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FILMARCHIVIERUNG IM DIGITALEN ZEITALTER

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Inhalt

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Film digitization – LAC's perspective two years in

Assembled over the past 140 years, Library and Archives Canada holds a vast collection of motion picture film that includes more than 90,000 titles and comprises more than 192,000 cans or 128,000,000 feet. The process of film preservation at LAC, before our introduction of film digitization, has followed the traditional path of optically reprinting damaged or deteriorating film reels to new, modern safety stocks. Small or obsolete film gauges have been blown up to 35mm for preservation. LAC has employed various model telecine machines over the years for the transfer of film material to video tape for reference use by researchers and it still operates a fully functional black and white motion

Bedienung der Maschinen zur Fertigstellung von Filmkopien für das Kino, 1920

BArch, Bild 183-1989-1122-518

picture film lab, one of only a few left in Canada.

In 2012, a number of factors began to converge, signalling the need to begin exploring motion picture film digitization and develop a digital film preservation strategy. The art of filmmaking and the motion picture industry had been evolving for years, adopting new digital technologies and progressively moving away from the use of photochemical film in both the camera acquisition and the movie distribution areas of the marketplace. The talent pool of those with expertise in photochemical reproduction and the specialized knowledge to repair and maintain the decades-old traditional film processing equipment still active at LAC was constantly shrinking, as was the availability of replacement equipment. Veteran specialists, not just at LAC, were retiring and taking their knowledge with them. Film projectors in local cinemas were rapidly being replaced with digital projection systems and, through a joint venture of the two largest cinema circuits in Canada, it was estimated that by the end of 2012 the digital conversion would be all but complete. The deliverables that LAC's clients were requesting had begun to dramatically shift as well. The broad-

cast industry had moved almost exclusively to high definition and we no longer had the tools in house to meet these resolution requirements.

The need to develop a strategy

LAC had been acutely aware of these trends, but in early 2012 when Kodak announced it was seeking bankruptcy protection, we could no longer delay answering the question of what comes after photochemical film preservation. The idea that one day film stock may become unavailable suddenly went from a hypothetical if to the more frightening reality of when. We began in earnest to take our ongoing internal discussions about film digitization to the next level and started developing a strategy for digital film preservation at LAC.

Ultimately, we needed a digital film preservation strategy that would direct our workflows and technological investment towards realizing two goals:

1. The addition of a motion picture film digitization process that would complement our existing photochemical preservation activities for as long as they could be maintained and then be robust enough to potentially succeed them in the event that materials and expertise became unavailable. The digital surrogates produced via digitization need to be rich enough to stand in for the original if the physical film deteriorates and there is no longer a functioning photochemical workflow at LAC.

2. The capability to produce a wide range of high-resolution deliverables from our film holdings for the evolving demands of our clients.

We began our strategy development by looking to what our peer organizations, large and small, were either actively doing or planning to do with regard to the digital preservation of their film collections. It became quickly apparent that motion picture film digitization for preservation was very much still in a nascent state. In 2012, there was a definite lack of consensus in the archival community around standards and best practices. The high cost of investment to build in-house motion picture film digitization capacity and the infrastructure to sustain it was simply out of reach for small and mid-sized organizations. The attention of the community was (and very much still is) focused on the digitization of analog magnetic media, deemed to be at a much higher risk of content loss than motion picture film holdings that have a potentially longer shelf life if stored in optimum conditions. We also discovered that many institutions that claimed to be doing digital film preservation were merely digitizing their collections to compressed high definition video file formats. These may have met the immediate needs of their clients in terms of access, but were not suitable as long-term digital surrogates for the original films.

Defining a set of standards

We then turned the discussion inwards to try and define our own set of acceptable standards. Immediately, this sparked two debates over minimum resolutions and the question of whether to overscan all our films "edge-to-edge" to visually capture the optical soundtracks, key codes and other information present on the physical film. We discussed internally at great length the question: "Is 4K good

enough for digital preservation?" A survey of film scanners available on the market revealed a consistent maximum resolution of 4K. Of course, greater than 4K scanning was possible, but only with very custom and potentially "one-of-a-kind" products that LAC was either hesitant to embrace or unable to afford.

Realistically, we needed to balance our philosophical ideals with pragmatic choices when establishing our standards. It did not make sense to demand specifications that either exceeded the capabilities of the scanners on the market, or, perhaps more importantly, exceeded our fiscal realities. We were already alarmed by the data sizes involved with digitizing at 4K, and the development of a complete information technology (IT) infrastructure that could support 6K or 8K scanning was simply beyond consideration. There was always the option to wait until technological and product advancements delivered an affordable scanner that could capture at resolutions greater than 4K, but LAC felt it was more important to invest and get started, as there would always be new technologies and we wanted to install a platform and begin making the mistakes we needed to make in order to learn.

We needed to balance our philosophical ideals with pragmatic choices when establishing our standards.

As for the internal overscanning debate, it perhaps can only be described as having ended in a truce. Ultimately, it was decided not to overscan. The greatest concern was that, if we adopted a policy of overscanning, we would actually be devoting fewer pixels to the image content area of the film frame, especially for 4:3 aspect ratio material. As we are not disposing of any of the films we are scanning, the original film can be consulted again if this information is required. This decision was not intended to invalidate the value of this physical "metadata" component of a reel of motion picture film, but instead to maximize the capture quality of the information that provided the projected experience for an audience. As is the case with all of our procedures, we are always evaluating them and open to change.

Regardless of these questions, a preservation quality film scanner would need to be tolerant of shrunken, warped and perhaps even damaged film that may have broken perforations or even tape splices. For an archive, the audio capabilities of any scanning solution would also be very important as our collection predominately consists of release prints with optical soundtracks that must be captured and preferably in the same pass as the image.

The Digital Moving Picture Exchange Bitmap (DPX) format would be used to store our preservation master quality version. The preservation master would be a one-light transfer, with the best settings determined before digitization to provide the most latitude in the scan so as to permit more involved digital colour correction and manipu-

File Type	Original	File Format	Codec	Scan Resolution	Bit Depth
Preservation master	35mm	Digital Moving Picture Exchange Bitmap (DPX) (image)	uncompressed	4K	10 bit (RGB)
		Broadcast Wave Format (BWF) (sound)			48 kHz / 24 bits
	16mm	DPX (image)	uncompressed	2K	10 bit RGB
		BWF (sound)			48 kHz / 24 bits
	Reformatted obsolete gauges	DPX (image)	uncompressed	2K	10 bit RGB
		BWF (sound)			48 kHz / 24 bits
Reproduction master		QuickTime (MOV)	Pro Res 4:2:2 HQ	2K	10 bit YUV
Access copy		MP4	AVC/H.264	1920x1080p	bit YUV

Fig. 1: LAC's decision on file formats and resolutions, September 2012

lation either in a later process at LAC or by a future client. The audio soundtrack would be captured in Broadcast Wave Format (BWF). The preservation master DPX sequence would not be wrapped, but organized in logical file system directories and committed to Linear Tape Open (LTO) format for data storage along with the associated BWF audio files (Fig. 1).

The reproduction master

LAC defines a reproduction master as a derivative of the original DPX scan to which LAC has applied some level of subjective digital restoration, colour-correction or reparation regarding image and sound. A reproduction master is a version that attempts to repair obvious deterioration of an original recording and/or augment its overall fidelity to ensure an acceptable presentation using modern digital methods of delivery and consumption. The Quicktime ProRes file format in 2K resolution was selected for the reproduction master as it is a common format used in post-production and, although compressed, is a visually lossless compromise between quality and file size that is suitable for repurposing many other lower resolution derivatives for clients. The MP4 file format was selected as the preferred solution for reference access as it creates a highly compatible file for non-professional use with manageable file sizes. It was also decided to have our access files conform to a broadcast aspect ratio of 1920x1080 as it allowed them to display as expected when posted on common social media channels or used as the source for authoring Blu-ray or standard DVD discs.

After a lengthy competitive process, LAC selected a film scanning solution built around the DFT Scanity film scanner and complemented by a colour correction suite featuring BlackMagic's Resolve software. Scanity met all our specifications for image resolution, safe film handling, scanning speed and audio capture support for both optical and magnetic soundtracks. The scanner and Resolve post-production system are tied together by a 40 terabyte high-performance storage area network (SAN) storage product (DVS SpycerBox) designed by Rohde & Schwarz. The system was installed and went live at LAC in February 2014.

A typical scanning workflow begins with film elements being retrieved from LAC vaults and inspecting their condition. If there are multiple copies of a given title in our holdings, they are all inspected and compared to determine the best candidate for digitization. The film is then cleaned and prepared for scanning. Once scanning is complete, the raw DPX sequence produced is viewed in the Resolve suite and verified for quality. If the DPX files pass verification, they are organized into a consistent logical directory structure on the SAN and are copied to LTO for longer-term storage. A film conservator continues to work with the master DPX sequence in the post-production suite to produce a reproduction master file that will include any colour correction or reparation work performed on the title. The reproduction master file is then used to produce any lower resolution derivatives that may be required for delivery to clients. Finally, the reproduction master and all access files created are also committed to LTO for storage.

It is imperative that a digital asset management platform be developed in parallel with any motion picture film digitization initiative.

Long-term storage – You can never have enough space

The long-term storage of digital master files at LAC, including data created during motion picture film digitization, is facilitated by archiving all data to LTO-6 format data tape. All archived data is copied to two separate LTO-6 tapes, which are then stored in separate locations. Due to the sheer volume of data and number of tapes, much of LAC's digital master files are stored offline and retrieved only when required. The sustainability of our strategy over the long-term is subject to our ability to be able to continually migrate this ever-growing collection of data tape forward to either a new generation of LTO-tape with a higher capacity or to a different future storage technology altogether.

Film conservators at LAC have now been working with our film scanning solution for approximately two years, and over that time we have determined that our film digitization workflow produces approximately 40 terabytes of master files and derivatives consistently every month. This number would appear to be the representation of what we can achieve at our current staffing level and capacity of

the IT infrastructure in place to service us. We have learned very quickly that your digitization workflow is only as strong or as efficient as the complete IT infrastructure that surrounds and supports it. Digitized film sequences at 4K resolution can create approximately 4 terabytes worth of data for every hour of material. We have discovered that you can never have enough space and that you can never move your data fast enough to make room so that you can keep on working! We thought we had an adequate understanding on paper of what we needed to get started at LAC. However, only a few weeks into full production mode we had already begun planning to double our SAN capacity to 80TB to provide more breathing space for scanning and storing multiple large projects at different stages in the workflow.

The addition of our film digitization capabilities, in combination with exponential growth in all digital areas, has become a challenge for the current data archival workflow at LAC. The act of data management from digitization to long-term storage still relies heavily on manual processes that may have been manageable five years ago, but have not scaled or developed in lock-step with the level of production activity in the migration labs. In hindsight, it is imperative that a digital asset management platform be developed in parallel with any motion picture film digitization initiative – this is a lesson we continue to learn the hard way as LAC develops and improves its overall digital management and preservation practices. Regardless of these ongoing challenges, it has been extremely exciting to be able to scan original nitrate film and produce stunning high resolution digital versions for preservation and delivery to clients.

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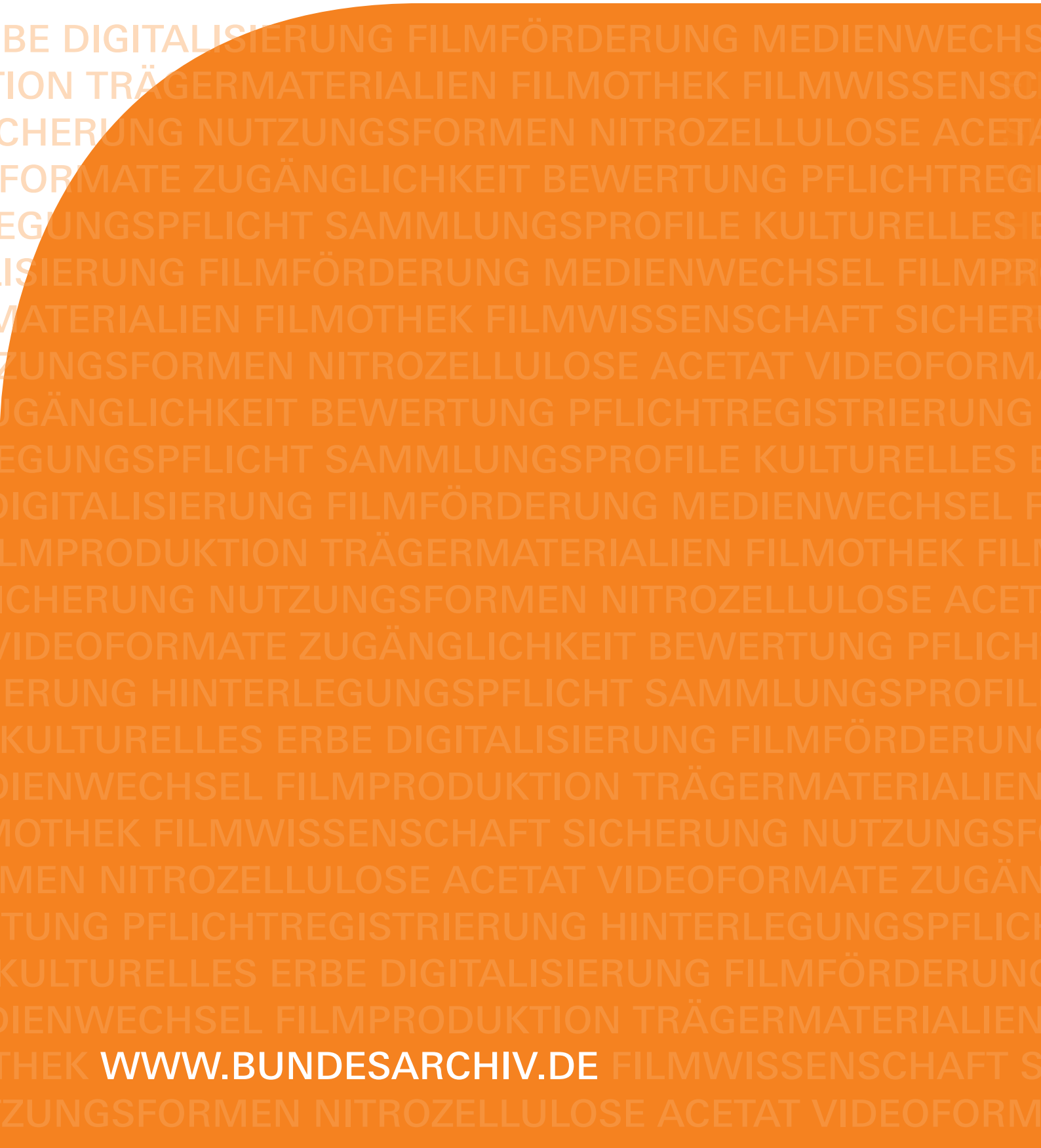
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CHERUNG NUTZUNGSFORMEN NITROZELLULOSE ACETA
FORMATE ZUGÄNGLICHKEIT BEWERTUNG PFLICHTREG
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ZUNGSFORMEN NITROZELLULOSE ACETAT VIDEOFORM
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DIGITALISIERUNG FILMFÖRDERUNG MEDIENWECHSEL
LMPRODUKTION TRÄGERMATERIALIEN FILMOTHEK FIL
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