



TAPE IT

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HP Linear Tape File System (LTFS)

The new tape-based filing system for HP LTO-5 that signals a new era for tape

“Eastern philosophers say that great deeds have a way of shaking the pillars of heaven. If LTO-5 and LTFS take off as they should, the pillars of heaven will certainly shake.”

Mark Ferelli, CTR, August 2010

LTO Ultrium tape technology was introduced a decade ago and each successive generation of the world’s most popular tape technology has continued to innovate in terms of reliability, performance, security and ease of use in order to meet evolving customer requirements. The latest generation, LTO-5, is no exception. Used in conjunction with the HP LTO-5 drive, HP’s

Linear Tape File System (LTFS) interface reduces complexity in data management and improves file access time by enabling tape files and directories to appear on a desktop in a directory listing; users can then employ file functions for tape in the same way as they would with hard disk and removable flash media.

HP LTFS is currently available with standalone HP LTO-5 Ultrium Tape Drives and Linux OS. However, there are plans to extend support to tape automation products and a wider range of platforms including MAC OS and Windows in the near future.

HP LTFS - Customer Benefits

HP LTFS provides everything customers need to use LTO-5 tape media as a disk. LTFS is based on Open Source software and precompiled operating system features are provided for supported platforms to deliver the following benefits:

- **Faster access to data:** When a tape is mounted, the stored tape files and directories appear on the desktop in the same way as a disk directory listing.
- **Simple drag and drop:** LTFS increases ease of use, simply drag and drop files to and from the tape.
- **Compatibility across customer environments:** Tape media written using the LTFS is self-describing so that data recovery from tape is independent of any hardware or software platforms.
- **Increased data mobility:** Easily share content to increase data mobility.
- **A single storage media standard:** Unify organization-wide file sharing with HP LTO-5. Tapes can be moved easily, while files on tape can be accessed using straight-forward drag-and-drop.



HP LTFS – Usage Applications

There are three key usage models for HP LTFS with HP LTO-5 Ultrium drives:

1. **Economical storage of large files that cannot be readily deduplicated** – for example image files such as Medical X-Rays don't easily dedupe. Consequently there is little point in paying premium deduplication costs when tape is less expensive and yet equally as fast at restoring large streaming file sets.

to enable users to find, manipulate and restore files within minutes.
Furthermore, as LTFS is self-describing, the tape format may be independent of any archive software and therefore able to stand the test of time when it comes to restore after several years.
2. **Faster access to files in archive** – for example media industry video archive footage. For single copies of large files (films, footage) that otherwise would take too much space spinning on disks, for infrequently accessed data, or data to be kept for compliance purposes, tape remains the most cost-efficient and dependable solution. In addition to delivering 3TBs of data in a small footprint, a media shelf-life specified to 30 years and a low cost per Gbyte, HP LTO-5 Ultrium Tape Drives now offer HP LTFS
3. **Greater data mobility by simplifying the sharing of larger files** – for example for surveillance video or archival required to support e-discovery, LTFS provides the ability to share data across platforms, as 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.

For more details on the benefits of using LTO-5 Ultrium for vertical applications, refer to the article later in this newsletter.



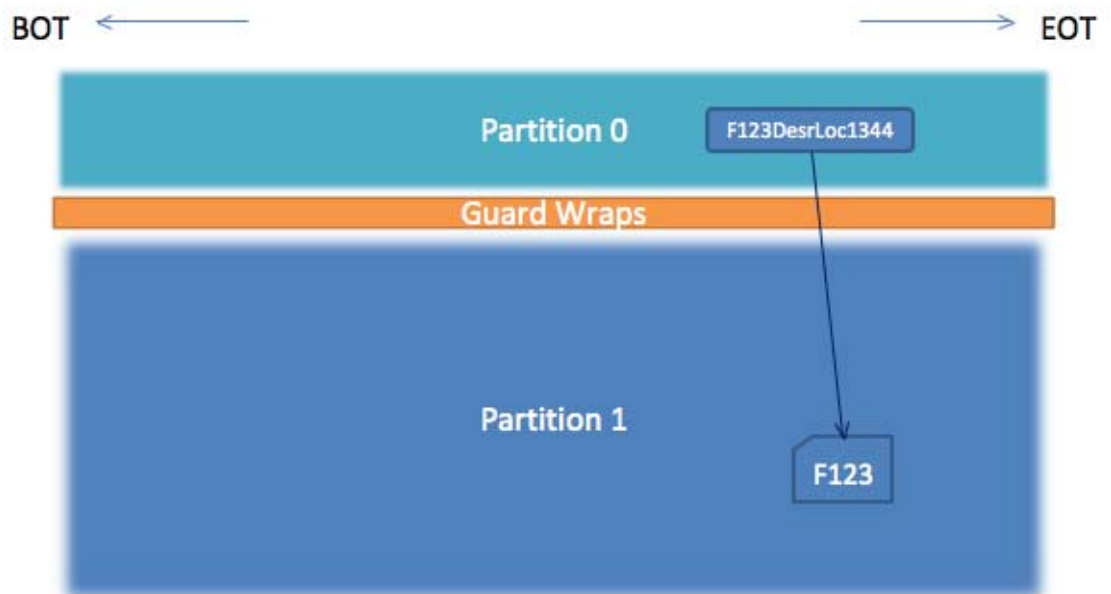
HP LTFS – How it Works

Tape Partitions

The LTO-5 tape format specifies two data partitions on the tape cartridge so that it can support a tape file system. These two media partitions can be independently accessed, allowing two different parts of the tape to be addressed as if they were two separate tapes, although not necessarily of equal size:

Partition zero: the smaller partition holds an index to the content, or the file system metadata which describes where a file is physically located on tape, and in the virtual file system of directories and sub-directories and associated permission levels.

Partition one: the larger partition holds the actual data files and the bulk of the capacity.



When mounting a tape onto a tape drive, HP LTFS loads the information in the metadata partition so that the system is able to find and locate the files stored on the tape. Once this is done, the tape appears in the operating system as any other file system, for example as a drive letter in Windows displayed on the desktop. The user can then do anything with the tape file system that they can do with any other disk or removable flash file system, including:

- Open files
- Delete files
- Modify files
- Drag-and-drop files

Self-describing Tape

As a result of the index partition, HP LTO-5 tapes become self-describing. That is, files are written directly to tape and read independently of operating systems or ISV applications. LTFS not only delivers a very simple way for users to interact with LTO 5 based drives, it also provides

a platform for easier interchange of media without requiring any specialised ISV applications. Tapes can be easily interchanged between systems reducing the complexity of data management and improving business response times.

What industry commentators are saying about LTFS

“ LTO-5 may look like a mild-mannered milestone on the LTO technology roadmap, but it does add a new wrinkle: the ability to partition media. ”

Mark Ferelli, CTR, August 2010

“ The metadata holds all the information necessary to get back to previous iterations of the tape (directory structure, everything). It's like snapshots, but for tape! Awesome! The more I thought about this idea the more I liked it! ”

W Curtis Preston, BackupCentral blog, August 2010

“ LTFS... casts an entirely new light on the future of tape and it will be interesting to watch how this LTFS technology plays out in the years to come. ”

Jerome Wendt, DCIG Inc. August 2010

“ We think that LTFS, if it can gain traction, could be one of the most significant developments in the tape drive space since the introduction of LTO itself. ”

George Crump, Storage Switzerland, August 2010



For further information on HP LTFS go to www.hp.com/go/ltfs

The Value of Tape in Vertical Markets

Why tape is increasingly important for data protection in Communications, Media, and Entertainment (CME), Healthcare, and Video Surveillance markets

Recent studies have shown that, despite hype to the contrary, storage managers continue to recognise the value of tape. The August edition of this newsletter reported that a Fleishman-Hillard Research survey¹ showed that over 60% of respondents indicated the use of a hybrid disk/tape storage blend, while an ESG Research² study showed that 82% of organizations still use tape to support all or a portion of onsite backup processes.

While tape is still widely used for data protection across all markets, it remains a particularly key technology for a number of vertical markets. In this article we take a look at the drivers for tape in the Communications, Media & Entertainment (CME) industry, for Healthcare data protection, and in Video Surveillance applications.

Communications, Media, and Entertainment

Over the last decade trends such as 2K and 4K motion-picture stream film restoration, SD (standard definition) to HD (high definition) Television and Web 2.0 enabling more user-generated content, have had

an enormous impact on media and entertainment companies. As a result, the amount of content and services being managed and manipulated is vast and expanding rapidly.

Who are they?

Companies within the Communications, Media, and Entertainment market include:

- Broadcasters such as BBC, ABC, CNN, Fox, Europe1 etc.
- Media content creators including Disney, Pixar, DreamWorks, Warner Bros, Time Warner etc.
- Social networking and photo sharing providers, of which there are many including Facebook, LinkedIn, Flickr, Snapfish, Kodak, iStockphoto, Getty images etc.
- Gaming providers such as WB Games, Electronic Arts, Lucas Arts etc.
- Media and entertainment services including the British Film Institute, TicketsNow, Google, Yahoo and many more around the world.

Data Protection Challenges

- **Managing huge storage volumes** – from classic film archive, to new digital films with complex special effects, to video gaming, social networking and user generated content including images and video – there is literally a data explosion in the communications, media and entertainment industry.

Example: Snapfish, a leading online photo service, currently hosts about five billion images and has 6PB of storage. They expect to have 30PB in the next 18 months.

¹ Source: Fleishman-Hillard Research Q4 2009, more information available on www.ultrium.com

² Source: ESG Research Report, 2010 Data Center Spending Intentions, January 2010



- **Transformation from analog to digital media storage** – including moving millions of hours of old reels of footage onto digital storage for long term archival.
- **Long-term archiving requirements** – for example, CNN alone captures, transports, ingests, processes and archives over 10,000 hours of video (many petabytes) annually.
- **Simplifying access** – the ability to repurpose content into numerous formats is driving companies to invest in converged, end-to-end, modular, scalable, open standards infrastructures.
- Meeting privacy and regulatory compliance mandates.



The cost and performance benefits of LTO-5 tape versus digital video tapes

Media: Traditionally, video data is recorded and stored on digital video tapes, for example the D5L format. Each D5L tape holds up to 94 minutes of HD video. A 3+ hour sporting event, such as an NFL game, uses two and often three tapes. The last tape is not full, and the empty portion remains unused. Each tape costs about \$200. Media costs for an average game are therefore \$400 to \$600.

In an IT-based system, the data can be buffered

on disk drives and then transferred to an automated LTO tape library. Disk buffering increases system reliability and saves cost by enabling the tape library to have far fewer tape drives than the number of concurrent recordings supported. LTO- 5 tapes write at between 140 and 280 MB/s (compressed 2:1) many times faster than real-time HD (32 -64Mbps). Multiple games can fit on an LTO-5 tape, and tape utilization can be over 99%. Each LTO-5 tape can store about 14 games and costs about \$100.³

³ Costs based on online tape media prices in August 2010 (<http://www.tapeonline.com>)

The Benefits of Tape for Communications, Media, and Entertainment applications

- Increases affordability by offering Tier 2 archive for full-size images and delivering streams at a fraction of the cost of other video tape media or disk-based storage.
- Store massive amounts of data (from archived classics to infrequently used new digital media) in a small footprint – 3TBs on a single LTO-5 cartridge.
- Fast transfers of up to 280MB/second (compressed) with HP LTO-5.
- Scale up to millions of TBs by simply and cost-effectively adding cartridges to tape libraries.
- Dependable long-term retention, with a media life specified to 30 years for LTO tape.
- Format/compression independent – store High Definition (HD), Standard Definition (SD), Graphics and Digital Film.
- Reduce the cost of long-term storage by eliminating the need for constant power and cooling.
- HP LTFS provides easy file management so that individual files may be quickly found and retrieved.
- WORM media can protect media files from being accidentally overwritten once they have been stored.
- Hardware based data encryption can provide an easy and affordable way of adding security for data at rest in order to meet privacy and compliance regulations.
- LTO tape with LTFS provides an ideal storage and data transfer medium for video workflow processes between production and post production houses.

The concept of data protection for communications, media and entertainment companies goes way beyond customer transactions and email. The digital assets that these companies generate include movies, recordings, games and photos – the very product of the company themselves. Performing traditional or two-stage backup to tape can cut the cost of long term storage and will also ensure that files are off-line and off-site, protected from outage, disaster or sabotage.

Tape Application for the digital film, broadcast and professional video industries from Cache-A Corporation

Cache-A (www.cache-a.com) supplies network-attached archive appliances for the digital film, broadcast and professional video industries. Cache-A's archive appliances provide both source masters for digital acquisition and project archives, using low cost and easy to deploy configurations based on industry standard LTO 4 and LTO 5 tape. Cache-A archive appliances provide networked storage direct to LTO tape, providing an economical, archive quality media for file-based content archiving, interchange and access. Every tape

cartridge contains a directory of its content making each one a self-contained asset repository that can be shipped around the world and stored for long periods of time. The content can be retrieved regardless of the application or software environment that recorded it. This is important for both portability and longevity since the software and OS environment that recorded a cartridge may not be available across locations or may not persist in time for 10, 20, or even 30 years.



Healthcare

The storage hardware market for healthcare is expected to grow to \$1.3 billion per year in the U.S, and in fact, Healthcare tops all other verticals with a CAGR of 14.3% (avg 5.7%) according to an IDC 2008 report.

The average hospital in the US has roughly 150 different applications, all generating fixed and dynamic data, each with their own requirements for storage retention, data protection, access, sharing, and mining. In addition, the average hospital requires ~60TB of storage for their

image archives of the 60,000–500,000 studies they perform annually and this amount keeps growing. With hospitals transitioning to electronic record management combined with imaging studies growth at >30% per year, hospital data volumes are doubling every two years.

At the same time, around the world, healthcare providers are facing a general decline in government-funding and have limited IT resources.



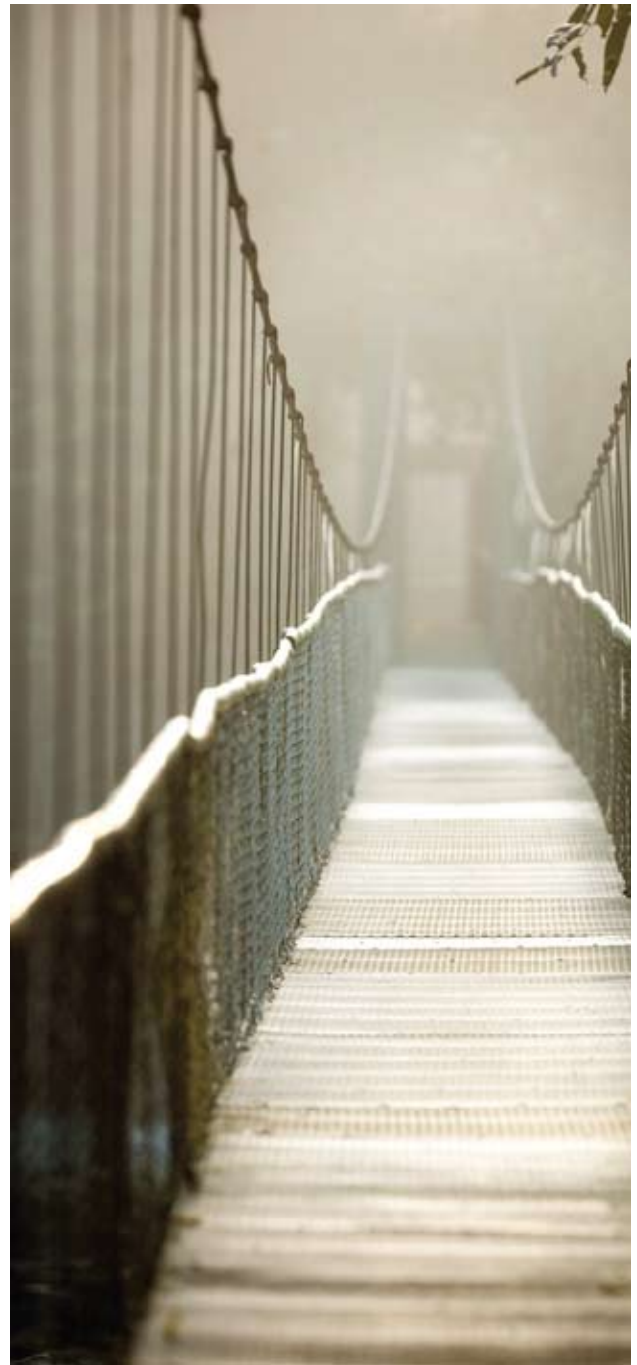
Who are they?

The healthcare vertical market includes hospitals (community and independent), research centers, university or academic hospital and integrated

delivery networks/health care trusts and even some larger local medical centers.

Data Protection Challenges

- **Rising data volumes due to the trend toward electronic patient records** - The healthcare sector is collecting ever more patient data and holding it electronically. This includes X-rays, CT, MRI, MAMMO, Cardiology and other types of electronic patient imagery that is difficult to deduplicate on disk and therefore takes up a large amount of storage space.
- **Cost constraints** - a lack of resources to manage data protection and a legacy of IT infrastructure sprawl.
- **Security and disaster recovery** – healthcare is necessarily one of the most regulated industries, with strict audit and data accountability regulations including The Health Insurance Portability and Accountability Act (HIPAA). Ensuring the confidentiality of patient data is a primary concern of many healthcare IT Managers. Errors in patient record keeping can lead to potential traumatic patient safety, legal and compliance challenges for healthcare institutions.



Example: Two million records were stolen at University of Miami Medical School in 2009. However, the Medical School was able to mitigate liability due to solid disaster recovery strategies.

The Benefits of Tape for Healthcare applications

- Simplify the backup process - consolidate and automate using tape libraries to reduce human intervention and resources needed to manage backup.
- Cost-effectively scale to meet growing data volumes, 3TBs on a single LTO-5 tape means multiple patient records can be stored, including thousands of images, at less than four cents per Gbyte⁴ and without taking up excessive physical storage space.
- Tape provides disaster recovery and the last line of defence – off-line and off-site, away from the risk to the primary data site. Unlike disk, which by its nature is on-line, tape is secure from accidental replication and overwrite, or more deliberate hacking and sabotage.
- Security for patient records - HP LTO-4 and LTO-5 hardware based data encryption can provide an easy and affordable way of adding security for data at rest in order to meet privacy and compliance regulations, including HIPAA.
- WORM media can protect media files from being accidentally overwritten once they have been stored.
- HP LTFS provides easy file management so that individual files may be quickly found and retrieved.
- DDS/DAT tape technology provides a cost effective and easy to use data protection solution for small to medium medical office practices.

Storing and protecting healthcare related data can be costly and resource intensive. Implementing a tiered approach that uses tape for archive data, can free up valuable storage space on more expensive, online systems while moving inactive or archive-ready data to less costly secure tape storage with built-in data encryption.



⁴Based on LTO-5 online cartridge prices (\$103 for 3TBs) in August 2010 - <http://www.tapeonline.com/search?q=LTO+5>

Video Surveillance

A video surveillance-based infrastructure is a wired and/or wireless network connecting cameras to servers and storage. Many factors are contributing to the fast growing storage requirements in the video surveillance market;

technology advancements in IP cameras and video software; higher file quality size; fast and easy access requirements; and archives and other applications needed for litigation and regulation purposes.



Who are they?

There are a wide range of organisations requiring storage for video surveillance in both the public sector (Central and Local Government, Health, Education, Police and other Public Security Organisations), and in the private sector including Banks and financial institutions, Retail centers, Car parks, Airports and other Transportation, Corporate businesses, and Leisure facilities (Gaming and Hospitality).

These organizations may have a large network of cameras distributed across several locations. In a high-resolution scenario, cameras capture as many as 30 frames per second, often operating 24x7. Once the primary data is captured, it may be centralized for storage and post-acquisition processing. Video is then archived for long-term retention.

Data Protection Challenges

- **Finding cost-effective ways of storing ever increasing data volumes** - due to higher resolution images from IP cameras, and the transition from analog to digital.
- **The addition of video analytics/video content analysis** - makes video files even larger.
- **Increased industry regulation** – surveillance and monitoring raise issues regarding privacy

and use of as evidence in legal matters. Federal Rules of Civil Procedure (FRCP) and other country, federal, state, municipal and business regulations dictate longer retention periods for digital video evidence. Video archive requirements will vary by industry, with long term archive often required to mitigate litigation risk.

The Benefits of Tape for Video Surveillance

- Tape provides a cost-effective way to archive video surveillance footage, at less than 4 cents per Gbyte and without requiring ongoing power or cooling it is the lowest cost form of storage for infrequently accessed data.
- Tape is “cheap and deep” – it can easily scale to meet growing data volumes without disrupting existing infrastructure. LTO-5 scales from 3TBs on a single tape to hundreds of TBs using a Tape Library. Simply add more cartridges for more capacity.
- Tape provides disaster recovery and the last line of defence – off-line and off-site, away from the risk to the primary data site. Unlike disk, which by its nature is on-line, tape is secure from accidental replication and overwrite, or more deliberate hacking and sabotage.
- Added security to comply with regulations - HP LTO-4 and LTO-5 hardware based data encryption can provide an easy and affordable way of adding security for data at rest.
- WORM media can protect media files from being accidentally overwritten once they have been stored.
- Fast access to the archived data – with HP LTFS on LTO-5 standalone drives video footage can be quickly found and retrieved.

Explosive data growth in the Video Surveillance market continues to be a growing area of opportunity for cost-effective, high capacity storage. Many factors are contributing to fast-growing storage requirements; technology advances in IP cameras and video software, higher file quality and size, requirements for fast, easy access; and archives and other applications needed for litigation and regulation purposes. Tape, and particularly LTO-5 with data encryption and LTFS, can deliver on all of these requirements.



In Summary

There are many vertical market applications where tape's low cost and power saving advantages are vital to meeting long-term data retention requirements and ever-more constrained IT budgets. LTO Ultrium technology innovations including hardware-based data encryption, and more recently LTFS available with HP LTO-5 drives, have added to the demand for tape in

these applications bringing additional security and manageability.

Tape in general, and HP LTO-5 Ultrium in particular, delivers an ideal solution for markets and applications where cost-effective, long-term and secure data retention is becoming more critical. HP LTFS adds to this solution by bringing prompt access to data in archival for even greater ease of use.

