

LTO Technology and LTFS



IS THE FIX.

www.lto.org



What is the LTO Program?



Quantum.

- › Technology Provider Companies: HP, IBM and 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 tape drive is a free download offered by HP, IBM and Quantum
- › LTO program website: www.lto.org



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Agenda (all the bits and bytes)

- › Storage Issues
- › Why tape is critical: Top 10 reasons
- › Best Practices in Data Protection
- › Overview – LTO-6 Technology
- › What is LTFS? How does it work?
- › User Examples

Storage Issues....Objectives

- › Data content is growing faster than I can manage
- › Not all data is alike – need to treat them differently
- › Costs are out of control
- › Data is vulnerable to corruption threats
- › My backup repository is growing
- › Need to easily transport some data
- › Must protect and preserve data assets now and for the future

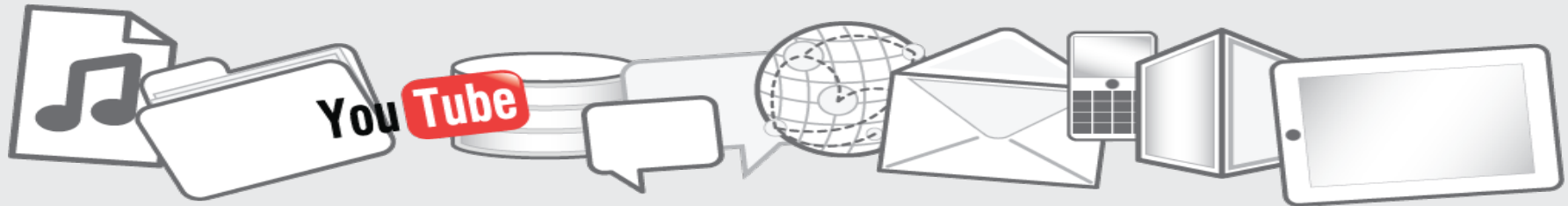


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The Data Growth Challenge

Primary storage growth accelerating at unprecedented rates



40% growth
annually **rate**

IDC: Digital Universe 2012

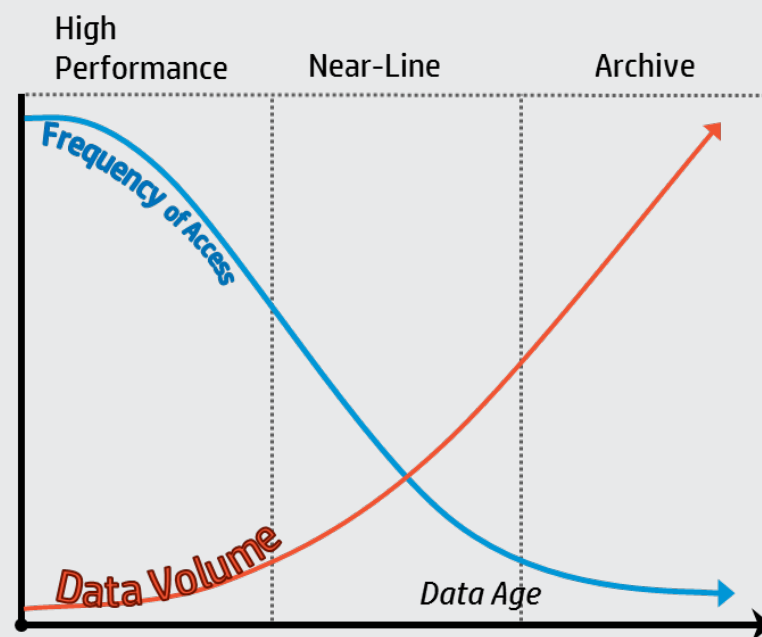
Managing Data Growth

▶ Putting cold data on ice

- Estimates suggest that over 95% of data is never accessed again beyond 90 days after creation*
- Actively archive older data from disk to less expensive tape
- Why fly all you data first class when coach will do?

▶ Delivering the most economical storage

- Saves power and cooling costs
- Minimizes floor-space utilization
- Infinitely scalable
- 30-year shelf-life for LTO Media enables long-term retention



* Source: Government Computer News, "Most network data sits untouched" by Joab Jackson

Numerous threats can corrupt and destroy your data

➤ LTO Technology provides the last line of defense

- Inherently off-line to intentional threats from virus, hackers, sabotage, disgruntled employee
- Easily removable for off-site storage – protects against accidental threats from natural disasters, fire, system errors, human errors, mirroring errors
- Easy to use – load, unload and storage of media

➤ Risks of downtime

- Lost of revenue and market share
- Lost of productivity
- Loss of reputation and customer trust
- Ultimately, loss of the business



LTO Tape Saves the Day at Google

➤ Bug in software upgrade deletes mail files on disk and on replicated disk

- Ben Treynor, VP Engineering and Site Reliability Czar for Google Gmail, used the official Gmail blog to explain the situation and provided a powerful endorsement for off-line removable tape storage:

“I know what some of you are thinking: **how could this happen if we have multiple copies of your data**, in multiple data centers...well, in some rare instances **software bugs can affect several copies of the data**. That’s what happened here. Some copies of mail were deleted...**To protect your information from these unusual bugs, we also back it up to tape**. Since the tapes are offline, they’re protected from such software bugs”.



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10 Reasons for Tape

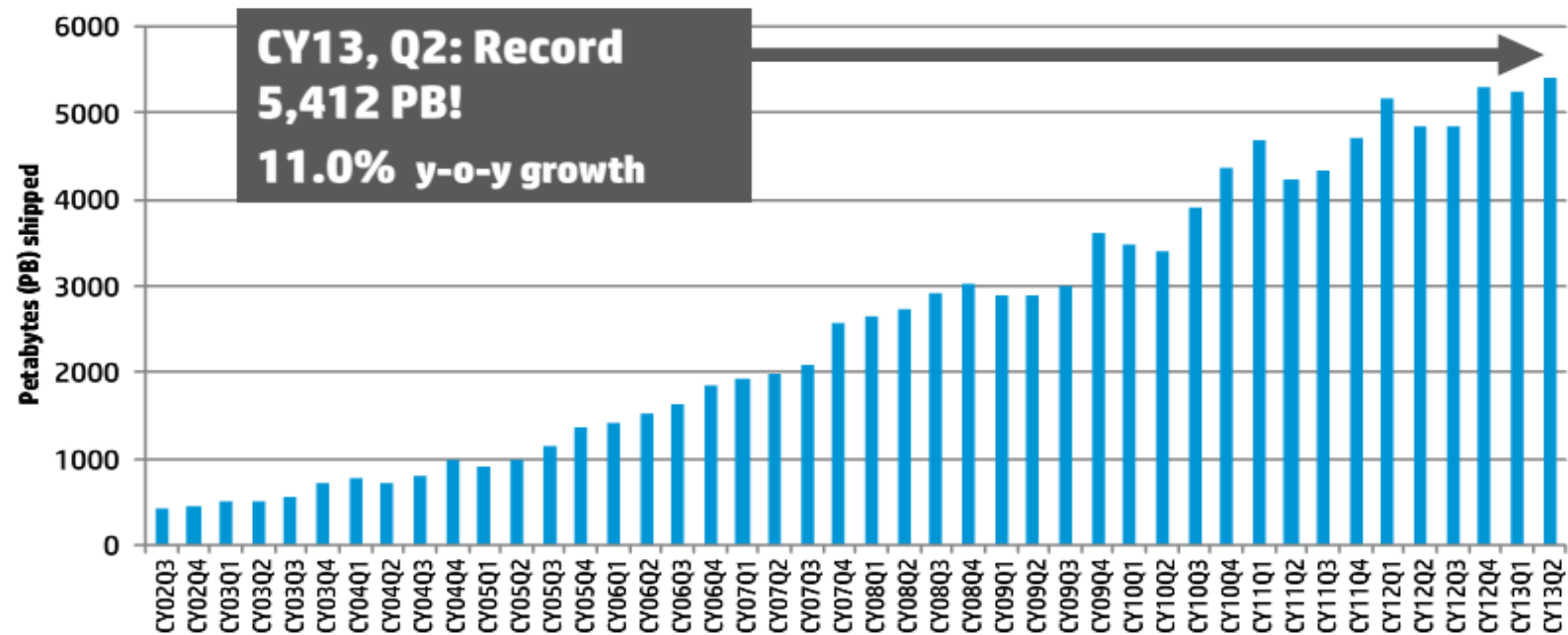
- 1. Costs Less:** 2¢/GB compressed. Up to 26X less than disk.
- 2. Easy to Manage:** PBs of tape vs. ~100TB of disk
- 3. High Reliability:**
 - Read after write verification for high data integrity
 - Servo tracking to help ensure precision tracking
 - Better bit error rate than disk! 1×10^{17} bits vs. 1×10^{15} bits
- 4. Data Protection:** off-line protecting against on-line data corruption
- 5. Easy to Use:**
 - Tape automation has simplified the process of using tape
 - LTFS makes tape easier to use than ever before
 - NAS - like
- 6. Long shelf life:** up to 30 years or more
- 7. Scalable:** Add cartridges for nearly “infinite capacity” on demand
- 8. Green storage:** cartridges on a shelf consume no energy
- 9. Transportable:** Media is easy to ship --» high bandwidth in a box
- 10. High Performance:** Streams very fast --» high capacity



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Tape media shipment capacities reach record levels to keep pace with data growth



- LTO generation 6 is experiencing faster adoption than LTO generation 5
- LTO-5 tape maintains double-digit growth over previous year
- More than 6.4 million drives have been shipped since the program conception
- The 225 millionth LTO cartridge has been shipped
 - This totals 90,000 PB of data protected and retained using LTO technology

Source: Santa Clara Consulting CY13Q2 report



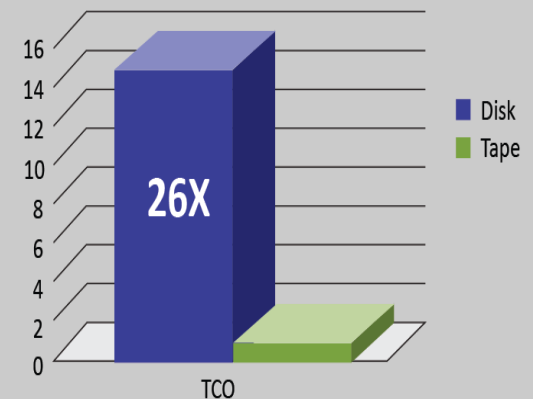
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LTO Tape Can Help Reduce Storage Costs

TCO: SATA Disk System vs. LTO Tape Library System¹

- 9 Year TCO Archiving Study
- Back-end storage costs: hardware, maintenance, floor space and energy
- Disk storage is 26 times the average Tape TCO
- The cost of energy alone for the avg. disk-based solution exceeds the entire TCO for the average tape-based solution



1. The Clipper Group Calculator report “Revisiting the Search for Long-Term Storage – A TCO Analysis of Tape and Disk”, May 13, 2013.

Best Practices in Data Protection

1. Have multiple copies or layers of protection

- Depending upon value of data, keep at least 3 copies
- Keep in different locations; one out of region
- Use disk and tape

2. Isolate one copy

- At least one copy offline for logical system isolation
- Avoid intentional/unintentional corruption that can occur with online storage
- Use tape; Keep offline

3. Have technology diversification

- Copies on different forms of media to avoid media or system disaster
- Use disk and tape

4. Protect access to data

- At rest and in transit
- Use encryption & WORM

5. Manage backup differently than archive

- Backup: multiple, point in time consistent copies for operational and DR
- Use disk and tape
- Archive: single instanced data for long term retention
- Use tape

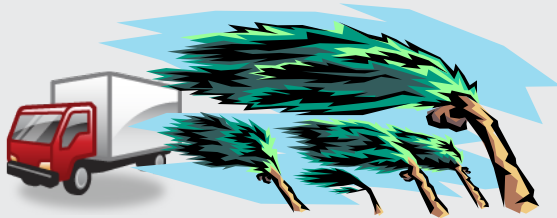
*Best Practices Source: Debbie Beech, Sylvatica Consulting / David Hill, Mesabi Group



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Large Truck Express Line Survives Hurricane Flood



" When it comes to disaster recovery, you can buy new hardware but you can't buy new data."

Dick Crosby
Systems Manager, Estes

Business Challenge

- Hurricane Gastone flooded Data Center with 5 ft. of water
- Total loss of HW, network, phone, generator, and utility power
- **Good news:** a tape backup of 100% of the data was made the night before – stored off site!

Solution

- Protect assets and business resilience with best practice strategy
- Create nightly disk flash copy for fast retrieval and window-less backup to tape
- Backup 100% production data to LTO tape library nightly
- On-site and off-site copies
- Global Mirror DR site and backup to LTO tape library – Lights out!
- Creates 5 copies of data (2 offline on tape in different locations)

Benefits

- No production system interruption
- No save window-Set it & forget it
- No production cycles, no operators, lights out operations
- Logical data protection and out of region protection
- Able to control TCO, access data and protect data with tiered storage strategy



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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

➤ 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 1.5 TB of saved data per drive/hr (compressed)

➤ Compatibility for Investment Protection

- Read/Write LTO-5 cartridges, Read LTO-4 cartridges
- Interchange between vendor drives

➤ Security

- WORM (Write Once Read Many)
- Encryption

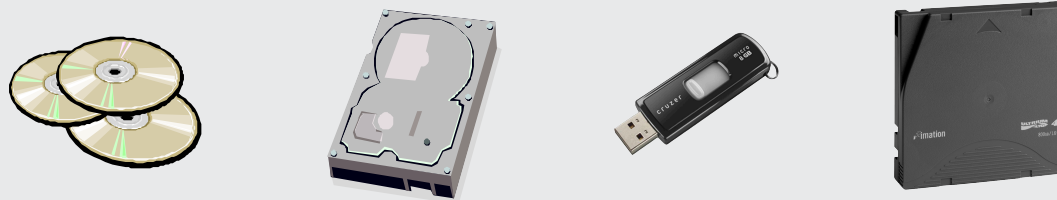


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What is the Linear Tape File System?

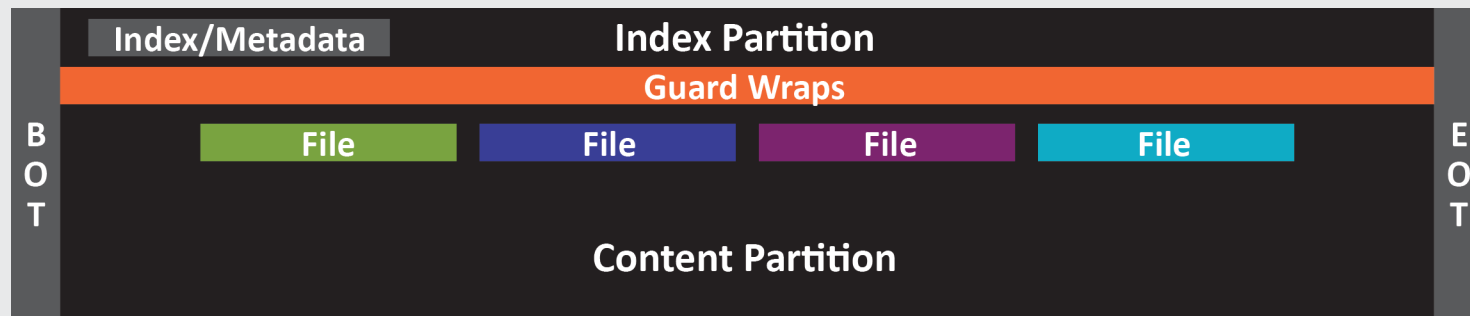
- › Open software specification
 - Allows simple and new ways of accessing data on tape (LTFS spec doc available at: www.lto.org/ltfs)
- › Self-describing tape format
 - Addresses data archive requirements
 - Tape tells you what is on it!
- › It presents tape as an extension of the operating system
 - Appears as drive letter, icon, folder like a disk or USB stick
- › No traditional backup software needed



LTO Tape Joins the Ranks of Easy to Use Portability

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/ltfs

Easily View, Archive and Share Files



BAMM.TV Archives Music Videos to LTO Tape and LTFS



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

**JAMIE MORGANSTERN,
DIRECTOR OF OPERATIONS**

Company Profile

- 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!

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 30-50 year life.
- LTFS standard format for easy sharing
- Assured data is protected with reliable off-line & off-site protection



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How Do I Get Started Using LTFS?

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!

LTFS software is free!

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



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