

Deliver a superior digital archive solution for the media and entertainment industry

How the Cache-A archive appliance employs HP Linear Tape File System (LTFS) to deliver long-term archival stability, ease of use and lower total cost of ownership

Business white paper

Who should read this paper?

Video production and digital media professionals who need a solution that makes digital content storage, sharing, and archiving easier



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Executive Summary

HP LTFS is a tape-based file system that signals a new era for tape applications. HP LTFS provides a self-describing file system on an HP LTO-5 cartridge, which enables the combined benefits of application independence, transportability, and protection from obsolescence.

LTFS makes tape self describing, file based, and easy to use. It provides users with the ability to use standard file operations on tape media for accessing, managing, and sharing files with an interface that looks just like a hard disk. In addition, LTFS enables sharing data across platforms, as you would with a USB drive or memory stick. Simply load a tape into the drive, mount it into the file system, and it becomes visible as a disk.

The benefits of HP LTFS are particularly relevant for media and entertainment companies that need storage solutions that simplify operations, improve manageability, and meet their long-term data retention requirements.

The Cache-A archive appliance integrates HP LTO-5 tape drives with LTFS and Cache-A archiving solutions to enable media and entertainment companies to more effectively safeguard content, increase data mobility, and share content organization wide.

Introduction

As a professional in video production or digital film, you may be all too aware of the increase in digital data content created as a result of enhanced image resolution, high-definition television, and 3D video. While these changes open new creative possibilities and greatly enhance the end user experience, they also result in vast amounts of data that are required to be stored and retained. Moreover, the high value of your digital assets means that protecting them against loss is often vital to the very existence of your business. So the question is, just how do you store your most valued assets with data integrity and availability over long periods of time?

Industry professionals are rapidly coming to the conclusion that the way to achieve lower cost, dependable data protection is to actively archive assets from online “production disk” to lower cost “nearline” library and “offline” shelf-stored or vaulted solutions, such as digital tape storage.

Up to now, archiving to tape has not been an easy task; creative professionals have lacked the tools and processes required to archive source footage, work-in-progress, or finished projects. Fortunately, growing recognition of the need for high quality, dependable data retention of high-resolution assets, frequently spanning multiple decades, has led to the development of new solutions.

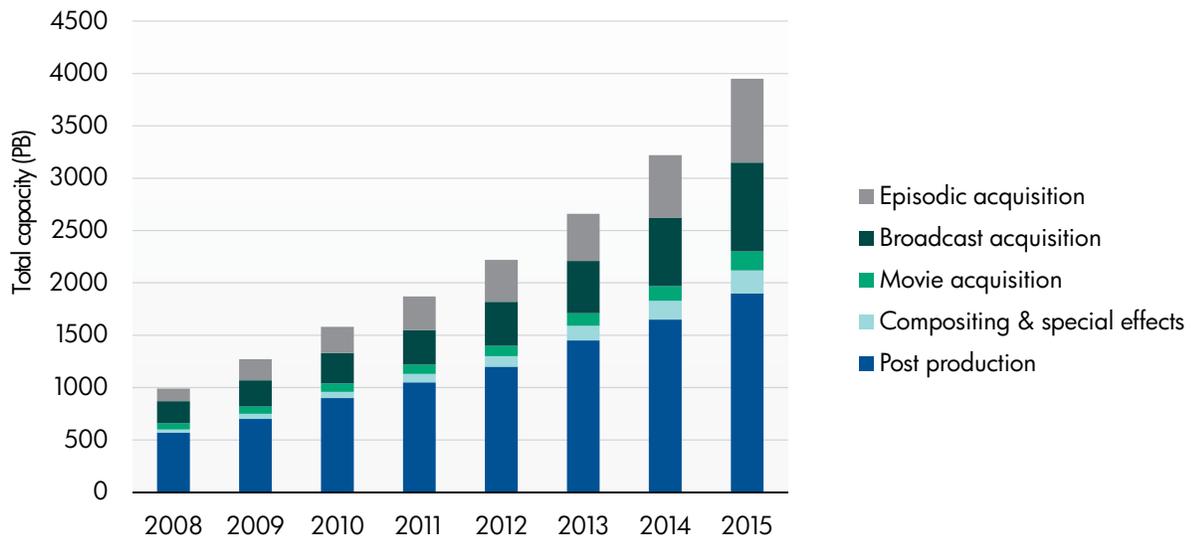
This white paper introduces the Cache-A archive appliance, which integrates HP LTO-5 tape drives with Linear Tape File System (LTFS) technology and Cache-A archiving solutions (hardware and software) to deliver long-term archival stability, ease of deployment and use.

Today’s digital content storage challenges for broadcast media & entertainment

Over the last decade, we have seen trends such as 2K and 4K motion-picture creation and restoration, SD (Standard Definition) to HD (High Definition) television, Ultra-HD, Web 2.0 user-generated content, and file-based acquisition from new video and digital film cameras. These trends have had an enormous impact on the amount of digital content needed to be managed, manipulated, and stored by producers and film makers in media and entertainment companies. In addition to this capacity growth, longer term retention of assets presents an additional challenge, especially with older analog footage now being transferred to digital formats for repurpose and retention. As of 2009, one estimate suggests that the total of as yet unconverted analog video and movie content is in the order of 200 million hours¹.

¹ Coughlin Associates, Digital Storage for Media and Entertainment Report, 2010

Figure 1: Annual capacity projections for creation of professional video content



Source: Coughlin Associates 2010

Data growth in the media and entertainment industry is a trend that is set to continue:

- Between 2009 and 2015, the media and entertainment industry will see a 10x increase in the required digital storage capacity and a 12x growth in storage capacity shipments per year²
- More than 46 exabytes of digital storage will be used for digital archiving and content conversion and preservation by 2015²
- Generating more than 500 GB/hour, HD video quintuples video's storage capacity requirements³
- 3D films more than double the HD capacity needed
- Ultra HD is predicted to require 20x the capacity of HD⁴
- Raw content captured can be larger than the final product. For example, the 3D film Avatar required more than 1 petabyte of total storage, even though the final product distributed to theaters was only a few hundred gigabytes in size⁵

² Coughlin Associates, Digital Storage for Media and Entertainment Report, 2010

³ Clipper Group Inc, Dealing with Cool and Cold Data, June 2010

⁴ Tom Coughlin, Digital Storage Trends—www.infostor.com 2009

⁵ Coughlin Associates 2010: Archiving in the Entertainment and Professional Media Market

Storing and protecting rising volumes of digital data is becoming an increasing challenge for media and entertainment professionals.

“Organizations will buckle under the weight of the data and costs associated with storing and protecting it unless there is a cost-effective way to store digital assets. Storing such data on disk quickly becomes inefficient and complex.

The market has recognized that tape must play an important role in providing a way to store data efficiently and effectively.”

IDC Report, Top 10 Storage Predictions for 2011

The Importance of digital archiving

A consistent message from industry experts is the need for active data management as the first step in controlling storage costs. A key discovery often made when analyzing stored data is that a great deal of the data is much older and less frequently accessed than originally assumed. While keeping all data close at hand on high-speed disks might seem ideal for access purposes, in reality to do so could be prohibitively expensive in terms of both hardware purchases and the cost of power, cooling, and physical space, especially when compared with tape storage.

Digital archiving serves to reduce an organization's overall "data footprint", and in particular the amount of data that is being stored on online primary storage. One definition of digital archiving is:

"An archive is a copy of data that is being retained in a safe and economical location for very long periods of time, usually for years and in some cases centuries. Archives are used throughout the entertainment industry for storing content that is not being used in current projects, but could be repurposed or referenced in the future"

"An archive may be active or online, where it can be accessed relatively quickly, or cold, offline, where it can be stored safely and economically, but it may take some time to mount the digital storage medium and read the archived data"⁶

Archiving differs from the backup process. Backup data is typically a temporary copy of a data set that is ultimately overwritten, while a digital archive represents historical digital assets that have been moved to a separate location and retained for long durations. The benefits of doing this are threefold:

- Enhance performance and efficiency by removing old data from primary disk storage
- Reduce business risk by holding data offline with enhanced security
- Cut costs by using lower cost storage such as tape

Today, digital archiving in the media and entertainment industry is being driven by two factors—the need to cost-effectively retain content for reuse and the need to convert historical analog content to a digital format to prevent degradation of content.

Where tape fits in today's professional file-based workflows

For many years, professional videotape was a mainstay of the media and entertainment industry, valued for its portability and low cost. However, over the years this non file-based medium has declined as workflows increasingly turned to file-based models.

"A decade ago, newsrooms shot on videotape, edited on videotape and kept their invaluable news archives on videotape. But now with the turn toward tapeless acquisition, there is no videotape byproduct to begin with, and the new acquisition media is too expensive to use once and relegate to the shelf for posterity. Broadcasters have had to migrate to some other form of storage, and though the rest of their workflow is becoming tapeless, for long-term archiving the answer is increasingly to use tape."

From Tapeless Back to Tape, Craig Johnston, TV Technology⁷

To quote one storage analyst: "The 21st century data explosion is here—and tape is well positioned to become The Digital Curator of the Information Age."⁸ Tape is strengthening its position as the ideal solution for data archiving.

Migrating inactive data to lower cost tape storage frees up primary storage, and storing inactive data on lower cost storage saves money.

⁶ Coughlin Associates 2010: Archiving in the Entertainment and Professional Media Market

⁷ <http://www.tvtechnology.com/article/96758>

⁸ Tape: The Digital Curator of the Information Age—Fred Moore, President Horison, Inc.

Introducing the Cache-A archive appliance

Cache-A Corporation is a leading supplier of network-attached archive appliances for digital film, broadcast and video professionals. Cache-A's archive appliances combine the random access of hard-disk storage with the longevity and reliability of HP LTO-5 Ultrium tape drives with LTF5 technology, delivering a cost-effective high-capacity "data tape deck" that is self-contained, network-accessible and platform-independent.

The benefits of HP LTO-5 Ultrium Tape

LTO Ultrium is the world's most widely adopted tape technology, with more than 3.7 million drives⁹ deployed for mission-critical data protection in a wide range of industries. Today, LTO Ultrium tape drives and media combine longevity with high capacity and performance, low cost of ownership, portability, high reliability and additional security features to make them an ideal archive solution.

HP LTO-5 Ultrium is the latest generation in a long line of LTO Ultrium products. Integrated in Cache-A archive appliances, LTO-5 delivers:

Lowest total cost of ownership

Tape acquisition and on-going operating costs remain very low. At approximately 5¢ per gigabyte (native) for LTO-5 tape media¹⁰, LTO Ultrium tape offers one of the lowest costs per gigabyte for long-term storage. This can result in significant cost savings. For example, when compared with traditional video tape such as SR or D-5L tape cartridges when recording an event such as a National Football League (NFL) sporting event lasting approximately 3 hours (180 minutes).

	SR/D-5L cartridge ¹¹	LTO-5 cartridge
Run time	124 minutes maximum	2,500 minutes (approximately)
Approx cost per cartridge	\$250	\$80
One NFL game requires	2 cartridges	Less than 1, approx 14 events per cartridge
Total cost per game is	\$500	\$6

Note that with SR and D-5L, a portion of the second cartridge tape remains unused, whereas multiple games can fit on an LTO-5 tape with tape utilization greater than 99 percent. Note further that while SR and D-5 tapes can only contain video, LTO-5 tapes can hold any digital information, including such related items as shot lists, still images, graphics files, etc. Additionally, SR and D-5 tapes must record in real time, whereas digital media content as files can be transferred to LTO-5 at much faster than real time.

Furthermore, a new report, published in December 2010 by The Clipper Group Inc studied the total cost of ownership (TCO) of using disk or tape to archive large binary files with a 45 percent annual growth rate over a 12 year period. The disk comparison point began with 2 TB disks assembled into fully configured arrays. The tape comparison point began with LTO-5 tape cartridges and drives housed in a fully configured automated tape library. In conclusion, The Clipper Group discovered that:

- Traditional HDD online disk is more than 15 times more expensive than tape for archiving
- Disk uses 238 times more energy—costing more than the total cost of the tape solution

Tape storage has been shown to decrease storage power requirements by 99 percent when compared to disk-based storage¹². Tape helps meet the goal of many data centers that inactive data should not consume energy.

"In every dimension, the TCO of the tape solution was found to be less expensive than the TCO of the disk solution for long-term data retention, especially for energy consumption, where disk consumes 238 times more energy than tape under assumptions that lean toward favoring disk."

The Clipper Group Inc. December 2010

High capacity, small footprint

With a native capacity of 1.5 TBs of storage on a single LTO-5 Ultrium cartridge, organizations can scale and keep pace with data growth simply by adding more LTO tapes.

LTO Ultrium palm-sized tapes measure approximately 11.3 x 2.79 x 11.1 cm or 4 x 4 x 1 inches. As a result, they can be safely stacked and stored in a vault at regular ambient conditions, reducing the cost and amount of premium physical floor space required to house data in archive when compared to disk or other tape storage media. Note that a single 6 x 6ft (1.8 m) wall rack with 14 shelves can store approximately 1000 cartridges, equivalent to 120,000 hours of 25 Mbps SD or 30,000 hours of 100 Mbps HD.

⁹ IDC WW Factory Exit Tape Drive Tracker Q4 CY'2010 (March 2011)

¹⁰ Average online LTO-5 media pricing in March 2011

¹¹ D-5L prices and product running times taken from <http://www.tapeonline.com/d-5> in March 2011

¹² <http://www.clipper.com/research/TCG2010054.pdf>

Proven reliability

HP LTO Ultrium drives significantly extend the boundaries of tape storage reliability and data integrity with features such as powerful error correction codes, timing based servo with dual/redundant servo heads, read-while-write verification and full recovery of a lost track or up to 32 mm of unreadable tape.

The drives are designed for high duty-cycles and automation solutions with features such as the leader capture design, soft load/unload mechanism, an active head cleaner and simplified tape path.

Furthermore, the unique HP Dynamic Data Rate Matching algorithm adjusts the speed of the tape to match the speed of the data streaming from the host to prevent the continual repositioning of the head on the tape as it waits for more data in many typical environments. Avoiding this “shoe-shining” effect has numerous benefits, including lessening head and tape wear, reducing power requirements and enhancing overall performance.

As a consequence of these reliability features, the HP LTO Ultrium tape drives are specified with a 250,000 hour MTBF at 100 percent duty cycle—that’s more than 28 years when being used 24x7.

Portability and durability

The promise that bandwidth would replace couriers for moving large data files over networks has not come true. The growth in the amount of data that needs to be transmitted exceeds the growth rate of bandwidth and will continue to do so for the foreseeable future.

Tape media is completely removable, and the lightweight, yet rugged cartridge designs are easily transported without risking data loss. Weighing just 270 g, or 10 oz, they provide the only convenient and practical way to transport large digital files and footage between sites.

Added data security

Removable media also has the advantage that data is held “offline”, which means that archive data on tape has the additional level of protection from the threats to online data from viruses, hackers, and cyber attacks.

Additionally, both LTO-5 and LTO-4 Ultrium tape drives include hardware-based data encryption to prevent unauthorized access to data held on tape, protecting your ownership and IP rights. They use the Advanced Encryption Standard (AES) with the longest and most secure keys, 256 bits, designed to be compliant with the emerging standard for tape drive security, IEEE 1619.1.

30-year media shelf-life

As a creative professional, you need to be confident that assets in archive are still there when you need them. With media specified to a 30-year shelf life, LTO tape provides an ideal long-term data retention solution. LTO is a proven technology with over 3.7 million drives and 150 million LTO Ultrium cartridges shipped since the technology was first launched in 2000.

LTO tape delivers a more robust, cost-efficient and durable archive solution than external hard disk drives

LTO tape media is more robust than standard external hard disk drives and enables safer offsite storage of data for disaster recovery. LTO tape media is also more cost-efficient than standard external hard disk drives for longer term high-volume storage. LTO tape also has a longer life span than standard external USB hard disk drives with a proven shelf-life for reliable long-term archival.

LTFS: Making tape as easy to use as disk

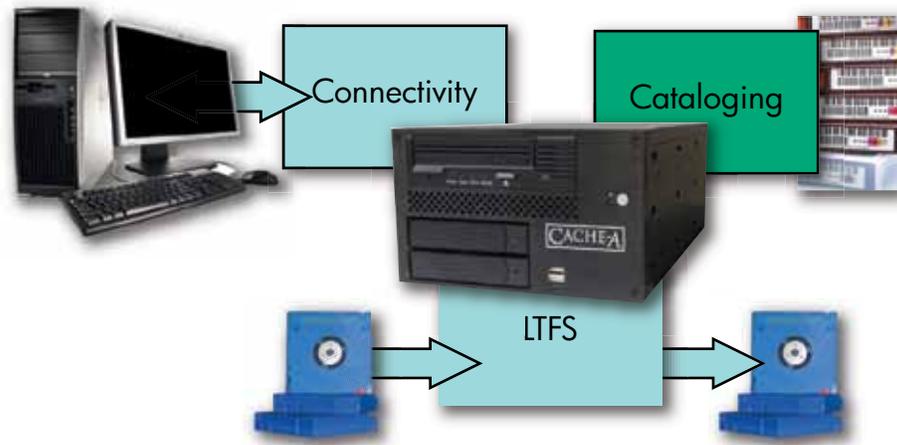
HP LTO-5 tape drives offer even more than a balance of price and performance; they now include LTFS technology which makes viewing the contents of tape as easy, flexible, portable, and intuitive as using other removable and sharable media, such as a USB drive.

“Data tape is the chosen archive format for many broadcasters. The latest generation of LTO, LTO-5, introduces a feature called LTFS that lends it to broadcast archive applications.”

David Austerberry, Broadcast Engineering

Part of the LTO Ultrium open standard, LTFS is enabled by the dual partitioning capability of LTO Generation 5 technology. LTFS technology provides file system access at the operating system level, using one partition to hold the content’s index and the other partition to hold the content.

As a result of employing LTFS, HP LTO-5 tapes become self describing. That is, each tape has its own file system and can be viewed in the same way as any other portable media, including devices like USB hard disk drives and flash drives.



Cache-A's archive appliance is a perfect complement to LTO-5 Ultrium tape drives with LTF5 technology because it presents the tape interface as a true network-attached storage device. To a user, tape both looks and behaves like a disk, and all tape operations are handled transparently by the archive appliance in the background. With LTF5, the archive appliance delivers a solution that is:

Self contained—platform neutral to stand the test of time

Systems built on computer-hosted drives are tied to a single machine type, dependent on specific operating systems and drivers that may not be available when stored content is needed a decade or two later. Cache-A archive appliances with LTF5 are self describing so that data recovery from tape is independent of hardware platforms or software applications so that it may stand the test of time when it comes to restore.



Eight-Generation Roadmap

	Generation 1	Generation 2	Generation 3	Generation 4	Generation 5	Generation 6	Generation 7	Generation 8
Compressed Capacity	200 GB	400 GB	800 GB	1.6 TB	3 TB	8 TB	16 TB	32 TB
Native Capacity	100 GB	200 GB	400 GB	800 GB	1.5 TB	3.2 TB	6.4 TB	12.8 TB
Compressed Data Rate	up to 40 MB/s	up to 80 MB/s	up to 160 MB/s	up to 240 MB/s	up to 280 MB/s	up to 525 MB/s	up to 788 MB/s	up to 1180 MB/s
Native Data Rate	up to 20 MB/s	up to 40 MB/s	up to 80 MB/s	up to 120 MB/s	up to 140 MB/s	up to 210 MB/s	up to 315 MB/s	up to 472 MB/s

Note: Compressed capacities for generations 1-5 assume 2:1 compression. Compressed capacities for generations 6-8 assume 2.5:1 compression (achieved with larger compression history buffer).
 Source: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only.
 Linear Tape-Open, LTO, the LTO logo, Ultrium, and the Ultrium logo are registered trademarks of HP, IBM and Quantum in the US and other countries.

Interchangeable—easy to distribute and interchange assets

Cache-A utilizes LTO Ultrium tape drives, the most widely adopted tape drive technology in existence today and accounting for 70 percent of all tape drives shipped in CY2010¹³. LTO tapes with LTFS can be used cross-platform in various parts of the workflow. Additionally, Cache-A's content tracking catalog within each tape makes searching very efficient and can even improve restore speeds over baseline LTFS implementations.

¹³ IDC WW Tape Drive Factory Exit Market Share for calendar Q4 2010

Extensible—scalable to meet future needs

An archival system should allow you to easily add capacity while keeping track of all content in an integrated system. The Cache-A archive appliance with LTFS allows for data sets to expand to hundreds of terabytes of library and shelf-stored content. Further, it is currently implemented with LTO-5 technology, and it is anticipated to be available with new generations of higher-performance, high-capacity LTO Ultrium drives scoped out to generation 8 and published in the LTO Ultrium roadmap. The LTO Program has established a decade-long track record of delivering to the roadmap, giving customers' confidence that the LTO technology will continue to provide investment protection through future scalability to keep pace with data growth.

Enhancing workflows with Cache-A archive appliance

The Cache-A archive appliance with HP LTO Ultrium and HP LTFS technology makes an ideal archiving and interchange solution, enhancing the following workflows:

Production

The archive appliance streamlines the creation of source masters from a diverse range of media, including the ability to directly connect many popular camera storage systems and cards directly to the archive appliance. This means that you can immediately protect field footage and free up high-cost, premium acquisition media for reuse.

Archiving to and restoring from files on tape is a simple drag-and-drop process within the archive appliance interface. Once files are archived, the destination LTO-5 tape becomes the source master, project master or interchange media for the underlying assets.

Post production

The archive appliance utilizes HP LTFS to create a searchable directory of tape content, including unique file name, creation date, modification date, etc. The directory can be viewed by Cache-A's browser-hosted interface, allowing you to track and restore contents without additional management software.

The archive appliance not only provides access to the directory of the currently inserted tape, but also maintains a catalog of all tapes that have ever been used on the system.

The archive appliance also allows fast multi-user access to any archived data so that editors in the workgroup can archive or access assets from any computer on the network. Furthermore, the archive appliance is platform agnostic to provide heterogeneous workgroup compatibility between Apple Mac, Microsoft® Windows®, and Linux/UNIX® systems. It also offers workflow compatibility with Avid, Final Cut Pro and other non-linear editors (NLEs).

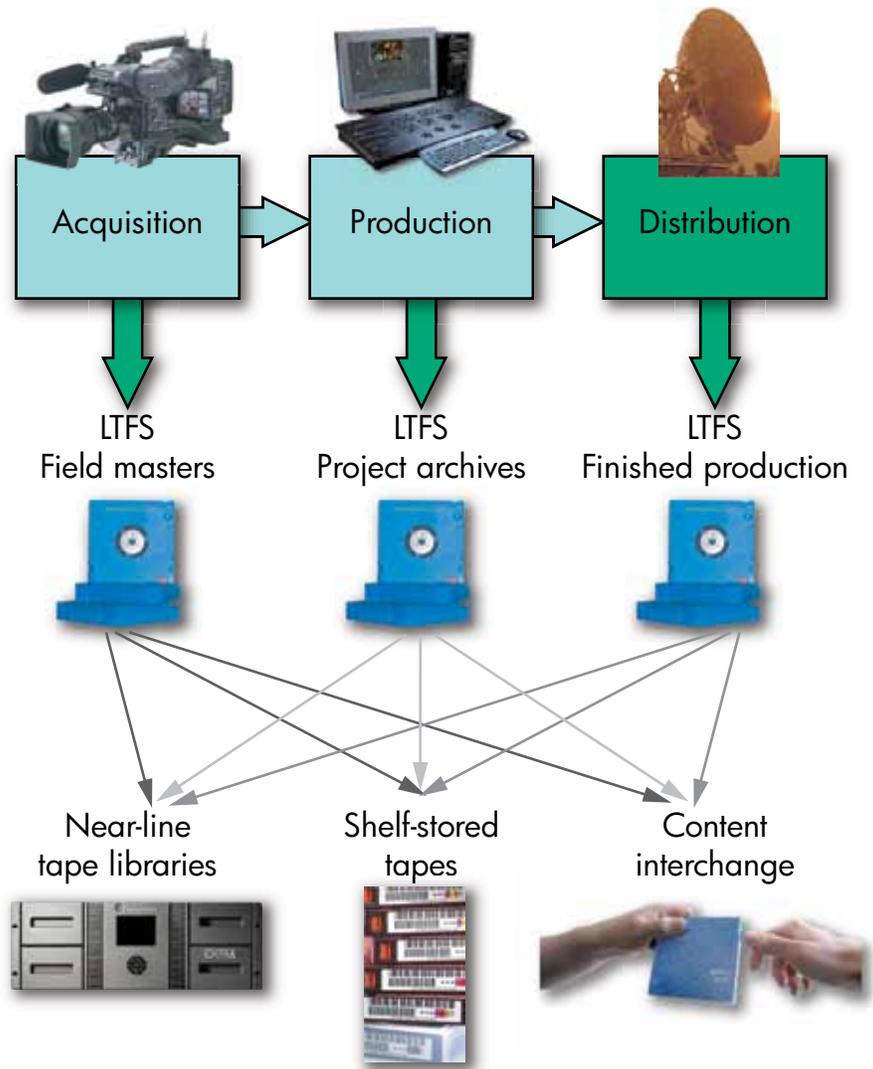
Once created, the tape may be shared with an editor using, for example a MAC OS, and from there it may be shared with a digital effects company using Linux.

HP LTO-5 drives offer fast transfer speeds of up to 140 MB/second (native), the equivalent of 500 GB per hour for data retrieval. This may be particularly useful when seeking and retrieving individual digital assets from a tape ready for reuse.

Asset management and interchange

LTO-5 tapes created by Cache-A archive appliances using HP LTO-5 with LTFS technology offer a reliable, self-describing medium for the interchange of assets between facilities, editors, and customers. The open-standard LTFS makes the tape contents compatible and accessible to any facility with an LTO-5 Ultrium tape drive. As a result, it provides a self-contained content delivery mechanism among stages of the workflow:

- Enable the integrity of the shoot through an insured and bonded deliverable
- A standard for content delivery
- A standard for final archive



Up to 1.5 TBs of file masters, outtakes, source clips and other associated assets can be stored together on a single LTO-5 cartridge at a cost of around 5¢ per gigabyte. These lightweight, high-density cartridges cost very little to post and can be couriered around the world.

With high densities of data in such a small footprint, LTO-5 tape also effectively removes physical storage as a major constraint on media library sizes—literally thousands of tapes can be kept on a single standard shelf unit. Furthermore, LTO tapes each have a unique ID stamped physically and electronically by the manufacturer that the Cache-A archive appliance tracks. This means that at a later date any archived tape can be speedily identified and located on the shelf. This tracking process can also be enhanced by the use of bar codes.

The combination of LTO-5 Ultrium tape’s 30-year shelf life and Cache-A’s ability to catalog and utilize HP LTF5 provides a future-proof solution for long-term, archival of precious video footage with enhanced security.

The diagram above shows how archival workflows in any phase of the content creation process, from acquisition to distribution, can produce archival records on LTF5 tapes. Any of these records can then be maintained in libraries for near-line access, shelf-stored or vaulted for offline protection with LTF5’s ability to be transported freely and read on any LTO-5 or later drive. They can be also maintained for content exchange, or for both shelf-stored or vaulted for offline protection and content exchange.

In summary: The benefits of digital archiving using Cache-A

Reduce business risk

- Retain, and protect valuable video and broadcast assets with enhanced security
- Provide confidence that your assets will be available when you need them
- Protect assets from being altered or accidentally deleted

More efficient operation

- Archive new and old digital content easily in a digital format for posterity
- Retain large volumes of digital footage in a very small space
- Index, search, and quickly locate and retrieve assets with accuracy and efficiency
- Remove inactive data from primary storage to improve application performance

Cut costs

- Free up disk or acquisition media for reuse and delay the need to purchase more
- Move inactive data offline, saving on power and cooling
- Move inactive data to media that has a much lower cost per gigabyte

Turn your digital content protection challenges into creative innovations.

For more information, visit: HP LTO-5 tape drives www.hp.com/go/tape

HP LTFS technology www.hp.com/go/ltfs

Cache-A Archive Appliances www.cache-a.com

LTO-5 and LTFS open standards www.ultrium.com



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