



Quantum

New LTO Linear Tape File System Helps Make Video Storage Easier

Introducing

LTO-5 Technology and
Linear Tape File System™



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Quantum

What is the LTO Program?

- **HP, IBM, Quantum:** Write LTO technology specifications
- **Specifications are open standard**
 - License to any organization
 - Over 30 Licensees
 - 5 Media Manufacturers (Fujifilm, Imation, Maxell, Sony, TDK)
- **About 4M Drives Shipped, 200M Cartridges Shipped**
- **LTFS for LTO-5 tape drive is a free download offered by HP, IBM, Quantum**

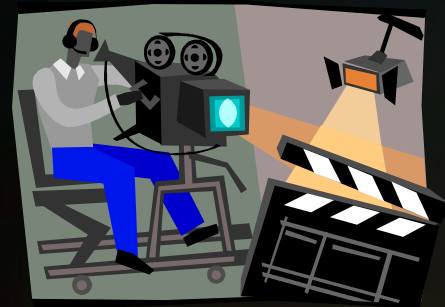


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Agenda

- Video Content Storage Issues
- What do I need to make video storage, sharing and archiving easier?
 - What is needed?
 - What can LTFS do? How does it work?
 - Can it save costs?
- LTFS use cases, user experience, developments and reviews



Video Content Storage Issues

- Files are huge (HD, 3D) and growing
- Budgets are tight
- Some current tape is comparatively slow, costly
- Must protect and preserve video assets



What do I need to make video storage, sharing and archiving easier?



Self describing format



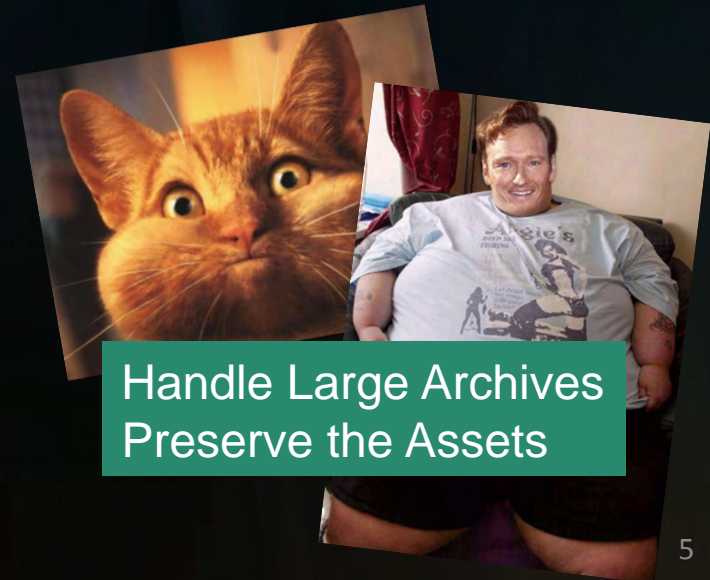
Application Independent



Lower Cost



Share across platforms



Handle Large Archives
Preserve the Assets

Self Describing Tape Format



Self describing format

- Linear Tape File System

- A open data format that doesn't rely on external software to read / interpret what is stored on tape
- Provides file system access to data on a cartridge at the operating system level
- Can allow viewing /access of tape files in a fashion like disk or other removable media

- Potential user benefits:

- Ideal support for workflow applications by providing 'direct-like access' to files at rates up to 140 MB/sec
- Ideal for archive of essence assets; tape tells you what's on it
- Ease of use with directory tree access; drag and drop

Linear Tape File System (LTFS)

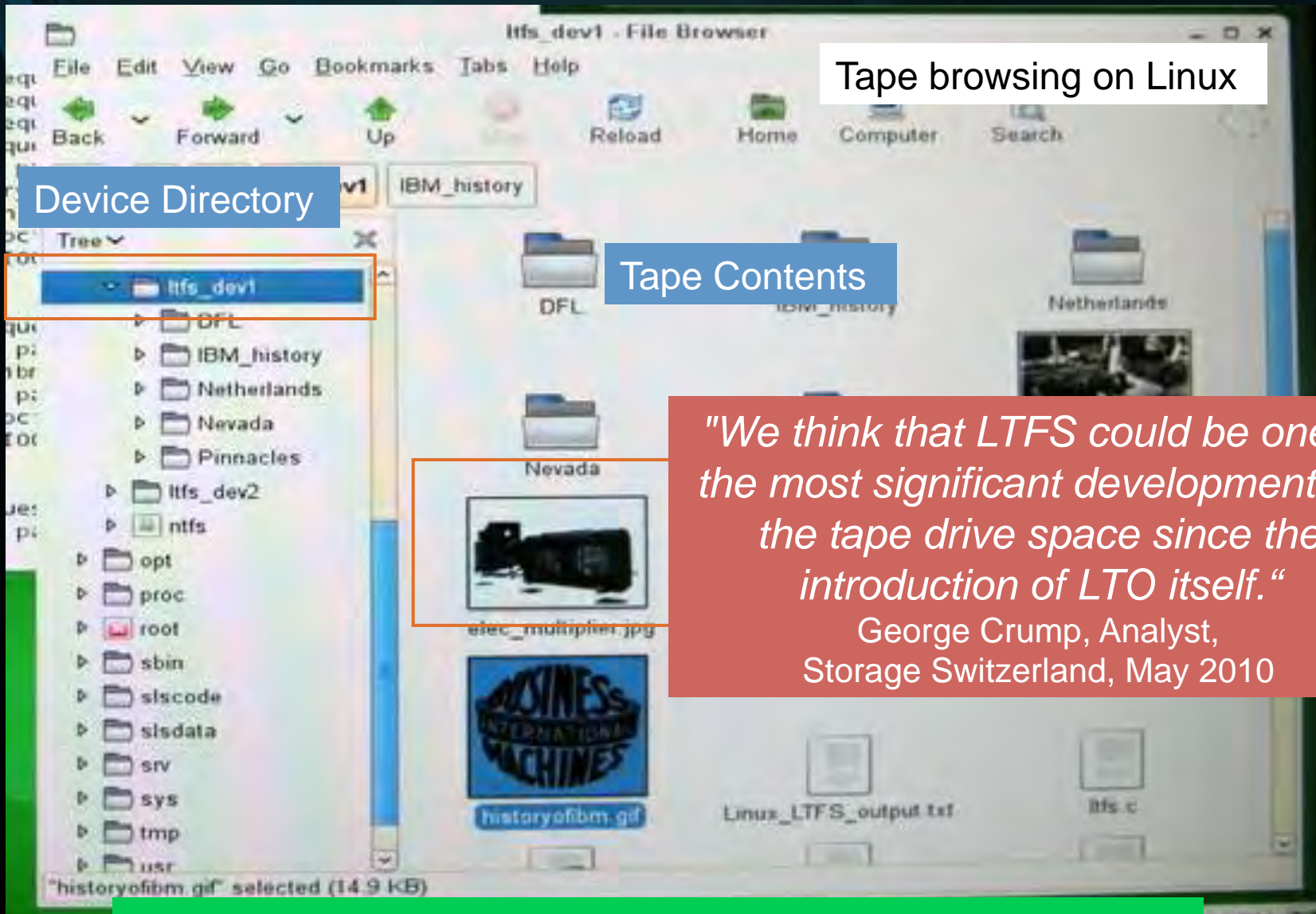
What is it - How does it work?

- Tape drive shareware that is downloaded on to Linux, MAC, Windows
- Utilizes the new LTO-5 dual-partitioning capability; Extension to OS
- Index partition & content partition: Mount a tape as if it was a hard drive
- Partition 0 (37GB): Stores index and metadata describing the contents
- Partition 1: Stores the contents and backups of the index
- During operations index is updated on PC ; backed up to tape



LTFS in Action with File Browser

Files can be accessed on tape directly from any application



Tape browsing on Linux

Device Directory

Tape Contents

"We think that LTFS could be one of the most significant developments in the tape drive space since the introduction of LTO itself."
George Crump, Analyst,
Storage Switzerland, May 2010

See LTFS in Action -1 Min. Movie Clip at: www.ultrium.com/ltfs

Client Reactions at NAB Show

After Viewing LTO-5 Drive and Linear Tape File System in Action

"I am shocked! This is exactly what we need!"

"You have made my dreams come true!"

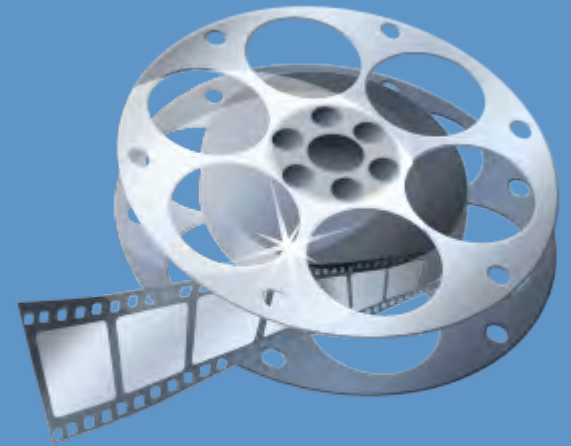
"You can't see it, but I am dancing inside!"

"LTO-5 technology gives tape-less work-flow....with tape!"

"We are going to get this (LTO-5 tape and LTFS)."

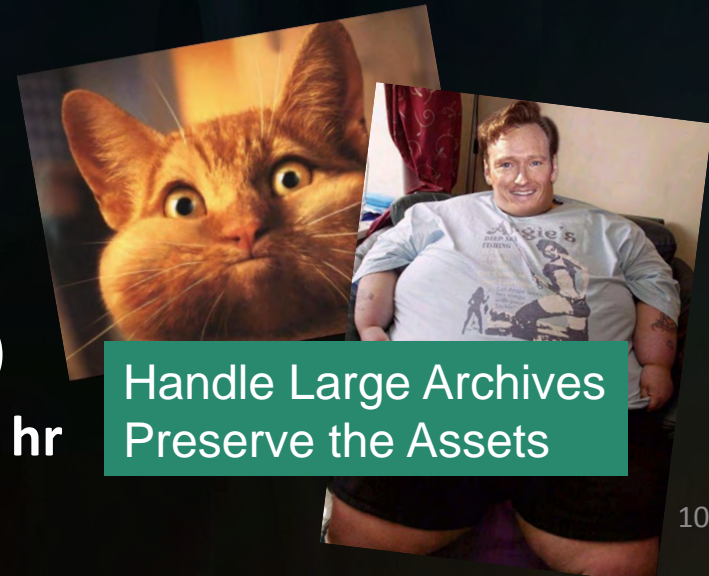
"Now I can offer an LTO-5 archiving service to my movie clients."

"We have LTO-3 and are now going to go to 5 with the file system"



Handle and Preserve Large Archives

- LTO-5 Tape is Huge and Reliable
 - 1,500 GB (1.5 TB) per cartridge native
 - That's about 30 DVD movies per cartridge
 - 50Mb/s bit rate => 70 hours (XDCAM50 HD quality) on LTO-5 tape
 - Automation offerings from 20-1,000s of cartridge slots
 - Highly Reliable: Servo Tracking, Read after Write Verification, 250K MTBF Hours, up to 30 year shelf life
- LTO-5 Drives are Fast
 - Up to 140 MB / sec. native
 - Up to 280 MB / sec. (2:1 compressed)
 - That's > 1TB of saved data per drive / hr (2:1 compressed)



No Application Dependencies

- No Application Dependencies

- No additional backup applications needed to store files on LTF5 formatted tape
- Until now a proprietary application was needed to store to tape
- LTF5 stores data independent of specific software applications
- You can think of it as a giant 1.5TB (uncompressed) memory stick



Application Independent

- Can provide the ability to recover from corruption or loss of centralized index database
- Years from now you can simply put the tape in the drive and view/access its contents – tape is self describing
- Tarring of files is not needed

Make Sharing Tapes Easier



- Share Across Platforms

- Supports versions of Linux, MAC OS, MS Windows
- Can share tape across platforms
- Supports metadata and MXF
- Can unify across organizations to a single storage media for video content

Reduce Storage Costs

LTO-5 Tape vs SR Tape¹

	LTO-5	SR
Min. ✓	3126	155
Cost/ ✓ Tape	\$75	\$164
Cost/ ✓ Min.	2.4 cents	\$1.06

Difference in cost/min of SR vs. LTO-5 tape is 44:1



TCO: SATA Disk System vs. LTO-5 Tape Library System²

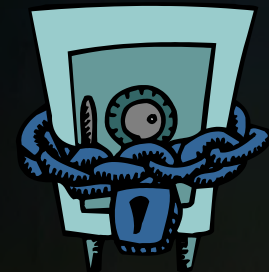
- 12 Year TCO Archiving Study
- Back-end storage costs covering hardware, maintenance, floor space and energy
- Disk storage is **15x** Tape TCO
- **The cost of energy alone for the average disk-based solution exceeds the entire TCO for the average tape-based solution**

¹Tape prices per internet, March. 2011.

²Clipper Notes report "In Search of the Long-Term Archiving Solution - Tape Delivers Significant TCO Advantage over Disk", The Clipper Group, Dec.23, 2010. This was a general TCO study and did not specifically focus on LTFS or video storage.

Some LTO-5 Drive and LTFS Use Cases

- Share the content with others
- Archive in Production-Acquisition Workflow
 - Get it on tape asap
 - Camera agnostic: store any content, any format
 - Must protect , preserve, minimize risk to video assets
 - Free up solid state field recording devices (P2, SD, CF...)
 - Address insurance bonding requirements
- Archive Post Production
 - Make copies of all edited versions
 - Preserve final cuts



FotoKem uses LTFS for Reality TV Archive

- **FotoKem background**
 - 700+ employees; HQ in Burbank, California USA
 - Film lab & post production facility
- **Business Need**
 - Must have reliable long term archive from XDCam disks
 - TAR Tapes not self describing
 - Need ease of use, reliable technology, low cost
- **Solution**
 - LTO-5 tape library and LTFS; Open standard; Cross O/S platform compatibility
 - Self describing LTO tapes: Can easily determine tape contents with browser
 - Offers long term reliable archive, easy to use, cost effective
 - Can store 100 XDCAM disks on 1 LTO-5 tape; Saves considerable space
 - Allows reuse of XDCAM disks
 - Can make 2 LTO tape copies inexpensively (keep one copy offsite)



Some LTFS Developments



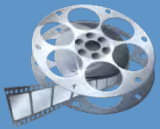
- **1Beyond**: high performance video production and post production, tapeless workflow and storage systems
- **Arkivum**: assured archiving, 100% guaranteed safe data storage service
- **Cache-A**: archive appliances serving the digital video industry
- **Crossroads**: online, file-based archive, combining disk storage with LTFS tape storage for a fast, cost effective, long-term data archive
- **FOR-A**: innovative products and advanced video and audio technology
- **Panasonic**: this product can easily archive P2 content and preview P2 content from LTO tape directly like video tape
- **SGL**: content archive and storage management solutions to the media and entertainment
- **Storage DNA**: Intelligent LTO-5/LTFS archiving for file-based workflows, application archiving (Avid, Final Cut etc.) and continuous backup
- **Thought Equity**: large scale archive management and “smart content” metadata tools
- **TOLIS Group Inc.** Bru Backup Software-Producers Edition version 2.3.0 provides native LTFS support for OS X users

LTFS Gets Rave Reviews

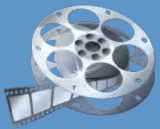
- [LTFS with its own File System: An Enabling Technology for Archive, Backup, Simple DR - even the Cloud](#)
By Eric Slack, Senior Analyst, Monday, October 18, 2010, [Storage Switzerland](#)
- [LTO-5 and LTFS: Shaking the Pillars of Heaven](#)
By Mark Ferelli, Aug 17, 2010, [Computer Technology Review](#)
- [LTFS: Crazy like a fox "The more I thought about this idea the more I liked it... \(LTFS is\) also excellent for long term storage \(i.e. archiving\)."](#)
By W. Curtis Preston, Aug 12, 2010, [BackupCentral.com](#)
- ["The file system allows users to drag and drop files to and from tape the way they do with disk."](#)
By Andrew Burton, Site Editor, Aug 2, 2010, [SearchDataBackup.com](#)
- [What is LTFS?](#) ...could be one of the most significant developments in the tape drive space since the introduction of LTO itself.
By George Crump, Storage Switzerland
- [LTO-5 with LTFS Gives Tape a New Lease on Life](#)
By Jerome M. Wendt on June 4, 2010



Why the excitement for LTO-5 tape and LTFS?



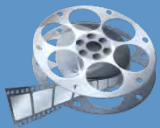
Archive and Protect: ideal for the archive of rich media assets; tape tells you what's on it with self describing format



Ease of Use: it is camera format and file agnostic; and, users can see what is on the tape with a directory tree structure – use like a removable disk drive....drag and drop!



Reliable Huge Capacity: can store long term with 1.5TB native for up to 30 year shelf life



Low Cost Savings: at about 5 cents/GB* uncompressed LTO-5 tape can cost up to 44X less than other tape storage media



Sharable: can share a tape across platforms without the need for proprietary applications



New use cases: ability to help address long term archive for video assets, digital video surveillance, medical and legal records, cloud apps and more

LTO Ultrium Technology and Linear Tape File System Helps Make Video Storage Easier

THANK
YOU

LTO-5 Technology and
Linear Tape File System



www.ultrium.com/ltfs