



LTO Technology



and LTFS





Quantum®

What is the LTO Program?

- **Technology Provider Companies**
HP, IBM, Quantum:
 - Write LTO technology specifications and published roadmap
- **Specifications are an open standard**
 - License to any organization
 - Over 30 Licensees
 - 5 Media Manufacturers (Fujifilm, Imation, Maxell, Sony, TDK)
- **LTFS for LTO-5 and LTO-6 stand alone tape drive is a free download offered by HP, IBM, Quantum**
- **LTO program website: www.lto.org**



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Top 10 Reasons Why Tape is Hot!

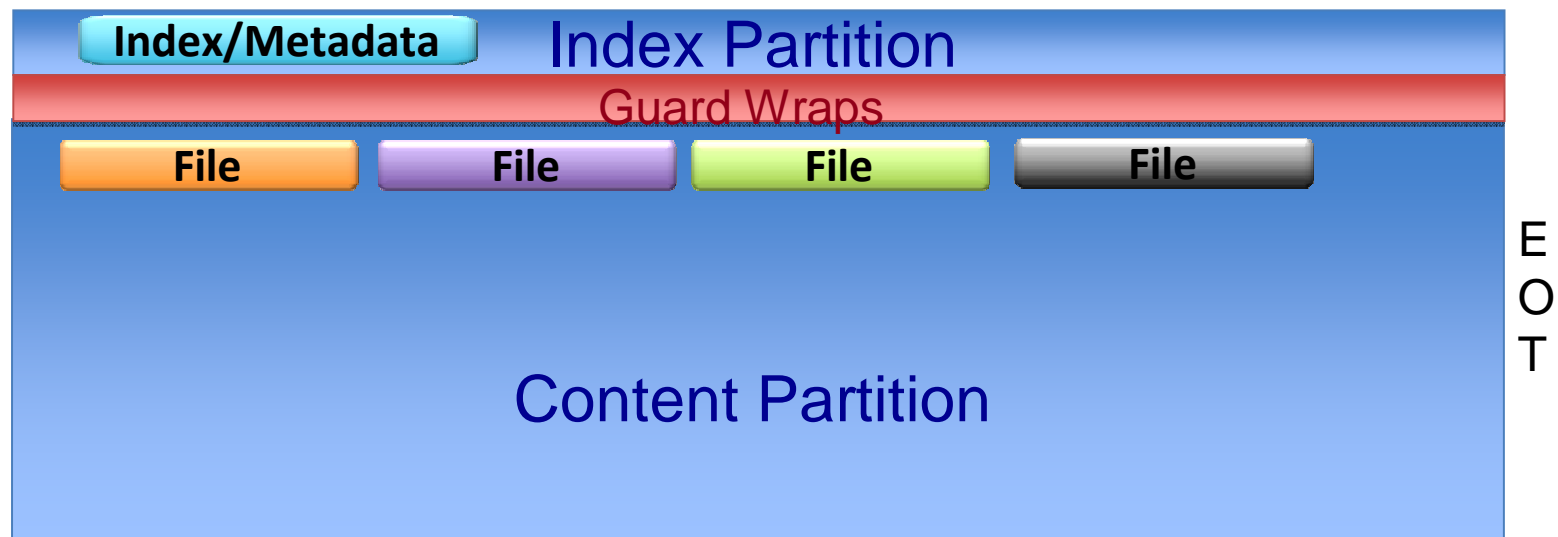
1. **Costs less:** only 2c per cartridge GB compressed and up to 15X less than disk systems
2. **Easy to manage:** an admin can manage multiple PBs of tape and only ~100TB of disk
3. **High reliability:**
 - ✓ Read after write verification for high data integrity
 - ✓ Servo tracking to help ensure precision tracking
 - ✓ Better bit error rate than disk! 1×10^{17} bits vs. 1×10^{15} bits
4. **Outstanding Data Protection:** tape is off-line protecting against threats that can corrupt on-line data
5. **Easy to use:**
 - ✓ Tape automation has simplified the process of using tape
 - ✓ LTFS makes tape easier to use than ever before
 - ✓ NAS - like: with LTFS applications tape can be used in a manner like network attached storage
6. **Long shelf life:** up to 30 years or more
7. **Scalable:** Easy to increase storage \Rightarrow add cartridges for nearly “infinite capacity” on demand
8. **Green storage:** cartridges on a shelf consume no energy
9. **Transportable-Sharable:** Cartridges are easy to ship \Rightarrow high bandwidth in a box
10. **High Performance:** Streams very fast \Rightarrow high capacity

Note: Cartridge cost is a list price estimate as of March 2013 based on compressed data and subject to change. User results may vary.



LTFS: How does it work?

- LTFS utilizes media partitioning (available on LTO-5 and LTO-6 drives) to create a **self describing** storage medium
- Tape is logically divided “lengthwise” into two partitions
 - **Index partition:** File system info, index, metadata (5% of capacity)
 - **Content partition:** Contains the files / content bodies
- When mounting the tape, the Index is copied to the workstation/server memory for fast access and updates
- Periodically the index is backed up to the content partition

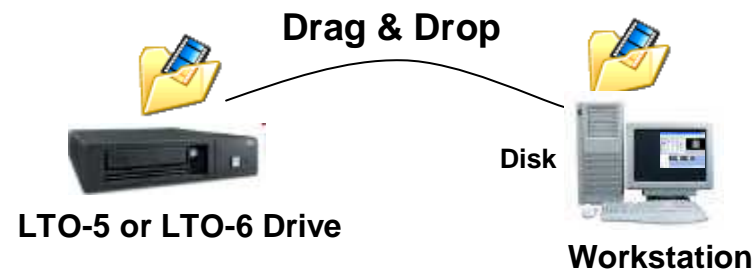


See LTFS Introduction video at: www.lto.org/technology/lvfs



How it works: LTFS – Drag and Drop

- File access on an LTO-5 or LTO-6 tape is similar to hard disk, CD/DVD disc or USB media
- Access with OS browser (e.g. Windows Explorer, Mac Finder) and drag & drop to/from the tape
- Can use workstation applications: File Open, Write, Read, Append, Delete and Close from workstation applications
- Use directory tree structures: the tape can be used in a random access fashion...
- ...The Tape is still a sequential device
 - Requires media to be moved to the correct position
 - On average can take 40 to 60 seconds to reach beginning of file
 - After location of the file, an LTO-6 drive provides a transfer rate of up to 160MB/s uncompressed



LTFS – Benefits

Easily View, Archive and Share Files



Easy to Use - Archive - Share





LTFS in the Workflow for M&E

Production

- Camera media reuse
- Backup
- Transport
- Economic direct access to data
- Archive - saving digital original camera 'negatives' (OCNs), raw digital capture files

Post Production

- Common dependable exchange medium
- Open specification, multi OS and vendor interchangeability
 - Hard to beat 'Fedex' for multi-Terabyte transfers
- Supports high speed tape hardware encryption
- Archive in workflow

Distribution

- LTO/LTFS tape can be a high capacity/high performance option
- Very large files can be moved between users and tools
- Can interchange between multiple functions, facilities and vendors
- Constantly shifting project priorities make the ability to 'park' and restore project files important
- Ongoing need for lower-cost tape for offline storage, portability and interchange



LTO Tape Can Help Reduce Storage Costs

LTO-5 Tape vs. Video Media

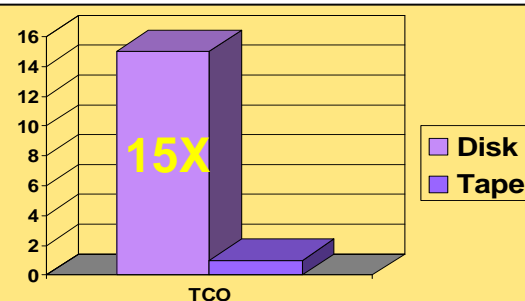
Format	GB	Cost per unit ¹	\$ / GB	LTO Tape Advantage
LTFS/LTO 5 tape	1425 ²	\$52.50	\$0.04	NA
G-Tech G-Drive	3072	\$297.00	\$0.10	3 X
HDCAM SR tape	698	\$217.00	\$0.31	8 X
XDCAM disc	50	\$67.50	\$1.35	37 X
P2 SSD card	64	\$828.00	\$12.94	350 X

Source: MTMP - LTFS Hits the Mark for M&E

1. Cost per unit based on market prices as of February, 2012
2. Capacity of an LTFS formatted LTO 5 tape data partition

TCO: SATA Disk System vs. LTO-5 Tape Library System¹

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



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¹Clipper Notes report "In Search of the Long-Term Archiving Solution - Tape Delivers Significant TCO Advantage over Disk", The Clipper Group. This was a general TCO study and did not specifically focus on LTFS or video storage.



Some of the Many Vendors with LTFS Supported Developments

- **1Beyond:** www.1beyond.com
- **Arkivum:** www.arkivum.com
- **Bright Technologies:** www.4bright.com
- **Cache-A:** www.cache-a.com
- **Codex Digital:** www.codexdigital.com
- **Crossroads:** www.crossroads.com
- **FOR-A:** www.for-a.com
- **HP:** www.hp.com/go/lvfs
- **IBM:** www.bit.ly/ibm-lvfs
- **Masstech:** www.masstech.com
- **Odyssey:** www.odyssey.com.uy
- **Panasonic:** www.panasonic.com
- **Qstar:** www.qstar.com
- **Quantum:** www.quantum.com
- **SGL:** www.sglbroadcast.com
- **Storage DNA:** www.storagedna.com
- **T3Media:** www.t3media.com
- **Tiger Technology:** www.tiger-technology.com
- **TOLIS Group Inc:** www.tolisgroup.com
- **XenData:** www.xendata.com

Note: Contents of this list may vary without notice. No warranties are expressed or implied. Contact the vendor for specific product, performance and warranty information. User results may vary.



FotoKem Uses LTFS for Reality TV Post Production

■ 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 - Benefits

- LTO-5 library, LTFS, Open standard, Cross platform compatibility
- Self describing: 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 tape copies inexpensively (keep one copy offsite)



www.fotokem.com

BAMM.TV Archives Music Videos to LTO Tape and LTFS



■ Company Profile: BAMM.TV

- San Francisco based
- Produces and distributes video for independent musicians
- 12 video / audio editors
- In house production and post-production

■ Business Need:

- Large storage need (HD, Hoard all footage)
- SAN storage is expensive
- Removable HDs are fragile (~8% failure rate), limited shelf-life, expensive and take up excessive space
- On site and off-site copies are needed
- Video/data is BAMM's livelihood and must be protected!

“LTO-5 technology is very reliable. Over the last year we've used over 60 tapes and have had zero failures!”

Jamie Morganstern,
Director of Operations

■ Solution Results: LTO-5 Technology with LTFS

- Effectively backed up 80TB of video and finished projects
- Slashed storage costs from ~ \$0.20/GB to ~\$0.05/GB
- Built an archive and restore workflow with fast recovery
- Scalable archive solution with a 30-50YR life
- LTFS standard format for easy sharing
- Assured data is protected with reliable off-line and off-site protection



AlphaTV Tunes in to LTO Tape and LTFS

The need:

AlphaTV in Greece needed to store huge amounts of television programming content while shrinking their storage footprint of DVCPRO tapes to create efficient backups, reliable archive and reduced storage costs.

The solution:

Deployed LTFS with stand alone LTO-5 tape drives initially and then added two medium sized LTO tape libraries to handle the television news and programming archive and to replace DVCPRO tapes & decks.

The benefits:

- **Replaced DVCPRO - Now store 3 times the number of television series at 1% of the media cost:** Now \$79-92 on LTO tape vs \$11,811 (USD) for one series on DVCPRO
- **Reduced physical space by 74%** 1,507 square feet to 388 sq. ft.
- **Lowered storage maintenance costs by 77%** from \$39K to \$9K (USD)¹²

Sister company, Village Cinemas, now using LTO tape and LTFS



“I had to do the calculations for the solution twice, because I could not believe that the amount of savings could be true.”

**–Constantinos Columbus,
CTO, AlphaTV**



LTO-6 Attributes—Big Data Preservation



- Designed for an Optimal Blend of Attributes:
 - Capacity, performance, compatibility, interchange, cost control
- Store more with LTO-6 Tape – Reduced Space
 - 2.5 TB/cartridge native: 6.25 TB / cartridge (2.5:1 compressed)
 - More than twice the compressed capacity of LTO-5 tape
 - That’s about 50 DVD movies per cartridge
- Improve Job Productivity
 - Up to 160MB/sec native; Up to 400 MB/sec (2.5:1 compressed)
43% increase over LTO-5 data rate
 - That’s nearly 1.5TB of saved data per drive / hr (compressed)
- Compatibility for Investment Protection – Ease Implementation
 - Read/Write LTO-5 cartridges, Read LTO-4 cartridges
 - Interchange between vendor drives

How do I get started using LTFS?

For stand alone drives LTFS software is free!

1- Get an LTO-5 or 6 tape drive and LTO-5 or 6 cartridge.

2- Download and install LTFS software from your drive vendor's web link.

3- Format and mount an LTO-5 or 6 cartridge using LTFS

4- Start using files on tape from your browser directory tree.



Now you can drag and drop files to and from your LTO-5 and 6 tapes!

Addresses the needs of industries with rich media such as:

- Media and Entertainment
- Digital Surveillance
- Medical Imaging
- Legal files / documents
- Architectural drawings
- Oil & Gas Exploration
- Cloud applications and more!

