White Paper

The New Archive Workflow:
Accessible, Online and Protected

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Introduction

Video gives us a way to visualize the dynamic relationships of the world around us. Higher resolution video at higher frame rates lets us experience our world at even greater detail and with a greater potential emotional impact. Combine higher resolution with higher frame rates as well as input from multiple cameras and the demand for digital storage for professional media and entertainment explodes, particularly for original or master content. Today some video projects produced with high frame rates and high resolution run a few petabytes (PB) in size. In the not too distant future the size of higher resolution, multiple camera video projects could be 100 times that size.

As the size and complexity of master and supporting preserved original content increases (raw captured content size could grow close to 500 X in the next few years due to higher resolution and frame rate as shown in Table 1), the digital archival systems used to preserve this content and make it available for use must become more intelligent. They also have to scale to meet the needs of growing content libraries and provide an easy path to continued data access as well as data protection over the life of the archive.

Table 1. Example Resolution, Data Rates and Storage Capacity Requirements for Professional Media Content

Format	Resolution (width X height)	Frame Rate (fps)	Data Rates (MBps)	Storage Capacity/ Hour (GB)
SDTV (NTSC, 4:2:2, 8-bit)	720 X 480	~30	6.25	22
HDTV (1080p, 4:2:2, 8-bit)	1920 X 1080	24	49.8	179
Digital Cinema 2K (4:2:4, 10-bit) YUV	2048 X 1080	24	199	716
Digital Cinema 4K (4:4:4, 12-bit) YUV	4096 X 2160	48	1,910	6,880
Digital Cinema 8K (4:4:4, 16 bit)	7680 X 4320	120	23,890	86,000

2012 Digital Storage in Media and Entertainment Report, Coughlin Associates, www.tomcoughlin.com

"Super Hi-Vision" Video Parameters for Next Generation Television, SMPTE Motion Imaging Journal, May/June 2012, P. 63-68

As shown above, the storage capacity needed for high-resolution imaging is monumental, and it's growing every day. Traditional offline archiving does not meet the fast-paced demands of modern digital workflows. Video professionals need a real-time, online way to simultaneously access stored content. This paper will examine the role of digital active archiving technology in professional media and entertainment workflows.

We shall show the use of LTO tape during a typical media workflow and in an active content archive. Examples of how a content library or a content archive use LTO tape for professional content will be given and the important role that the LTFS file system in LTO tape provides for content storage will be explained. While LTFS and LTO are important technologies for the creation of file-based archives, on their own, they are not enough. Thus, we also need to look at intelligent storage architectures and solutions that harness LTFS to deliver data protection, scalability and manageability for massive data volumes. We will conclude with some thoughts on the future of content archiving and the growing value of an intelligent preservation archive.

Alive in the Archive: Tape's Modern Role in Media Workflows

Archiving (and digital tape) plays an important role in professional content storage from the very point of creation through distribution. In large movie projects that involve significant investor money, production houses must create a copy of new raw content on archive media as well as production media. Digital magnetic tape, usually LTO tape, is used in the field to create archival quality copies when the digital footage is downloaded onto a hard disk drive from the camera content media. This is particularly true for expensive solid-state camera cartridges where the cartridges are cycled quickly for reuse. Several media production support equipment companies make storage systems that are used in the field for making copies of content on magnetic tape and HDDs and thus meet these bonding requirements.

Likewise, in a post-production facility for film or television, magnetic tape is often used as working archive behind a HDD (and possibly even some flash memory) storage array that serves video workstations. These various storage media are used to optimize a storage solution using the trade-off in performance versus storage costs of the various storage technologies. Flash memory can be fast but the cost per GB of storage capacity is often ten times or more expensive than HDD storage. Magnetic tape is less expensive than HDD storage, particularly in normal operating costs (e.g system power and HAVC costs) and the storage media life of magnetic tape is longer than HDDs. In a larger facility using network storage this archiving storage tier would likely be closely integrated with the network storage as shown in Figure 1.

The LTFS file system on LTO tape allows the creation of file and even object-based archives using this low-cost storage media. LTFS is useful for media and entertainment applications since file access makes LTO tape act like a storage volume (similar to a HDD or USB drive). File information makes content on tape (metadata) viewable without special applications. As a consequence, it is easier to use LTO tape in workflows. Increased data mobility using file formats (such as the LTFS) makes sharing across workflows easier, and thus magnetic tape can be an important element in a M&E "sneaker net."

**Figure 1. Video Post Production With Networked Active Archive Storage**
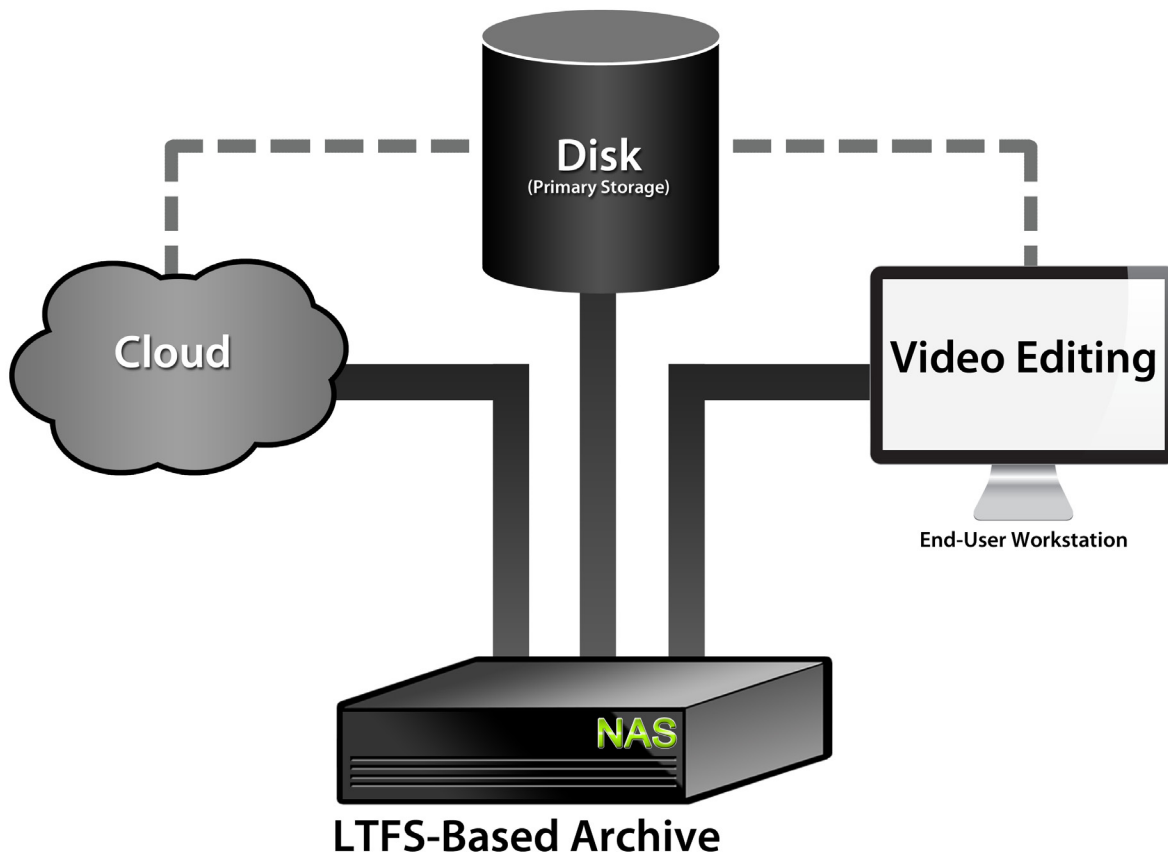
Some media facilities use magnetic disk storage for their content archives. Magnetic tape can be much more cost effective, particularly because the operating costs of tape sitting on a shelf in a tape library is less than spinning disks in drive arrays.

As shown in Figure 2, over a 20 year retention time the total costs of storing content on hard disk drives is more than twice as large as storing it on magnetic tape in a tape library.

LTFS has generated a lot of interest from content creators, even smaller facilities, for long-term tape archives. Because LTO-5 or 6 tapes can be used across multiple platforms, they can be used in various parts of the workflow. LTO can replace pro-video tape archives, and it is less expensive to operate than disk-based storage. LTO tape-based archives are playing a crucial role in cost-effective archive storage because of the physical life of the storage media, the backward compatibility of LTO tape formats and their low operating costs for long-term storage.

Figure 2. Comparison of Estimated Annual Cost to Save 1 PB for 20 Years on HDDs Arrays and a Tape Library1.
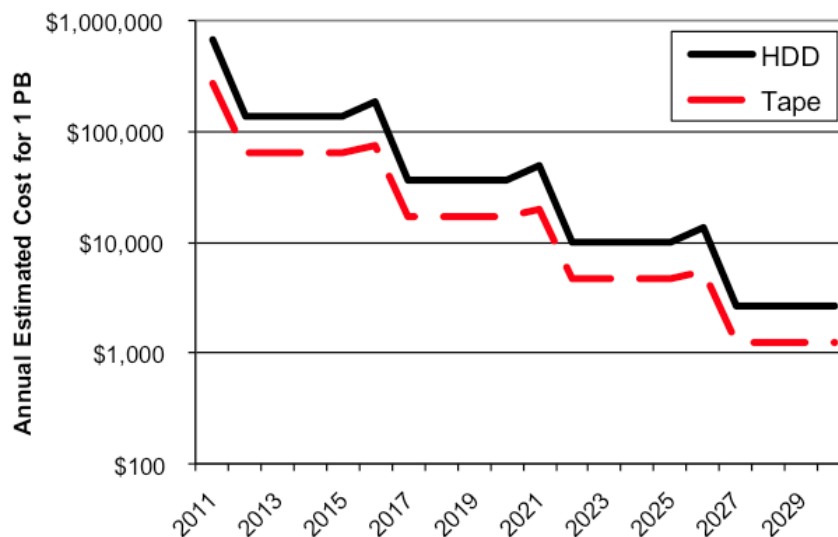
But tape, by itself, cannot deliver the rapid access to data needed by media and entertainment facilities. That's where an intelligent active archive management solution is needed. One such solution, the StrongBox from Crossroads Systems, uses a disk caching layer to enable multiple, simultaneous accesses to an underlying tape library.

Best Practices for Protected, Accessible Tape Archives

These factors have made LTO tapes popular with many video content libraries. For example, Fox Studios uses LTO tape for archiving all their high definition content. We will look at a couple of other examples of LTO tape with intelligent storage for professional media and entertainment from boutique post-production facilities to major broadcast networks.

ProductionFor is an Austin, TX based production and post-production company that provides media acquisition, editing and customer animation graphics. Data from a single project can start with hundreds of source files taking up to a terabyte of storage capacity. Editing this content increased the storage capacity demand and required a scalable cost-effective long-term storage system that could handle massive video files.

A Crossroads StrongBox tape-based NAS storage appliance using LTO tape was found to be an effective repository for high-volume long-term post-production content. Multiple copies on several pieces of media stored at separate locations provided protection of the archived content. StrongBox's multi-copy, hash-coding and system monitoring helped ensure that the video content data was securely protected and accessible. The LTFS-enabled file structure allowed content on the tape archive to be easily available to ProductionFor's file-based workflows. This enabled single file access availability at the click of a mouse.

The use of LTFS file system allowed any LTFS media to be kept in the StrongBox, whether it was created by ProductionFor or not, and independent of the operating systems used. This allowed greater collaboration with content on LTO tapes and meant the storage content could last beyond the life of the production system.

Major League Baseball (MLB) Network is the source for premier baseball content including live games, studio shows and feature programming. A custom developed StrongBox LTO storage system was installed in late 2011 to provide a portable data vault for long-term file retention.   The internal HDD cache enabled rapid file access, and the LTFS file system enabled drag-and-drop file movement simultaneously for multiple users.

The MLB Network logs and categorizes HD recordings by viewing proxy video files, recorded in real-time. Most of this HD video is stored in the LTO library and is searched using DIAMOND and the Grass Valley Aurora system. MLB Network is looking to store the long-tail proxy content on LTO tape as well.

Conclusions

Archiving plays a critical role in video content workflows, from content capture, through post-production and for long-term preservation and library access. LTO tapes offering the LTFS file system provide file-based storage that allows tape to be partitioned and used for project based storage of high resolution original content as well as transcoded files for distribution networks or proxy files.

Archiving on magnetic tape results in significant cost reductions over the life of a digital archive. The operating cost advantages of LTO tape storage and the file access of the LTFS file system make intelligent archiving solutions, like StrongBox, an important element in a video facility's media asset management, real-time content access, disaster recovery strategy, and in a preservation repository.

As the size and complexity of professional video projects increases in coming years, file-based and even object-based access to well-organized content will be even more critical to successful video production and broadcast. Future magnetic tape technology will continue to develop both in storage capacity as well as data accessibility.

About the Author, Tom Coughlin

Tom Coughlin, President, Coughlin Associates is a widely respected storage analyst and consultant. He has over 30 years in the data storage industry with multiple engineering and management positions at high profile companies.

Dr. Coughlin has many publications and six patents to his credit. Tom is also the author of Digital Storage in Consumer Electronics: The Essential Guide, which was published by Newnes Press. Coughlin Associates provides market and technology analysis (including reports on several digital storage technologies and applications and a newsletter) as well as Data Storage Technical Consulting services. Tom publishes the Digital Storage Technology Newsletter, the Media and Entertainment Storage Report, and the Capital Equipment and Technology for the Hard Disk Drive Industry Report. Visit www.tomcoughlin.com.

About Crossroads Systems and StrongBox

Crossroads Systems, Inc. is a global provider of solutions and services that ensure stored data is proactively protected and reliably recovered. Crossroads offers organization powerful data protection, proactive data security, intelligent storage connectivity, unmatched performance, and significant cost savings. Crossroads was founded in 1996 and is based in Austin, TX and holds more than 100 patents granted and pending.

StrongBox is a shared storage solution purpose-built for data archival and preservation. Using Linear Tape File System (LTFS) technology and intelligent storage architecture with standard file systems (CIFS/NFS), StrongBox empowers online, all the time, file availability with uncompromised data protection, full data mobility, non-proprietary file storage and significant cost-savings. StrongBox unifies your archive - past and present - while providing seamless scalability and reliability for the future.

Visit Crossroads at: www.crossroads.com