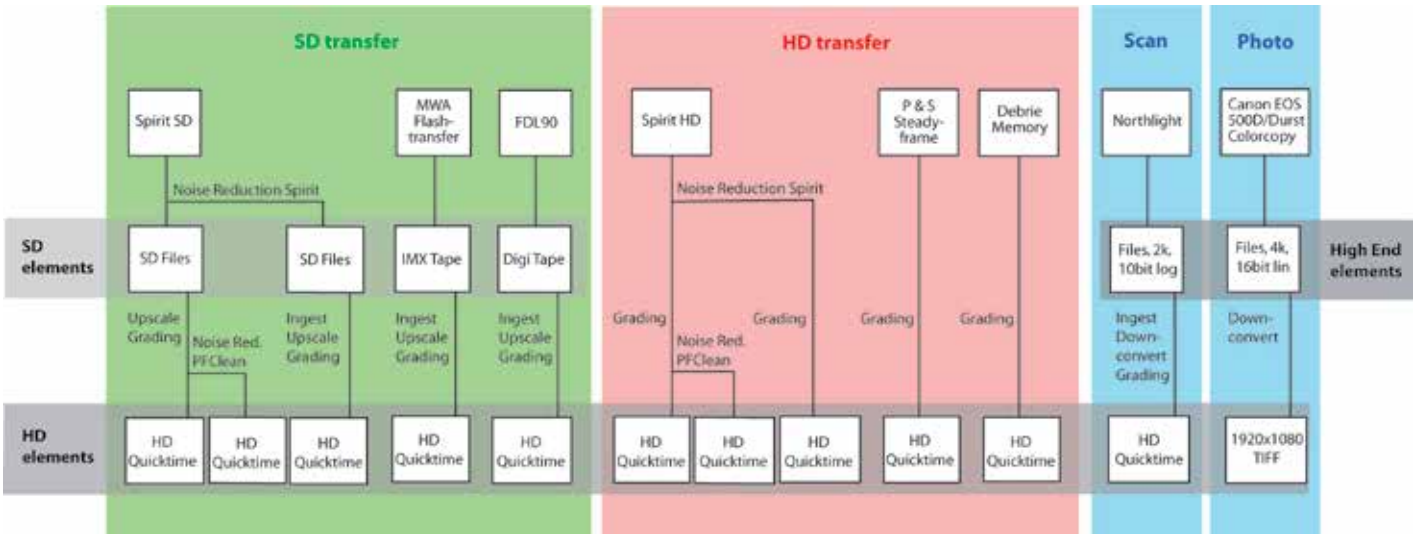
By David Pfluger

In 2009 and 2010, Memoriav, a Swiss institution mandated with preserving and developing Switzerland's audiovisual heritage, conducted a series of film transfer tests. Officially, Memoriav is an association whose members are mainly archives of audiovisual media. The association itself does not manage an archive. Its main task is to preserve, valorise and ensure the wide use of Switzerland's audiovisual cultural heritage in a proactive and sustainable manner. It coordinates a network of institutions and people involved and interested in its mission.

Memoriav consists of four groups dedicated to audio, video, photography and film respectively. Each group has a competence centre and network to help and support archival institutions. An important partner for the video group is the Swiss national television. Their archives hold large quantities of 16mm reversal motion picture film that is being digitised for repurposing. Up to 2009 these encodings were almost exclusively made in SD, to the then available SD tape formats Digital Betacam and IMX. With the rise of HD use in production and broadcasting the question arose whether it would make more sense from a technical and financial perspective to start the transfer to HD. As most of the 16mm reversal film material at stake has a lower range of apertures and more grain than negative film stock, the prevalent idea was that it would not be worthwhile.

However, valid arguments arose also in favour of HD transfer, when looked at from a future proofing perspective: as broadcasting would evolve to HD anyway, having a back catalogue in HD might facilitate a better integration in >

The extreme grading of this underexposed frame is revealing. A top quality transfer shows how much information there is in a film print. Even reversal material, with its reduced aperture range, can capture quite an amount of detail in an underexposed shot. When transferred in low quality, the results are modest, even if grading was done well. In this case image compression is adding to the problem. However, HD transfer can look similarly bad if — due to a lack of skills or communication — the grading is sloppy and information in the dark areas was lost.



Overview of transfers conducted for Memoriav's Digitisation of Small Gauge Film to HD project

future projects. Also, there was and is a growing opinion that digitising historical documents should extend beyond a resolution that just about represents the image sharpness of the original. This opinion is further supported by the fact that there exists a broad variety of reversal stocks with differing properties, some of which can be of much better quality than may be expected from their age.

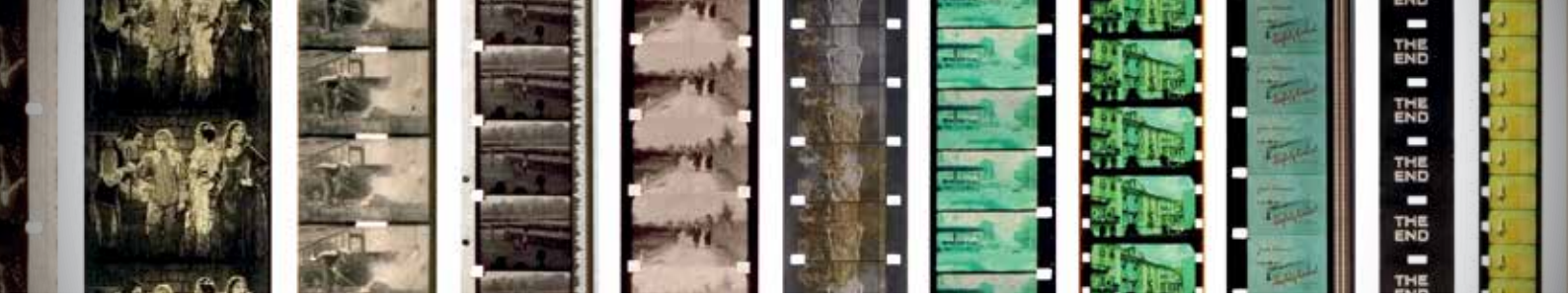
Thus, a project called *Digitisation of Small Gauge Film to HD* was initiated in 2009 under the guidance of Memoriav involving a series of tests to evaluate the quality of the 16mm reversal filmstock in SD and HD in relation to the potential needs of Swiss broadcasters and with respect to archival standards. From 2009, the first tests were accomplished based on a test reel combining archival content from the French speaking Swiss television.

In principle, Memoriav's project did cover similar questions to those studied in 2008 and 2009 by the Netherlands Institute for Sound and Vision — a study extensively covered within a 2011 published PrestoCentre White Paper *Film Scanning Considerations*. But where Sound and Vision's study concentrated on their complete film stock comprising very different materials from a wide variety of periods, Memoriav's test tried to concentrate on a much more narrow segment in greater detail, analysing single frames of the scanned material. Memoriav's project, therefore, serves as an interesting extension to PrestoCentre's whitepaper, and its approach, findings, and challenges are summarised below.

Setting the Scene

Memoriav's *Digitisation of Small Gauge Film to HD* tests were carried out during 2009.[1] HD transfers were not so common in 2009 but the market was starting to expand. News about new scanner models was frequent and post houses hurried to equip or re-equip their facilities with the latest machines. Switzerland, being a small market for television and cinema production, has and had limited postproduction services. >

1. All information about the services and equipment of providers in Switzerland refer to the situation of 2009.



When applying the test reel in 2009, only two of the Swiss providers had scanners, and that were still in testing, something that influenced the timing and the approach of the project.
The results of the study, nevertheless, remain current. The scanner market has not changed significantly since that time. There have been some quality updates and improvements in speed but after the big wave of new models the market has become saturated. It seems that the already established companies release updates from time to time, but hardly any new companies do enter the market.

Memoriav's project delivered a series of tests to help to critically evaluate the quality of 16mm reversal film during its transfer to HD. External influences were kept to a minimum. The aim was to clarify which factors have an impact on the various quality criteria of a transfer. Having reviewed literature of similar previous tests and taking into account the time and financial constraints, it became clear that the scope of the test series had to be kept within narrow parameters in order to deliver comparable results.

The scope:
- 16mm reversal film stock;
- Black and White;
- Aspect ratio 4:3;
- Transfer to HD 1920x1080, 4:2:2, uncompressed.

Technical focus:

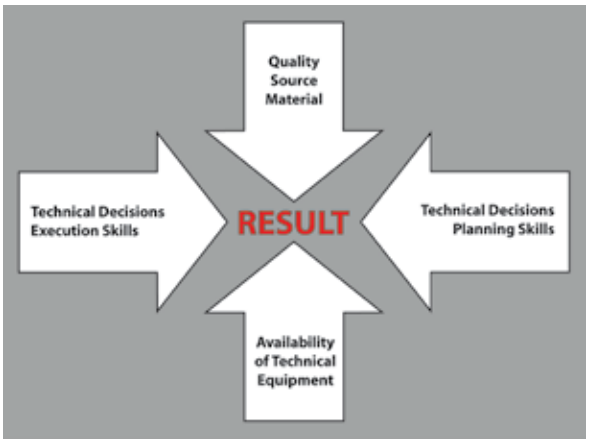
- Reproduction of detail;
- Reproduction of different contrast levels and over- and underexposures;
- Reproduction of different grain intensities;
- Identifying factors influencing the quality criteria above;
- Applicable workflows with the infrastructure existing in Switzerland at the time;
- Challenges when working with private enterprises;
- Challenges of mass transfers.

With a side-glance at:

- 16mm colour reversal film stock;
- Comparison to SD Telecines from the existing transfer workflows of the Swiss television, one of which includes a compressed format;
- Comparison with a 2k scan;
- Effects of degrain procedures.

The goal of Memoriav's project wasn't to explore the maximum quality that could be reached from 16mm reversal stock when scanning in the best quality and resolution available. The aim was to consider the compromises between SD and HD, looking for hints that could tell if HD provides a sufficiently better quality to justify the additional expense.

Rather than for colour reproduction purposes, the extra colour reversal film stock tests were carried out for considering their varying grain structure. Colour reproduction could have been of great interest, but since the financial means were limited and the major portion of 16mm reversal stock in Swiss television archives is >



Memoriav's study: a choice of compromises

8mm	Negative	Drama	Kodachrome	Preparation of Originals	Tape Formats
Super8	Intermediates	Documentary	Ektachrome	Prioritising	Jpeg2000
16mm	Reversal	Broadcast	Black & White	Transfer	Uncompressed
35mm	Positive Print	Amateur	Tinted	Digital Archiving	Access Formats
...	...	...	...	...	...

Prioritising the collections according to Sound and Vision's study. Memoriav's research continued research on one particular film type (highlighted).

in Black and White, it was decided to mostly exclude colour from the project and focus on resolution.

A Choice of Compromises

When doing a transfer to digital there are always tools involved, both hardware and software. Memoriav, therefore, could not ignore the impact of certain tools. Film scans are never just reflecting the quality of film but also of the performance of the equipment used, including its strengths and flaws. For example, the fact that there is no one single technique to digitally record film images makes things more complex: depending on the characteristics of light source and light sensor, the data coming from different scanner heads were not directly comparable. Also, signal-processing techniques used by manufacturers would significantly influence the results. These processes are difficult to understand for non-specialists and often something that companies will not easily reveal. Data go through complex procedures before ending up as seemingly technically identical uncompressed HD clips.

In short: even though Memoriav significantly reduced the scope of its study, the analysis could never be as straightforward as hoped for. This conclusion, however, was also considered a very useful one in the context of the project: no matter how many and how well tests and research efforts are being conducted for measuring the quality of motion picture film reproduced in a digital format, no one really can go around the variety of the original material and the varying transfer techniques available. In most cases, the analysis will boil down to performing visual comparison tests for the source material and scanner output. This shows how difficult it is to break down any characteristics of analogue media to a set of exact numbers.

Summary of Findings

The results of Memoriav's study showed that a transfer process is not simply a source material and machine equation. The major base for a satisfactory result is harmonic team play. It involves the quality of the source material, the decisions on planning of the workflow, the capability to also execute the plan, to find skilled experts and to maintain good communication between all entities involved and to get the best out of the available technical equipment. The best machine will not give you good results if you are not able to run it properly. The best technician will fail if you do not know or are not able to communicate what you need. In a workflow where compromises in quality are an unavoidable reality due to time and financial constraints, the consequences of a mistake in one of the steps can be severe, whether or not you have abundant resources. Complexities exist in every step of the process. Skilled human interaction is vital, from initial preparation of the film, prioritisation of transfer sequence, the selection of ultimate resolution, and the choice of digital image processing.

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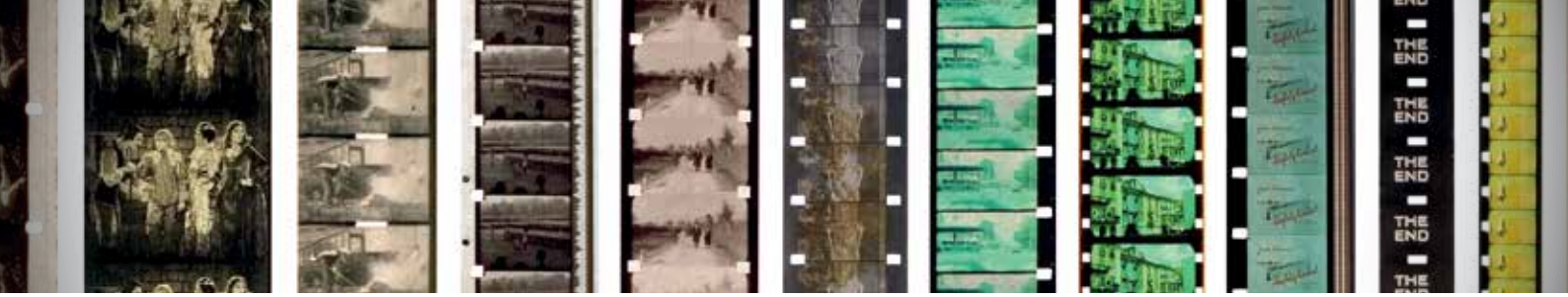

Taking all these considerations in mind, when evaluating most reversal film stocks, it appeared that the sharpness of the image is reasonably reproduced in SD, but lossy compression must be avoided when using this relatively low resolution. Well controlled workflows proved to avoid a disproportional drop of quality with problematic material. Skilled work at a resolution of 2k, with a colour bit depth of 10 bit log is necessary if the complete characteristics of the historical document are to be preserved. HD, which equals a resolution of about 1.5k and commonly with a bit depth of 8 bit, ends somewhere in between. Broadcasters, and sometimes archives seeking quick and relatively cheap solutions, tend to prefer transfers in SD for reversal film stock. But this is an area of huge tension. The PrestoCentre white paper based on Sound and Vision's study offers a welcome and valuable insight into a useful selection process that allows archives with more than just one choice. It bases its choices of final transfer resolution on the original intended purpose of each film roll and prioritises works of different value, helping to achieve a maximum efficiency with the available resources. ■

A detailed report of *Digitisation of Small Gauge Film to HD* is available for free online: www.prestocentre.org/library/resources/digitisation-small-gauge-film-hd. It includes links to high-resolution still images from the digitised film documents used by Memoriav supporting in-depth exploration of the subject of film digitisation quality. The report is aimed at all those involved in the long-term conservation of film reversal material, especially those responsible for archiving ciné film and television archives.

The PrestoCentre Whitepaper *Film Scanning Considerations* is available for free at the PrestoCentre library: www.prestocentre.org/library/resources/film-scanning-considerations. It covers the work done by The Netherlands Institute for Sound and Vision. It is broader in scope and looks at the Institute's total film collection that, besides broadcast material, comprises a large variety of film titles representing all periods of filmmaking. It describes all steps of the process from conservation of the originals, to prioritising the collections, to the digital transfer and its digital archiving challenges. It is an excellent introductive overview of the extensive work that has been done and the vast experience that has been collected in this field. See also Reading Room on page 29.

Preservation Oriented Codecs and Wrappers for Scanned Films

CST-RT21 Mezzanine File Format Specifications for Film Heritage
By François Helt

The digital revolution is accelerating and the question of conservation of cinematographic works in digital form is becoming more and more important. The central question is not whether or not digital preservation will replace traditional long-term film storage but how to preserve digital records in the long term. A lot of developments are taking place to test and promote a large variety of methods, ranging from improved magnetic tape systems to dynamic management of data in the cloud, and including various optical recording on glass discs or on traditional photochemical support. My view is that within ten years a few competing solutions will emerge to solve this digital preservation paradigm.

Two important factors are pressing the digitisation of films: the degradation of aging films and the necessity to provide easier access to cinematographic heritage. It seems therefore reasonable to embark on digitisation of films for the ten years to come. In order to get the most out of photochemical support it is important to use the best possible methods and technologies available.

Digital Preservation Workflow

The entire digitisation workflow is made of many steps each requiring careful considerations. We will divide here this workflow in four parts: digitisation, file wrapping, metadata management and long-term storage preservation. The last two steps will not be covered here. The specification and management of metadata for long-term archival has been studied extensively by numerous projects and the Open Archival Information System framework is helping much in defining the required functionalities. The long-term storage developments will not be discussed either.

Within ten years a few competing solutions will emerge to solve the digital preservation paradigm.

Digitisation

As far as conversion of photochemical support to digital data is concerned, the Eurostars CineXPRES project (see AV Insider 1) has defined a workflow for scanned film which is intended to keep the best possible quality carried by the film stock and to allow full interoperability. This proposal is based on transmittance scanning. Its implementation is not difficult but it is up to the scanner manufacturers to allow recording the linear values with enough dynamic range and use open source code for 16 bits unsigned floating point. But this is only the first step in the process of preserving film in a digital world. Once the film is scanned properly, the digital data must be encoded and wrapped in a format that is suitable for long term preservation and access for future renewed distribution. Therefore the next steps are about defining a codec and wrapping the encoded data in a suitable file format.

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Coding and Wrapping Constraints

There are a number of considerations to keep in mind when defining a file format for high value content and long-term storage. A file format is not restricted to the definition of the container; how the content is represented by codes, how these codes are arranged and how important side information is carried inside or alongside the file are also important questions. The data recording should be organised within some constraints:

- Keeping the highest possible quality;
- Carrying the right spectacle experience provided by past viewing;
- Allowing safe and continuous access.

The quality of the digital content is dependent on more than one factor. There is the resolution, i.e. the number of pixels in the final image file. Current sizes are HDTV, 2K, 4K or more. There is the dynamic range. This characteristic is carried through the use of various bit-depths (8, 10, 12 or 16), together with the optional use of gamma (or Electro-Optical Transfer Function) which goal is to minimise bit-depth requirements by taking advantage of the human vision non-linearity of human vision.

There is also the question of compression types. The compression choices are between visually lossless and mathematically lossless. Both approaches are used to reduce the amount of data while the mathematically lossless method is the only one allowing exact recovery of the scanned data. For typical images, like natural scenes, a compression factor of 2 is achievable. To further reduce the resulting size it is necessary to use stronger compression, which causes losses of details, i.e. lossy methods. Visually lossless compression is a lossy method. It is not a well-defined concept and it raises many questions like what is worth to loose and on which display it is considered that there is no loss of visual perception.

Carrying the right spectacle experience is a more interesting question. It is specific to the transmission of film heritage. In the context of film preservation in digital form the encoding specifications must allow the transmission of a content that has been already shown in public. Its visual characteristics have been carefully chosen for its distribution with the technological knowledge of that time. All that is necessary to know about these facts must be understood, recorded and transmitted. This is including the conditions of projection of films at the time of distribution. All this information is based on a technical knowledge and practices that must be rendered available along the digitised content. This is partly solved by the inclusion of appropriate metadata. But this is also implying that cinematographic techniques need to be documented and kept in a dedicated repository.

The last constraint is of course dependent on future storage technology but the encoding itself may be chosen in such a way that the content is easily recovered despite problems that may happen because of storage itself. As far as migrations are concerned the best choice is to use *multivalence* (see the SHAMAN project, http://www.shaman-ip.eu). This concept is about avoiding content transcoding by maintaining software codecs.

The best methods for digital conservation of film content were the topics discussed within a group working on a real implementation of codec and wrapping for scanned films, the CST-RT21 recommendation.

CST-RT21

The French government has recently funded a cinema digitisation programme to help make past and current film catalogues available in digital form. The programme stipulates that the digital assets be delivered in a dedicated open file format. An ad hoc committee has been formed at the request of the *Centre national du cinéma* to work on the recommendation. It is >

worth stressing that the format is part of a legal requirement and that it is expected to stay valid for a good number of years. Therefore the specifications for the mezzanine format are subject to careful review.

A first work group has defined and proposed good practices. As a consequence, a CST-RT21 draft was published mid July 2012. The Interoperable Master Format (IMF) was selected as a candidate file format for preservation and exchange of cinematographic works. At the end of 2012, after publication of the recommendation, a new work group was established in order to define technical specifications for this *mezzanine* format. In order to keep a large interoperability one of the basic requirements was to build a recommendation compliant with the developing IMF format. The anticipated *IMF application 2* extended seemed a natural for implementing the programme on a practical level. This IMF application meets the requirements of a demanding workflow while preserving the highest quality for film.

Interoperable Master Format

The IMF is an emerging file format suitable for distribution of audiovisual works. Started by the Entertainment Technology Center, a department at Carnegie Mellon University in Pittsburgh, United States, it is now debated, refined and expanded at SMPTE by a number of dedicated groups.

The main thrust behind this work is to adapt and refine the successful packaging methods developed for Digital Cinema. The work of the Digital Cinema Initiative has provided a way to embed together image and audio files within a file structure describing completely a cinematographic master ready for distribution. Talented people that contributed to this format are now working to enlarge and improve the same approach for all kinds of audiovisual masters.
It is difficult to resume what this format is about not only because of its ambitious goal and elaborate structure but also because it is a work in progress. Interested readers can go to the IMF forum, http://www.imfforum.com. To stress the importance of this format one can say that it is a considerable progress over both the unstructured numerous individual image and audio files needed for a film and the various video streams inevitably tied to their specific encoding.

Technically there is a definition of Core constraints and different *applications*. Each application is allowing a set of options dedicated to specific part of the audio-visual industry.

Specification of CST-RT21-MFFS

The CST-RT21 work group has worked from the assumption that an IMF compliant application would be found with options satisfying the initial requirements of this mezzanine format. To this effect the group is having close discussion with the proponents of the IMF. In order to be efficient the group has started with a limited number of participants and will stay the same until the publications of version 1.0 of the specifications. After this important step other participants, from France and Europe, are invited to join for recommendation work and test sessions. This includes senior technical people from laboratories and manufacturers as well as representatives from the *Commission Supérieure Technique de l'Image* et du Son in charge of supervising the quality of the production and broadcast of sound and images in France, and FICAM — the federation of French audiovisual industries.

The group's work was to recommend a file format for exchange and preservation of cinema masters in digital with the following characteristics:

- Facilitating exchanges between laboratories;
- Guiding the digitisation work during scanning and reconstruction phases;
- Defining technical specifications of a "digital duplicate" coherent with Digital Source Master;

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- A Business to Business need for a preservation master;
- Do not need to be read in real time;
- Should not be used up for direct viewing by customers;
- Do not imply guidelines for display/distribution.

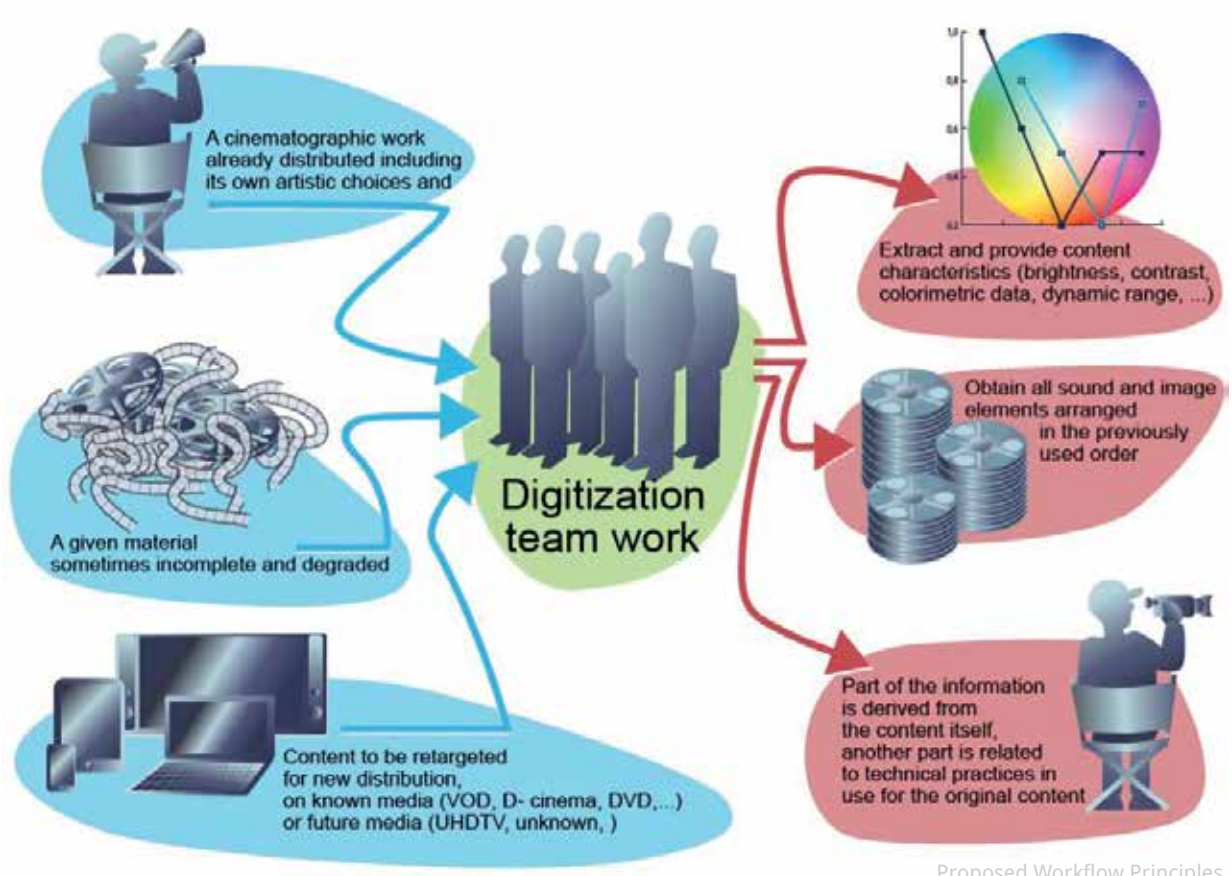
After having published a draft in July 2013, a first version of the specification should have been published by the end of 2013 under the name of CST-RT21-MFFS (Mezzanine Film Format Specification).

Workflow

The planned workflow was conceived around the need for complete data acquisition and transmission of all necessary information to build new distribution masters. This conception is distinguishing two clearly separate steps.

One team has to acquire, digitise and bring all useful data into the mezzanine format without interpreting or adapting the content for a given usage. With older works, it could likely happen that elements may be missing or deteriorated. The goal of the first team is thought to avoid interpretation or replacement of existing material. Nonetheless recognised missing pieces should be indicated.

Another team, at a different time or in succession within the same company or in a different laboratory, has to use all the data provided by the mezzanine format and build from it a new distribution master. During this operation content may be interpreted, through specific grading, missing pieces may be replaced and the whole work may be adapted to the distribution channel.



Proposed Workflow Principles

Specifications

Discussions inside the group resulted in selecting the appropriate technical requirements.

- Core IMF compliance. Adoption of this developing format was thought to be likely by the group. It was important to avoid a file format that would not be broadly accepted and to avoid by the same token costly additional transcoding;
- The preceding choice implies using a Component Play List. In our application the detailed structure of this CPL should include enough information allowing description of progression, synchronisation and a way to specify placeholders, the indication of missing elements;
- MXF wrapping derives also from choosing IMF;
- Using a basic non-compressed audio encoding is compliant with IMF and D-Cinema practice (Wave format);
- Image compression using lossless JPEG2000 format. JPEG2000 image compression standard is one of the options for image coding in IMF. As we are looking for preservation of important content the choice is for a JPEG2000 lossless profile. This should allow keeping the highest quality;
- Simple universal colour encoding. Choosing XYZ colour encoding is a compromise between avoiding complexity and the fact that digitized films are already graded.

	IMF Application 2 constraints	**CST-RT21**
Frame Size	Maximum 1920x1080	2K (2048x1536), 4K (4096x3072), 6K (6144x4608), 8K (8192x6144)
Frame Rate	From 24 to 60000/1001	16,200/11,20,240/11,24,25,30,48,50,60
ColourSpace	YCbCr or RGB	XYZ
Bit Depth	8 or 10 bits	16 bits
Sampling	4:4:4 or 4:2:2	4:4:4
Profile	JPEG2000 Broadcast Profile 2 Single Tile (Levels 1 - 5) or Multi Tile Reversible (Levels 6 or 7)	JPEG2000 Profile 2 mathematically lossless.

Specific Requirements — Placeholder and Robustness

The conservation of cinematographic works has some consequences on the specifications of the format. In addition to recognised extensions of options to accept larger sizes of images and extended dynamic range, other topics are to be considered. The needs to carry incomplete or deteriorated content as well as the robustness of the encoding against bit rot have been examined.

A first example is the notion of placeholder. It may happen that one element of the film to be scanned is either missing or is so deteriorated that it is impossible to scan it. The missing content may be found within a different source with a poorer quality. If one reel of negative is missing this must not forbid the digitisation of the film work. Therefore the group has proposed to use a *mock* file, called a placeholder, for the missing reel, allowing existing reels to be digitised, structured and synchronised following the original composition. It is left to the team in charge of building a new distribution master to replace this missing piece.

A placeholder file should also allow carrying replacement content. For example, a print or a copy from a video may be put into this file in order to provide source content for the mastering team. The CST-RT21 will include dispositions to embed this capability.

The other topic under discussion has resulted in a proposition to use a different JPEG2000 >

option than the expected IMF recommendation in order to improve the robustness of coded images. Studies have shown that data corruption appears with any kind of storage as soon as the size of stored data is sufficiently large. Image data represents the largest percentage of digital information in a structured record of the IMF type, especially if lossless compression is used, roughly 96%.

Therefore image data has by far the highest probability to be impacted by bit rot and it is important to study simple ways to improve the robustness of JPEG2000 encoding.

The group has proposed to use a mock file, called a placeholder, for the missing reel, allowing existing reels to be digitised, structured and synchronised following the original composition.

The JPEG2000 standard itself has methods to cope with data corruption but none of them is allowed in D-Cinema neither included in IMF work. But results of research funded in the PrestoPrime project have demonstrated that a very simple change in lossless JPEG200 encoding could simplify error recovery, namely the use of LRCP progression.

In fact LRCP progression is giving better results than classical CPRL progression when corrupted data is recovered:

1. There is a better average PSNR (29.44 dB over 25.78 dB);
2. Recovered image show slightly blurred results rather than monochrome with flat patches.

As a consequence of these findings it appears that consideration should be given to the use of a progression which improves robustness without augmenting complexity or adding specific tools. It is left to storage service providers to add any robustness methods or error correction tools if they wish. It is also important to know that the LRCP progression is the default option for most of the lossless codes available on the market with the consequence that a large percentage of the JPEG2000 lossless encoded audiovisual content is using this option.

Conclusion

The work of the CST-RT21 group will release very soon a recommendation for a file format that is the closest possible structure for an archival format. The overall structure, CPL and MXF, is using a recognised standard. The experience driven from years of Digital Cinema distribution has proven that this generic structure is surviving multiple copies in digital and various storage and network systems.

Extended options are proposed allowing image sizes and ratios and carrying high quality content. Dedicated workflow and mechanisms are also proposed to carry the original content in the best possible way. The robustness of the coding is improved by a simple built-in method.
The archive community is invited to join the efforts of this group in order to make this proposal an internationally recognised standard. For more information, email us at editor@prestocentre.org. ■

François Helt has a background in mathematics, semantics and filmmaking. He has 30 years of experience in designing image processing software for audiovisual applications. He is an R&D manager of teams dedicated to special effects software including film scanners and film printer drivers. He has been the technical director of Doremi Technologies from 2006 to 2012. Since 2013 he is chief scientific officer of Highlands Technologies Solutions, a Doremi Technologies spin-off serving the cinema industry.

Open-Source Digitisation at the Austrian Mediathek

By Silvester Stöger

The Austrian Mediathek, Austria's national audio and video archive, has been digitising its audio collection for the past ten years and during 2010 they also began to look at their videotape archive. It was clear this would be another considerable challenge — facing all of the tapes accumulated in the archive, with their expiry date clearly visible on the horizon. Besides typical questions like "What digitisation tools should be used?" and "What file format is the most future proof?" a significant amount of time was spent to define the criteria for the preferred codec and container that would serve as the master archive format. The goal of the Mediathek was to find a minimalistic standard: it was to do the job in the best quality but should be built as simple as possible. No proprietary formats should be employed. The format needed to be well documented, compliant to standards for video production and archiving. And the implementation should be as transparent as possible. Moreover, the codec should be common and in wide use and be light on storage to remain affordable in the long run. Uncompressed data, therefore, was not a choice. Lossy compression was also not an option for long term preservation. The format promoted for long term preservation was lossless JPEG2000 in MXF. However, after inquiring with other archives about experiences with this set in their daily working routine, interoperability seemed to be difficult. There were only a few applications capable of handling JPEG2000 and MXF (both standards compliant). Most of them only supported lossy mode, and of the few that could handle lossless, none were able to replay or transcode files without errors when these were produced by other systems.

The Mediathek continued their investigation and evaluated other lossless options (image/video codecs) for preservation. The final choice was FFv1. They could implement FFv1 throughout their entire workflow, from capture to production and FFv1 also fulfilled most of the criteria for a minimalistic long term preservation format. Additional benefits included the ability to play the files with a variety of out of the box software on standard hardware (e.g. VLC), and the fact that SD material could be captured and played back in real time. FFv1 can be installed as a system codec in most common operating systems, so a large variety of programmes that are able to use system codecs can read/write FFv1. In the case of the Mediathek this was important, because it allowed them the continued use of previously acquired applications within their workflow, regardless of whether or not a vendor intended to support FFv1. Should FFv1 not open directly, a transcoder can be used to convert the master archive format to a production or distribution format. There is a great variety of transcoders to choose from and every transcoder using system codecs may be used. >

The goal of the Mediathek was to find a minimalistic standard: it was to do the job in the best quality but should be built as simple as possible.

The lesson learned from proprietarily implemented standards (e.g. JPEG2000/MXF) is that they suffer from similar issues like fully proprietary formats. Although FFv1 is not the absolute simple solution as the codec is not yet an approved official standard, open implementations under a free license often cause less interoperability problems because there are no artificial restrictions or conflicts of vendors' interests. Therefore, technically, they are immortal. Thanks to FFv1 being released under a Free License, the Mediathek could contact the developers and initiate the implementation of additional features to improve its performance for archiving. The latest version, FFv1.3 will support multithreading, slices and CRC checksums — for error detection and resilience — embedded directly in the stream. At the moment it already supports 8 to16 bits per component for YUV and up to 14 bits for RGB. One of the main arguments against FFv1 is that it is currently not very well known among professionals, and vendors of the most popular video production suites have not considered implementing it yet. Besides deciding upon a codec, Mediathek also needed to chose a container in which the FFv1 stream should be kept. The possibilities were MXF, AVI, MKV or MOV. AVI is the one best supported. However, for storing more than just audio/video in the container, AVI is out of the game. Yet, being conscious of the benefits of minimalistic standards, the Mediathek's choice remained with AVI since it turned out that having more information than necessary in one file complicates access, migration, and interoperability — i.e. overall sustainability. Therefore, all non-audiovisual metadata is kept in separate files (e.g. METS XMLs). This also enables the metadata to stay humanly readable and it won't get lost during transcoding. >

Random impression of DVA-Profession: monitoring and administrating the digitisation tasks

While implementing FFv1 for their mass digitisation, the Mediathek decided to take the road less travelled. Instead of buying a *Samma Solo* workstation, they redirected its cost to develop their own toolset DVA-Profession. They coded the desired programme for a digitisation workflow and released it under a Free License. After the programming, they not only had a workflow set up, but also software for as many workstations necessary without further licensing costs. In addition, every other institution with the same needs can use and adapt it to fit their needs.

While implementing FFv1 for their mass digitisation, the Mediathek decided to take the road less travelled. Instead of buying a Samma Solo workstation, they redirected its cost to develop their own toolset DVA-Profession.

DVA-Profession has a modular concept. Various open-source products are utilised and so DVA can potentially be changed and extended quite easily. The ingest module was consciously separated from DVA in order to facilitate different ingest paths. It was designed for digitisation of videotapes but will be updated for born digital material in the near future. DVA's entire engine is designed around text files and folders and does not require a database. This unconventional approach was chosen in order to keep it simple, and for anyone who understands text files and folders to administer the system. Its interface is browser based, so it is OS independent. It semi-automatically collects technical metadata and calculates preview proxies and thumbnails. It also detects scene cuts, generates MD5-checksums and an analysis graph. Furthermore, it provides a user interface for thorough quality control.
At the moment, videos are divided into segments of 1500 frames (= 1 minute PAL). These small files have certain advantages, such as higher stability for archiving (repeated headers and the checksums for each minute) and they simplify partial retrieval. In the near future DVA will also be able to deal with inter-frame lossy compressed born digital material without requiring segmentation in order to avoid breaking group of pictures structures. DVA writes the data to the storage but it is not a DMAM, nor a cataloguing tool. It solely collects technical metadata. Or, in other words, it does the job in the best quality and is built as simple as possible!

Afterthought. PrestoCentre recently launched its Communities of Practice — a refreshing and welcome initiative that supports the development of more fine-grained groups of stakeholders in the various subsectors of AV preservation. Indeed, many audiovisual archives are engaged with very similar preservation interests and challenges, leading to similar solutions. If they work together to identify their common needs for new technology, the related products and support services could be better tuned towards all stakeholders. Imagine then the opportunity created for open source and the increased level of shared ownership for each community. ■

Silvester Stöger works at the Austrian Filmarchiv as digital film restorer. He holds a diploma in Media Art from the University of Applied Arts, Vienna.

Archives in the Picture:
Danish Film Institute

Lene Halvor Petersen, head of DFI's Archive & Cinematheque department, started in her current position two years ago. Coming from the Danish Broadcasting Corporation where she had worked for over 18 years within new media, streaming platforms and channel strategies, her immediate focus at DFI has been on the establishment of a digital film repository and the associated digital workflow.

The Danish Film Institute (DFI) is located in the centre of Copenhagen, neighbouring the old Royal Castle *Rosenborg*. Several museums and cultural institutions, including the Danish National Gallery and the Natural History Museum, surround the institute. Since 1997, the main national film institutions have resided here as a single entity. Production subsidies, film consultants, film workshops, a research library, preservation archives for film, stills and posters, a so called *Experimentarium* for children and schools, and three cinemas together constitute the DFI.

Tell us about your department. "The Archive & Cinematheque department employs a staff of 32. The archive's collection consists of thirty-three thousand films, of which one-third is feature films and another third is documentaries. Approximately nine thousand films are of Danish origin. The stills and poster collection — more than two million stills, portraits and cinema related photos, as well as more than twenty-two thousand posters — contains material from virtually all Danish and foreign films premiered in Danish cinemas since the silent era. The Cinematheque shows approximately nine hundred film titles to an audience of one hundred thousand annually."

What volume of current productions originate on film? "Only very few films are still shot on film. Virtually all post-production has been digital for the last ten years or more. The last wet-lab in Denmark closed in November 2012. The entire Danish cinema sector has changed to digital projection and very few analogue projectors have remained, since not many 35mm prints are still in distribution."

Does DFI have legal deposit obligations to meet? "With the Danish Film Act of 1964, the deposit of Danish films with the film archive became compulsory. The first depos- >

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It is striking how sentimental film people can be!

Lene Halvor Petersen, Danish Film Institute

its were used film prints. From 1984 this was extended to unused prints, and from 1991 to duplicate masters. In 2005, film finally became part of the Legal Deposit Act, resulting in the legal deposit of both master elements and copies of DFI subsidised films. Also stills, posters, commercials and trailers are deposited. The legal deposit is linked to the final subsidy payment."

Film and broadcast are becoming more and more part of the same family.

"During analogue times, legal deposit requirements were to receive a duplicate positive and a new print from the film's negative, as well as the final mix. The legal deposit legislation allows for DFI to stipulate the requirements of legal deposit, which currently are a DCDM, unencrypted DCP and a final mix as a WAV file. Files are ingested, checked and output to two separate tapes. The long term digital repository that is in the planning stage works with geographically distributed backup copies. However, the current setup only allows for two copies in different rooms."

"The legal deposit institutions in Denmark constitute a formalised network that operates as a best practice network for the smaller archives. In practice the tasks of receiving, registering and preserving the different legal deposit formats is shared, such that different institutions gain and serve key competences within their core formats. DFI is the national competence centre for film, whereas the Royal Library is for photography and the National Library is for sound. The media archive of the National Library in Aarhus is the legal deposit institution for radio and television and therefore the primary partner for Danish Radio, Denmark's public broadcaster."

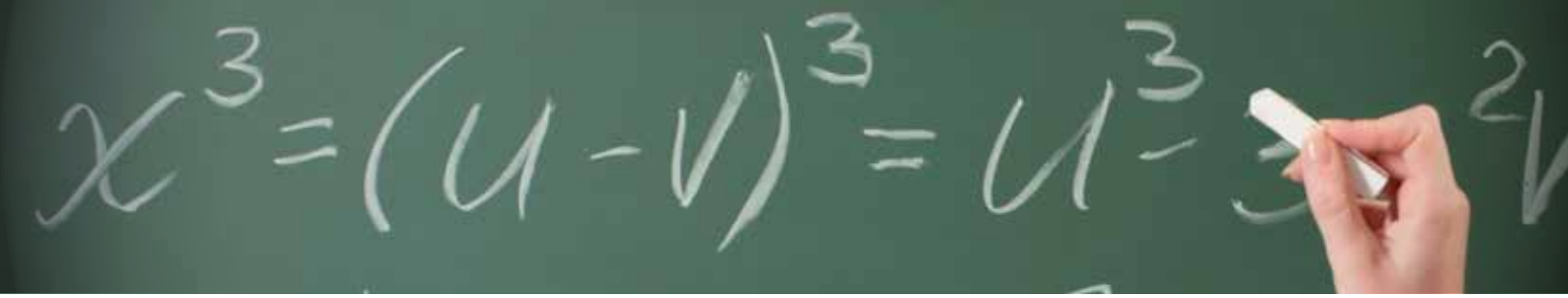
At what stage of the digital archive roadmap does DFI find itself? "The Danish cinema sector has switched completely from analogue to digital distribution and screening. The last analogue film lab has closed, and many facilities struggle or have had to close their doors too. This situation didn't come to DFI as a surprise. In 2012, DFI made the switch from analogue to digital legal deposit. We issued a tender for a digital ingest system, providing LTO backup, encoding and transcoding, and a service agreement. We combined the investment with a large-scale preservation project funded by the Danish state to digitise DFI's analogue tape collection. In June 2013 we finished another pre-qualification and selected a supplier for our D-Cinema ingest and long term repository solution. It will be a multiple strand archive with geographical redundancy, which can handle future data migrations and has the capacity to store both digitally born, as well as digitised films in full D-Cinema quality. The solution must be capable of handling future expansions and add-ons, such as VOD platforms, payment solutions, and expanded rights management and access control."

You moved from broadcast to film archiving. What differences have you experienced? "In my previous job with Danish Radio I gained experience with storage and migration and the preservation costs involved. Film archiving is different of course but less than you may think. There are comparable savings for film coming from new ways of production and distribution. Analogue films used to be very expensive to produce, transport and screen whereas digital files are much cheaper to duplicate and can be transcoded to many formats that can be exploited on a variety of platforms. In that respect, film and broadcast are becoming more and more part of the same family. Moreover, in broadcast, where files used to be relatively small and many, next generation resolutions are now pushing towards very huge files, with which DFI has already many years experience."

"At the same time, the workflows for broadcast and film continue to be very different, as do the structure and purpose of their archives. But much like the reuse of a broadcast archive, I see >

DFI first and foremost as a cultural institution that is also a library, a documentation centre, a theatre. And the archive serves these various purposes. As part of the film domain,, DFI's roles are very challenging in that respect and the roles that the archive has to serve are very alive. It is also sometimes striking how sentimental film people can be. All the formats talk may be interesting to some, but in the end we're not preserving formats but content! An archive for digitally born and digitised film heritage enables us to bring about our vision for film preservation. We do not archive films to keep them from the citizens. We preserve films to be able to share them with others: as an art, for storytelling, as a testimony of human life and creation from the last 115 years."

"We do often share experiences and information with Danish Radio and partake in the same cultural ministry development groups. We also collaborate in the dissemination of the Danish cultural heritage through the same national web portal. But since the bulk of Danish Radio's archives consist of videotapes, the digitisation process is quite different from film digitisation. They have predominantly outsourced their digitisation. Furthermore, their media archive is a production database, which is not created to shield specific sections for preservation purposes. Contrary to our collections, Danish Radio predominantly has videotapes and only few films, while the DFI collections are the reverse. However, Danish Radio has gained experience in the field of film scanning, which we draw on in our own efforts." ■ **TC, CF**

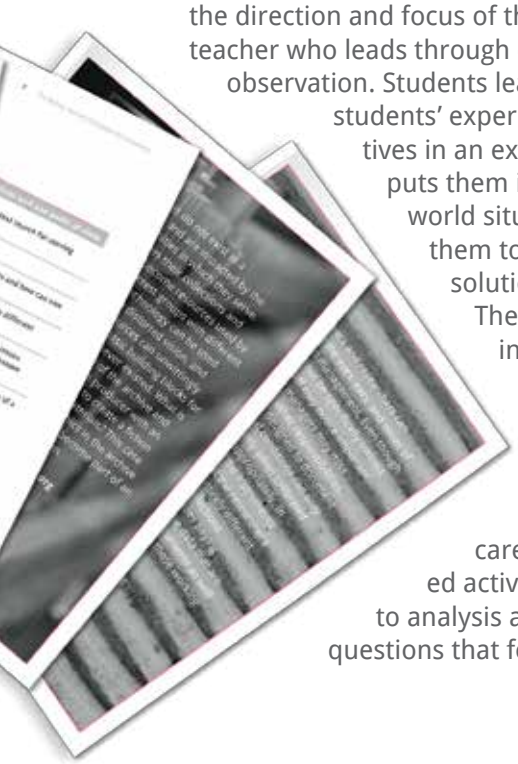


Preservation Case Studies for Archives

Improve Your Teaching and Training Experience

Preservation Case Studies for Archives is a new, innovative educational experience published by PrestoCentre. It places the archival student in the role of the decision maker, where one has to balance both resources and constraints. Through a dynamic process of idea exchange, students first learn about the situation, then identify and analyse the problems to determine the causes, and finally develop alternative strategies for a solution.

Preservation Case Studies for Archives provides the context for teaching the real world issues confronting archives staff and managers in a dynamic and exciting way. The students do most of the talking and are stimulated by learning in a supportive environment. Each case study contains important activities that help guide the direction and focus of the discussion by the teacher who leads through questioning and observation. Students learn from their fellow students' experiences and perspectives in an exciting forum that puts them in the centre of real world situations and requires them to develop real world solutions.



The scenarios contained in Preservation Case Studies for Archives cover a wide range of situations that students may encounter in their careers. Some suggested activities and approaches to analysis are provided in the questions that follow each scenario.

If you have never taught using the case study method or even participated in one, you will find that case study is a dynamic and exciting way to both learn and teach. The case study method of training provides a flexible approach to teaching that may be tailored to suit a particular set of needs. The key to the success of case study training is in engagement and participation by students. Students learn from each other as well as from the trainer.

Case study method fits within a larger curriculum structure. Case method instruction is not a substitute for core knowledge instruction; rather it is a real world context in which to apply it. Students will still require resources such as technical information to be able to understand and analyse the case sufficiently to develop feasible strategies. As instructor you will direct the students to focus their thinking and discussion about a particular aspect of a scenario that fits within a broader set of goals for the training. For example a case that discusses acquisition may also be used for other issues such as staff training, storage environments and health & safety.

Preservation Case Studies for Archives is written by Jim Lindner and Mick Newnham. It is an essential resource for every trainer, student or archivist. However experienced you are, you will find something useful. Currently three case studies are available as eBook (watermarked PDF/A) in the PrestoCentre bookshop at www.prestocentre.org/casestudies for 1,95 Euro each. **MS**

Everything You Always Wanted to Know About:

Video Compression

Richard Wright

Digital audio and digitised film can also be compressed, but there are particular issues – and an interesting (well, for some) history – for video, so I will emphasise video. The general principles apply to any signal (including audio and scanned film), but not to files and digital data in general.

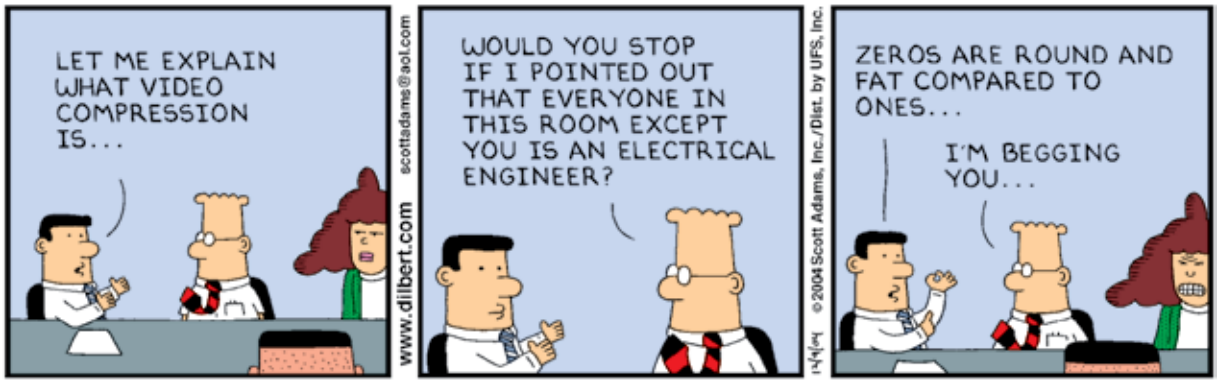
A signal is where engineers start with audio and video. A sound field (the variations in pressure in a three-dimensional space) is a complicated thing, but a microphone inside that sound field produces a voltage that varies with time: a signal. The visual field is equally complicated, but a video camera allows the pattern of light (through a lens onto some sort of receptor) to create a two-dimensional pattern, which can then be scanned. Scanning converts the pattern into a voltage that varies with time: a signal. A Datacine machine does much the same to film: converts an image into a signal.

Signals carry information, with greater or lesser efficiency. The data rate of the sequence of number representing a signal can be much higher than the rate of information carried by the signal. Because high data rates are always a problem, technology seeks methods to carry the information in concise ways.

Video: Compressed from Birth

Television started out by trying to produce successive images at a rate fast enough to exceed the 'flicker fusion' threshold of the human eye. At somewhere above 30 to 40 images per second, the pattern looks continuous and the eye is fooled into thinking it is seeing continuous motion. But television technology (in 1936) was incapable of transmitting 405 lines of information at 50 times per second, so they threw away half the data and sent half the image in one 20 millisecond time slot, and the second half in the next. The result was the needed 50% reduction in (analogue) bandwidth, the rough equivalent of (digital) datarate (bitrate). To make the 'compression' as visually acceptable as possible, odd numbered lines were sent as the first 'field' – and even ones in the next: interlace.

When colour television was developed, there were further problems. Ideally colour is two separate dimensions (the two dimensions of a 'colour wheel'), which add colour information to the black and white pattern described by the luminance signal. The three signals form component video. For broadcasting this all had to go into one signal, so colour was jammed into the luminance signal as composite video — another kind of compression (and another compromise). Some videotape formats (eg analog 1/2-inch, 1-inch, VHS, Betamax and U-matic; digital D2, D3) record a composite signal. In dealing with principles such as 'keep the best' and 'keep the original' it is important to know what the original actually is! It gets murkier: it was hard to >



get even composite video onto a videotape, so many composite analogue recorders (notably U-matic in the semi-professional area) also shifted the frequency modulation of the colour information, to get it into another place in the overall spectrum where colour information caused less interference to luminance: the colour under approach.
The conclusion is that alteration of video to squeeze it into limited bandwidth or into limited tape recorders has been with us from the beginning of video: interlace, composite, colour under.

Redundancy

Redundancy relates to the data rate of a signal being higher than the actual information. For instance, if I'm on a noisy telephone line I might start repeating key information. It takes more signal (more time), but improves the odds that the information will be transmitted.
A CD carries audio at 1.4 million bits per second. If the audio is a person speaking, they may be conveying about 3 words per second. With a 30.000 word vocabulary, that works out as about 45 bits per second (because 30.000 is about the 15th power of two). If the audio could be run through a speech recogniser, the 45 bits could be transmitted and the speech could be regenerated at the other end using a synthesizer. The compression achieved would be enormous: a factor of about 30.000. But the synthesized sound would convey only the words, and not what the speaker sounded like or any other aspect of the original sound except the 'meaning'. On music, nobody would be pleased. A transcript of a Janis Joplin song just doesn't capture what matters.
Which brings us to the crux: what matters, and what can be thrown away? For images, the 'meaning' is undefinable, but image quality metrics have been defined. It is difficult to come up with an equation that exactly fits the judgements a person would make about degree of impairment to an image, but the metrics come close. Essentially, video compression methods attempt to maximise the reduction in data rate while minimising the estimated visual quality difference (before vs after).
If the information is still there, and the data rate is reduced, then that's A Good Thing, isn't it? Not necessarily. Redundancy is useful, as in my telephone conversation where I repeated things. Redundant signal are robust signals (they have a higher probability of undergoing some sort of mishap, and still carrying the information).

(Continue reading on page 26)

Dave Rice

Uncompressed audio has various specifications: channel configuration, bit depth, etc. Support for these specifications is broad so that archivists may select specifications that most precisely match their source material, such as ripping a CD to uncompressed stereo, 16 bit audio, or using mono, 24 bit audio for a full track audio reel. Handling uncompressed video is not nearly as elegant. For instance in Final Cut and QuickTime there are usually only two options for uncompressed video that fix many specifications together: 8 bit YUV 4:2:2 and 10 bit YUV 4:2:2. If your source is 4:2:0 (as much of HD and almost all web video is) or 4:1:1 (such as NTSC DV) or in RGB or is encoded at a bit depth besides 8 or 10 then these uncompressed options won't be authentic migration options for your video. Tools, such as FFmpeg, do handle uncompressed video at a variety of settings. FFmpeg can convert 4:1:1 DV into 4:1:1 uncompressed video or convert a 4:2:0 h264 file into 4:2:0 uncompressed video data, etc. However, support for uncompressed video outside of the 8 or 10 bit YUV 4:2:2 is very limited in production and broadcast environments.

Feasibly one could use QuickTime to convert 4:1:1 DV to uncompressed 4:2:2, but I strongly agree with Richard Wright's points on 'Do no harm' as it applies to transcoding video in a preservation context to combat obsolescence risks. To add to this I would recommend that encoding aspects such as colour space, chroma subsampling, and bit depth be considered as 'significant properties' that should not be unnecessarily tampered with during such transcoding. If an animation in RGB colourspace is transcoded to uncompressed YUV 4:2:2 then the resulting uncompressed file will be affected by losing much of the colour data as well as all the mathematical rounding involved in colourspace conversion.

As costs for digital storage decline we could consider that managing uncompressed video becomes more feasible. This is also one of Richard's best practice arguments. However, if we look at electronic document communities their develop-

(Continue reading on page 27)

Heavily compressed signals are fragile: they can look great, but touch them and they shatter.

Managing Compression

As with everything else about archiving and preservation, a key issue is management: knowing what you're dealing with, having a strategy, monitoring the strategy, keeping on top of things so loss is prevented. I think some basic principles can be stated for audiovisual archiving, and these principles can be used to manage the use of compression:

1. Keep the original: means that compressed signals should be in the archive, and should be preserved – because compressed signal do come into the archive. The overhead is: software will also need to be preserved so the compressed signal can be converted back to a standard video signal.

2. Keep the best: if there is a compressed signal, then by implication somewhere there was an uncompressed signal. For instance, many professional high definition video cameras write a compressed signal to a solid-state memory card. Compression is used to get more minutes per card, which is important. But many of these cameras also have an uncompressed output. It may be fantasy to think the uncompressed signal from the camera could ever get to the archive, but in some cases (maybe not if the compression is in the camera, but just possibly if it is in post-production) an uncompressed or less-compressed version could be obtained by the archive. It's worth asking, and it's worth pushing acquisition and post-production (if that is at all possible) to consider whether it's time for them to upgrade to higher quality and lower compression.

3. Do no harm: this is a principle from medicine, but archives need to be just as careful. Audiovisual archives have the strange necessity of, from time to time, making a 'new master'. Art galleries don't repaint the Mona Lisa (though just what is acceptable as restoration is a tricky issue they do have) but audiovisual archives make new master copies when the 'old master' is coming to the end of its life.

>

Best Practice for dealing with a compressed master:

- Clone what arrives at the archive (keep the original);
- If what arrives at an archive is lower quality than somewhere higher up the production change, investigate access to an archive version made earlier; this step particularly applies to broadcasting — and to film archives faced with DCP files;
- Remove all encryption and copy protection constraints (if possible);
- Make an access copy from the clone, in the current access format;
- Make a new access copy (from the clone) when a new access format become current;
- Eventually migrate the clone, when the original codec is obsolete. If the original is uncompressed it will never need to be re-coded, though it may need to be re-wrapped to suit whatever a 'file' is in the future;
- Migration to another compressed version (because of obsolescence of the original codec) will be a cascade of different types of compression. This is best avoided;
- Just possibly emulation (of the original system running the codec) could be used to continue to decode the clone into the indefinite future.

While the software still works to play a compressed file, that file can be moved and replicated ad infinitum with no problems. When the software becomes obsolete, there is a problem. Unless emulation is a possibility (discussed below), the file will have to be converted to something else, either compressed or uncompressed. If compressed, it will use a new algorithm (the old one is obsolete). This will then be a cascaded compression.

Television production has been cascading compression ever since composite signals went onto videotape. The signal is played back, decoded, and then if videotaped again it is encoded and re-recorded. When the second version is played back, there is an inevitable generation loss. Video production and post-production has always lived with generational losses, but they have always been seen as a necessary evil, and as something to be managed and kept to a minimum.
The particular issue for managing cascaded digital compression systems is the unpredictability of results. Broadcasters knew how many generations of BetaSP or Digibeta could be produced before visible impairments were highly likely. The problem with cascading today's JPEG2000 compression into tomorrow's who knows what compression is that we have no idea about the probability of visible impairment, and also no idea of the probably fragility of the result of the cascade. So the principle of do no harm is at risk when cascading disparate compression methods, and the risk increases with every repetition of the process

Compression is not here to stay — it is here to be managed. The next migration will dispense with the issue by migrating away from compressed to lovely, stable uncompressed video. ■

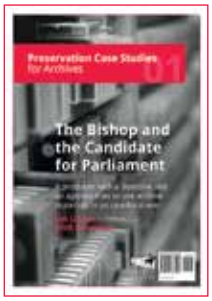
ment work is still guided toward lossless compression. Modern document formats like Microsoft's Open Office XML (.docx, .xlsx, etc), Apple's office formats (Pages and Keynote), and open formats like ODF now rely on lossless ZIP compression. Because of the ubiquity of office documents, decisions to integrate lossless compression save hard drives, save electricity, and save bandwidth. Within an archive the selection of utilizing uncompressed video over lossless increases resources requirements on many fronts.

Uncompressed video is massive. Every channel of every pixel is described with its own dedicated bits. An hour of uncompressed video encoded in 8 bit, YUV, 4:2:2 at NTSC frame rate in standard definition will utilize 75,540,729,600 bytes (~70 gigabytes). Changed to 10 bit (using v210) uses 100,720,972,800 bytes (~94 gigabytes). Changed to 10 bit in HD uses 596,865,024,000 bytes (~556 gigabytes). Changed to 10 bit in 4K uses 2,566,519,603,200 bytes (~2.3 terabytes). Although storage costs drop at a steady rate, bandwidth and electricity costs don't perform as well. Additionally archives are increasingly receiving more materials in larger frame sizes, and faster frame rates. Even if the cost of an LTO tape or hard drive may cost X percent less than it did last year, the savings is lost if the collection is now newly acquiring material in HD or 4K. For instance, ten years ago I worked in an archive receiving video at 4:1:1 720x480 SD, now I work in archive mostly receiving video at 10 bit 4:2:2 HD, I suspect in ten years collection will be receiving video in 4K or 3D or other formats with increasing space requirements.

As lossless ZIP compression is used in electronic documents, there are options for lossless video compression such as jpeg2000, ffv1, huffyuv, and h264 which are either lossless codecs or codecs with lossless options. Almost all lossless video codecs can encode visual data to be stored in roughly a third the size as uncompressed video would require. Aided by systems such as SAMMA, DVA Profession, and Archivematica more archivists are working within lossless workflows and more vendors are supporting lossless formats. Just as with office documents the integration of lossless compression increases technical requirements; however, the overall savings in infrastructure and common use by others in the community make this a safe option. If it takes an archive a week to duplicate an LTO collection of lossless video versus a month for uncompressed video, that's a significant difference. ■

The Bishop and the Candidate for Parliament

Jim Lindner, Mick Newnham (2013)



Archives do not exist in a bubble, and are impacted by the communities in which they serve. Sometimes their collections and staff can become resources used by special interest groups with different agendas. Technology can be used to provide a distorted vision, and archival resources can unwittingly become the basic building blocks for a reality that never existed. What is the ethical role of the archive and archivist when a producer with an agenda chooses to create a fiction using archival materials? This case study explores ethics in the archive and how staff can become part of an ethical transgression

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www.prestocentre.org/library/resources/bishop-and-candidate-parliament

Dominos

Jim Lindner, Mick Newnham (2013)

Humans frequently remember where physical objects are located based on appearance. Once digitised, documents that may have previously had a physical location are now virtual, and are no longer distinguished by appearance or a unique physical location. Not all objects are adequately described, and in the case of AV objects, one physical object may have contained many different sequences. Once digital the relationship to the former physical object no longer may be relevant. A digital migration can create unrealistic expectations for the users and a nightmare for the institution. This case study explores the relationships between physical objects and their virtual proxies, and organizational changes necessary to bring both worlds together.

This publication is part of the series Preservation Case Studies for Archives.

ISBN 978-94-91873-01-0

www.prestocentre.org/library/resources/dominos

The Odd Smell

Jim Lindner, Mick Newnham (2013)

Volunteers and researchers can become the eyes, ears, and noses of collection management. Even though they may not be specifically trained, general staff may notice important things that managers may miss due to their other responsibilities. Instruments designed to document environmental conditions can only function properly when calibrated and deployed appropriately. In this institution, the instruments say one thing but the researchers nose signals an entirely different situation. Good collections management includes paying close attention to the data that are provided by the instruments as well as the input given by those working with the collection.

This publication is part of the series Preservation Case Studies for Archives.

ISBN 978-94-91873-02-7

www.prestocentre.org/library/resources/odd-smell

Digest: Film Scanning Considerations

PrestoCentre (2011)

This PrestoCentre digest summarises the considerations and decisions made for a large film scanning operation by the Netherlands Institute for Sound and Vision. Sound and Vision guarantees the sustainable preservation of the Dutch national audiovisual heritage and makes it accessible to professionals, educational institutes and the general public. The considerations presented by the authors (Tom de Smet and Harm Jan Triemstra) are of most relevance to collections with large quantities of 16mm film to be digitised within time and budget constraints. The project describes an approach to digitising 3000 hours per year, meaning more than six million feet per year of 16mm film. This PrestoCentre Digest is based on the original Technical Report written by Tom de Smet and Harm Jan Triemstra.

www.prestocentre.org/library/resources/digest-film-scanning-considerations

Digitising Video for Long-Term Preservation: An RFP Guide and Template

Paula De Stefano, Kimberly Tarr, Melitte Buchman, Peter Oleksik, Alice Moscoso

This guide is intended to take an institution step-by-step through the process of drafting a Request for Proposals (RFP) for the transfer of analog video -- specifically VHS -- to digital carriers for preservation. The template can be used by libraries, archives, and other cultural heritage institutions and submitted to qualified transfer vendors. It should instill a bit more confidence in those with significant collections of analog video that needs digitising, and it should inspire those involved in the creation of standards, guidelines and recommendations to come together in a timely manner with a sensible path or paths to video preservation in general.

In addition to the RFP Guide, the document also includes a number of appendices that aim to assist those unfamiliar with audiovisual analog-to-digital transfer projects. The appendices include: a sample of a completed RFP by a fictitious institution, a suggested metadata model, a suggested method of collecting transfer notes from a vendor, a glossary of terms and concepts, and a selected resource list.

www.prestocentre.org/library/resources/sustainability-digital-formats

Webinar: Digitisation and Digital Preservation Challenges at the BBC

PrestoCentre (2013)

This recorded PrestoCentre webinar presents an overview of the key challenges and processes involved in digitisation and digital preservation through a real world case study from the BBC Broadcast Archive. The BBC has been copying from old videotape formats to new ones for over 20 years, but for most of that time they copied from analogue videotape to digital videotape. For the last six years they have been making files from digital videotape. What's the difference? In the webinar Richard Wright gives a brief overview of digital preservation, covering three stages: digitising analogue formats; making files from digital physical formats; Preservation actions on files. Tom Heritage (BBC R&D) describes the actual work over the last six years at the BBC, dealing with two digital formats: Panasonic D3, and Sony DigiBeta. He will cover how they 'capture the bits', problems and solutions, and how they hold and preserve the results. By watching this webinar, you will gain a basic knowledge of digitisation and digital preservation challenges, better understand the issues around digitising analogue and digital formats, learn about the importance of preservation actions, and know all about the digitisation experiences, problems and solutions at the BBC Archive dealing with specific digital formats.

www.prestocentre.org/library/resources/webinar-digitisation-and-digital-preservation-challenges-bbc

Events (for full information see the PrestoCentre calendar at www.prestocentre.org/calendar)

January 2014

Unlocking Sources – The First World War online & Europeana Conference
January 30 - 31, Berlin, Germany

The conference is focused on the use of digital resources: How do digitised materials fit into research and teaching? How can different online activities contribute to the "digital humanities"? What ideas for the teaching of history in schools, museums, and media are developed? What are the strengths, and what are the weaknesses of the existing and newly created offers? In addition to the critical discussion and reflection at the panels, innovative projects approaching the theme of the "First World War" by using digital forms can present their results to a broader public.

February 2014

9th International Digital Curation Conference
February 24 - 27, San Francisco, USA

This year the IDCC will focus on how data-driven developments are changing the world around us, recognising that the growing volume and complexity of data provides institutions, researchers, businesses and communities with a range of exciting opportunities and challenges. The Conference will explore the expanding portfolio of tools and data services, as well as the diverse skills that are essential to explore, manage, use and benefit from valuable data assets. The programme will reflect cultural, technical and economic perspectives and will illustrate the progress made in this arena in recent months.

March 2014

Jisc Digital Festival 2014
March 11 - 12, Birmingham, UK

A two-day event (showcasing and celebrating the very best in UK digital talent by bringing together experts and providers from the higher education, further education and skills sectors to share ideas and best practice. It will be an opportunity for professionals to get together and discuss real solutions to improve teaching and learning and enhance the student and research experience.

Orphans 9
March 30 - April 2, Amsterdam, The Netherlands

NYU Cinema Studies joins with EYE and the University of Amsterdam for the ninth international biennial gathering of archivists, curators, scholars, technology experts, librarians, collectors, preservationists, and artists devoted to screening and discussing orphan films (i.e., an eclectic variety of neglected moving images). Film, video, and digital works from around the world will be projected in the magnificent EYE building in Amsterdam, all presented with context provided by expert speakers and creative accompanists.

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