IBM Quantum

LTFS

Linear Tape File System

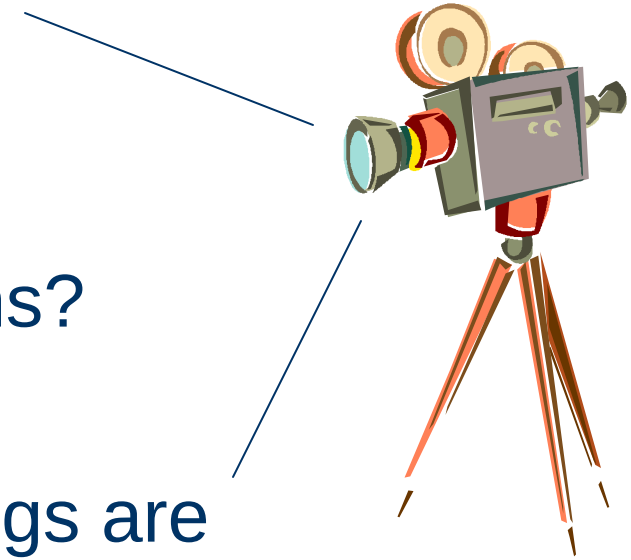
Setting Your Videos and Data Free Now and for the Future!

What is the LTO Program?

- HP, IBM, Quantum:
  - Write LTO technology specifications and published roadmap
- Specifications are open standard
  - License to any organization
  - Over 30 Licensees
  - 5 Media Manufacturers (Fujifilm, Imation, Maxell, Sony, TDK)
- LTFS for LTO-5 tape drive is a free download offered by HP, IBM, Quantum

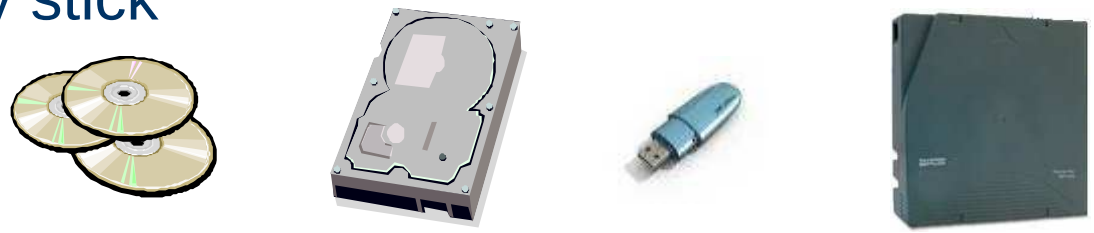
Agenda

- What is LTFS?
- How does it work?
- What are the cost comparisons?
- What are the benefits?
- What LTFS Supported Offerings are Available?
- LTO User Stories
- What the experts are saying
- How do I start using LTFS?



What is the Linear Tape File System?

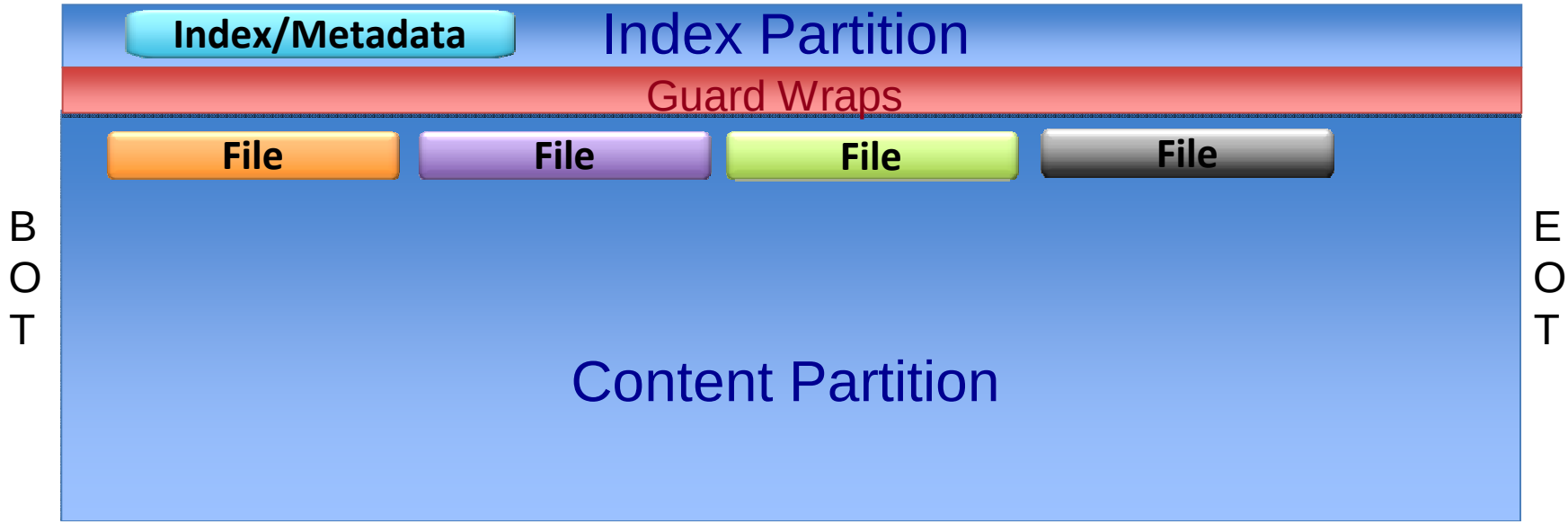
- A open software specification that allows simple and new ways of accessing data on tape
  (LTFS spec doc available at: www.ultrium.com/ltfs)
- Self-describing tape format to address data archive requirements
- Implemented on dual-partition LTO-5 tape
  - First partition holds the tape index / metadata
  - Second partition holds the content
- It presents a tape as an extension of the operating system: appears as another drive letter, icon or folder like a disk or memory stick



LTO Tape Joins the Ranks of Easy to Use Portability

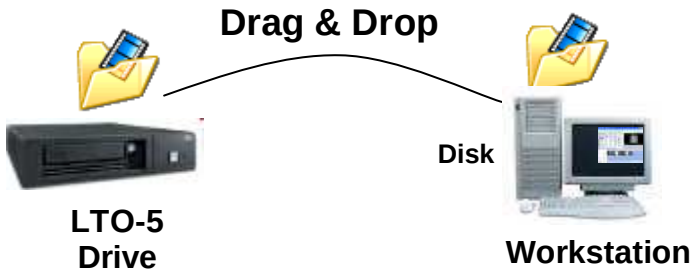
LTFS: How does it work?

- LTFS utilizes media partitioning (new to LTO Gen 5)
- Tape is logically divided “lengthwise” into two partitions
  - **Index partition**: File system info, index, metadata (37.5 GB)
  - **Content partition**: Contains the files / content bodies (1425 GB)
- 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



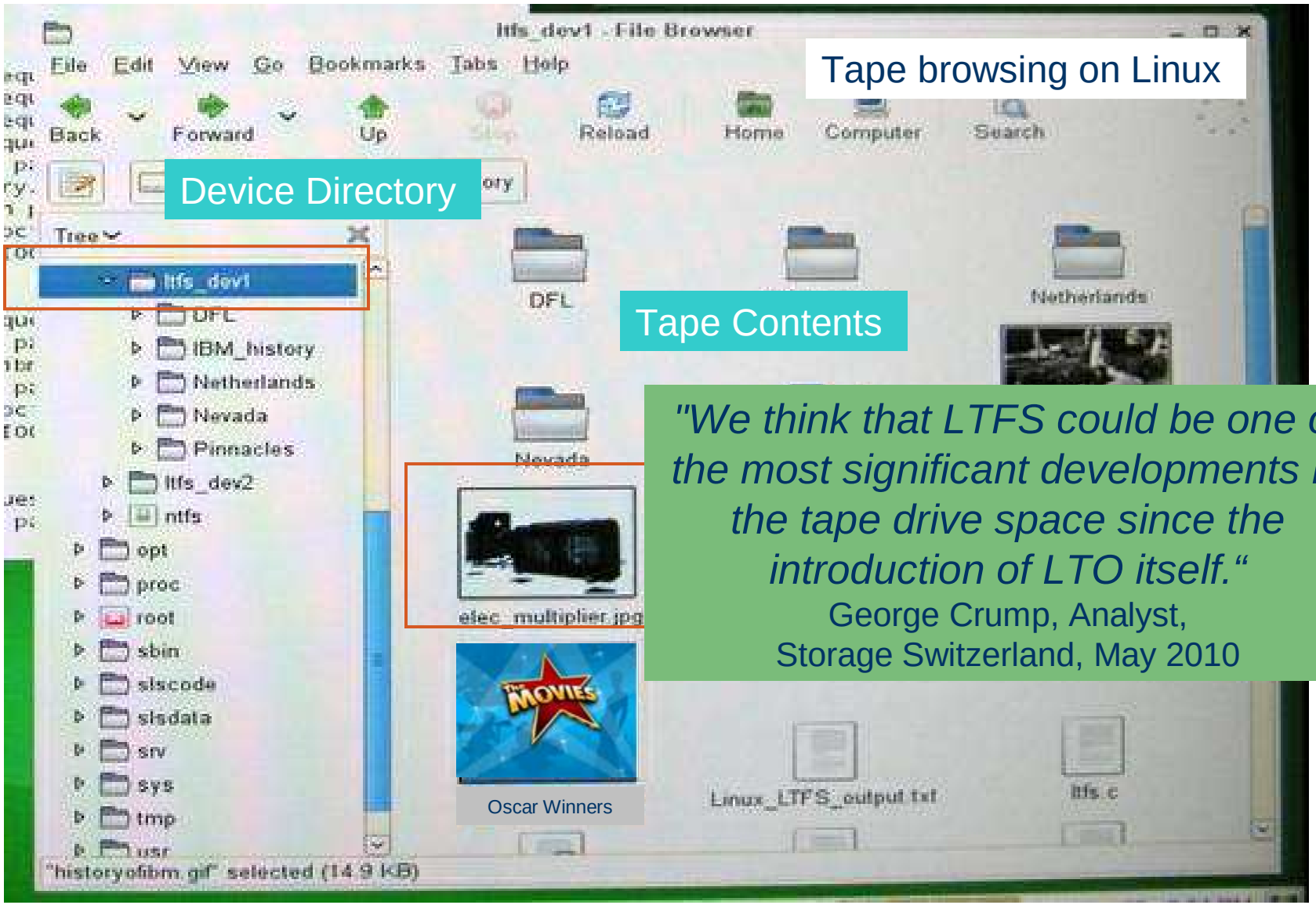
How it works: LTFS – Drag and Drop

- File access on an LTO-5 is similar to hard disk, CD/DVD disc or USB media
- Access with OS browser (e.g. Windows Explorer) 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, provides a transfer rate of up to 140MB/s (280MB/s 2:1 compressed)



How it Works: LTFS in Action with File Browser

Files can be accessed on tape directly from any application

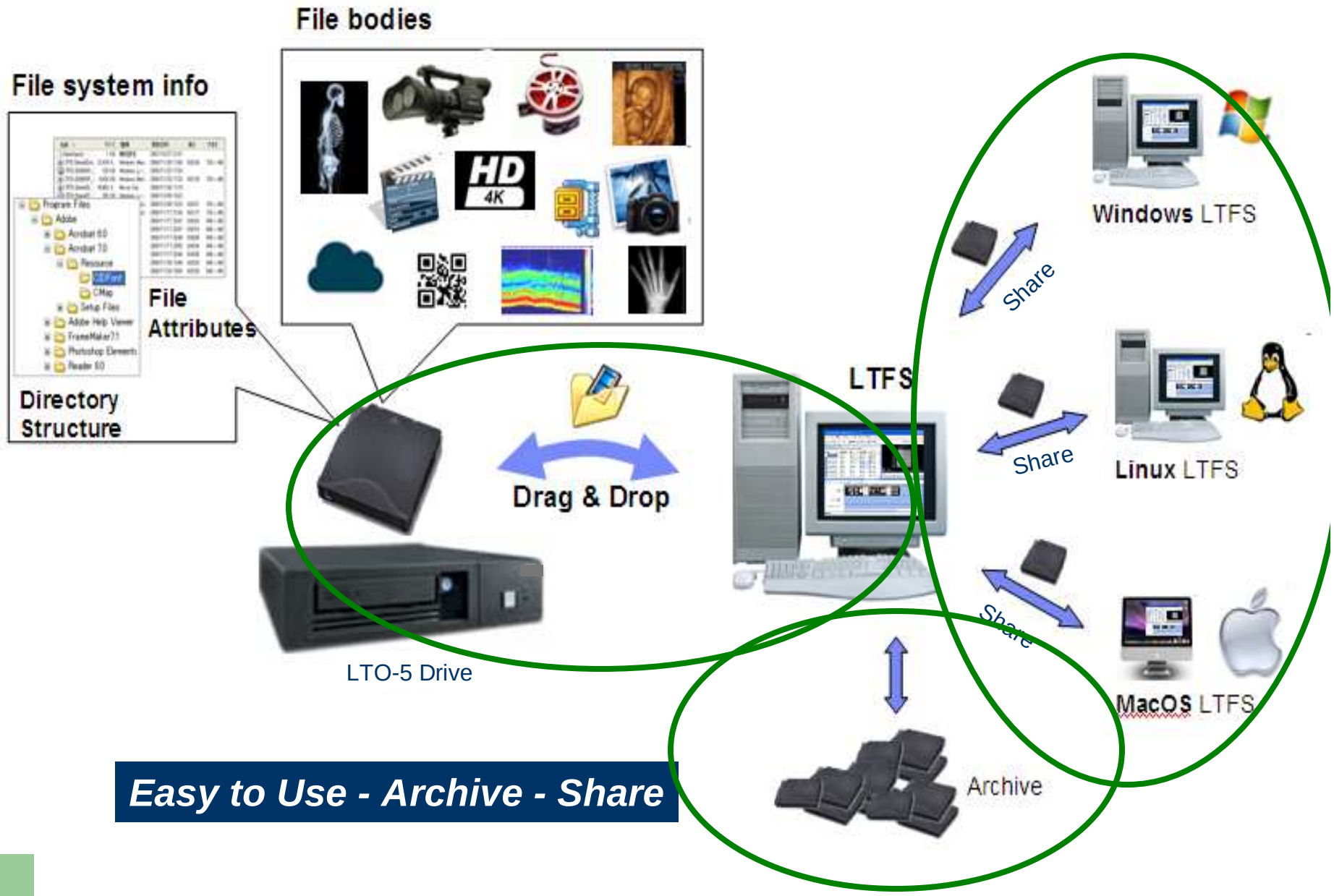


"We think that LTFS could be one of the most significant developments in the tape drive space since the introduction of LTO itself."

George Crump, Analyst,
Storage Switzerland, May 2010

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

LTFS – Easily Exchange, Archive and Share Files



Easy to Use - Archive - Share

LTO Tape Can Help Reduce Storage Costs

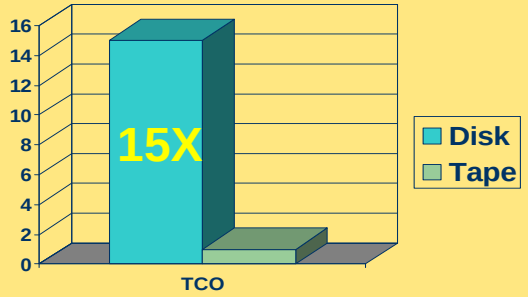
LTO-5 Tape vs. Video Media

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 March 2012
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 System[1]

- 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 average disk-based solution exceeds the entire TCO for the average tape-based solution



[1]*Clipper 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.

Tape Reliability Soars

Both disk and tape have made significant reliability improvements in recent years. **For tape, reliability progress has been even better than disk** comparing the BER (Bit Error Rate), which is quickly becoming a more popular means of measuring reliability.

Published Values for Bit Error Rate (BER)

Tape drives (Midrange and Enterprise)		
Midrange (typical LTO Ultrium drive)	Hard Error Rate	1 x $10E^{17}$ bits

Disk (FC, SAS, SATA)		
Enterprise FC/SAS	Hard Read Errors per Bits Read	1 sector per 1 x $10E^{16}$ bits
Enterprise SATA	Hard Read Errors per Bits Read	1 sector per 1 x $10E^{15}$ bits
Desktop SATA	Hard Read Errors per Bits Read	1 sector per 1 x $10E^{14}$ bits

BER is the percentage of bits that have errors relative to the total number of bits received in a data transfer

LTO Tape: 1 bit error in 100 Petabytes
Ent. SATA disk: 1 bit error in 1 Petabyte

Source: Tape Storage Future Directions and the Data Explosion
Fred Moore, President, Horison, Inc. 2011

LTFS: What are the potential benefits?

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

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

- **Easy to use**
  - -View contents in OS browser directory tree
  - -Simple “Drag & Drop” movement of data
- **Improved archive storage**
  - -“Memory stick like” self describing file system
  - -Tape can tell you what’s on it now and in the future
  - -Up to 30 year shelf life

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

- **Increased data mobility-portability**
  - -Compatibility across OS environments
  - -No backup/archive software needed to view content
  - -A single storage media standard
  - -File, HW, SW and camera agnostic
- **Reduced costs and energy consumption**
  - -LTO tape is less expensive than other storage formats
  - -Tape is “green”…a cartridge draws no power!

Some Independent LTFS Supported Developments

- **1Beyond**: high performance video production and post production, tapeless workflow and storage systems (http://www.1beyond.com/)
- **Arkivum:** assured archiving, 100% guaranteed safe data storage service (http://arkivum.com/)
- **Cache-A**: archive appliances serving the digital video industry (http://cache-a.com/about.php)
- **Crossroads:** online, file-based archive, combining disk storage with LTFS tape storage for a fast, cost effective, long-term data archive (www.crossroads.com)
- **Digital Media Logix:** LTFS enabled solutions for M&E, Video Surveillance, Archive Management (http://digitalmedialogix.com/)
- **FOR-A**: innovative products & advanced video/audio technology (http://www.for-a.com/)
- **Masstech:** media asset management (MAM) solutions for the media and entertainment industry (www.masstech.com)

Note: Information concerning vendor products, performance or services may vary. No warranties are expressed or implied. Contact the vendor for specific product, performance and warranty information. User results may vary.

And more…LTFS Supported Developments

- **Panasonic:** this product can easily archive P2 content and preview P2 content from LTO tape directly like video tape (www.panasonic.com)
- **Qstar:** enterprise-class archive, data management and archive disaster prevention software (www.qstar.com)
- **SGL**: content archive and storage management solutions to the media and entertainment (http://www.sglbroadcast.com/)
- **Storage DNA**: Intelligent LTO-5/LTFS archiving for file-based workflows, application archiving (Avid, Final Cut etc.) and continuous backup (http://storagedna.com)
- **T3Media (formerly Thought Equity Motion)**: large scale archive management and “smart content” metadata tools (www.t3media.com)
- **TOLIS Group Inc:** Bru Backup Software-Producers Edition version 2.3.0 provides native LTFS support for OS X users (http://knowledgebase.tolisgroup.com/?View=entry&EntryID=260)
- **XenData**: LTO video archives for the media industry scaling to multiple petabyte enterprise solutions (www.xendata.com)

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FotoKem Uses LTFS for Reality TV Post Production

- **FotoKem background**
  - 700+ employees; HQ in Burbank, California USA
  - Film lab & post production facility

www.fotokem.com

- **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 tape library and LTFS; Open standard; Cross O/S platform compatibility
  - Self describing 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)

AlphaTV Reduces costs with LTFS and LTO-5 tape technology

The need:

AlphaTV in Greece needed to store huge amounts of television programming content while shrinking their storage footprint, creating efficient backups and reducing storage management costs.

The solution:

AlphaTV deployed the LTFS, LTO-5 tape drives and a tape library to handle their television programming archive.

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

–Constantinos Colombus, chief technology officer, AlphaTV

The benefit:

- **Reduced physical storage footprint by 74%** from 1,507 sq. ft. to 388 sq.ft.
- **Lowered storage maintenance costs by 77%** from $39,369 to $9,186
- **Can now store three times the number of television series at 1% of the media cost** $79-92, versus $11,811 for one series on DVCPRO

BAMM.TV Archives Music Videos to LTO-5 Tape and LTFS

"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

- **Company Profile: BAMM.TV**
  - •San Francisco based
  - • Produces and distributes video for independent musicians
  - •12 video / audio editors
  - •In house production and post-production

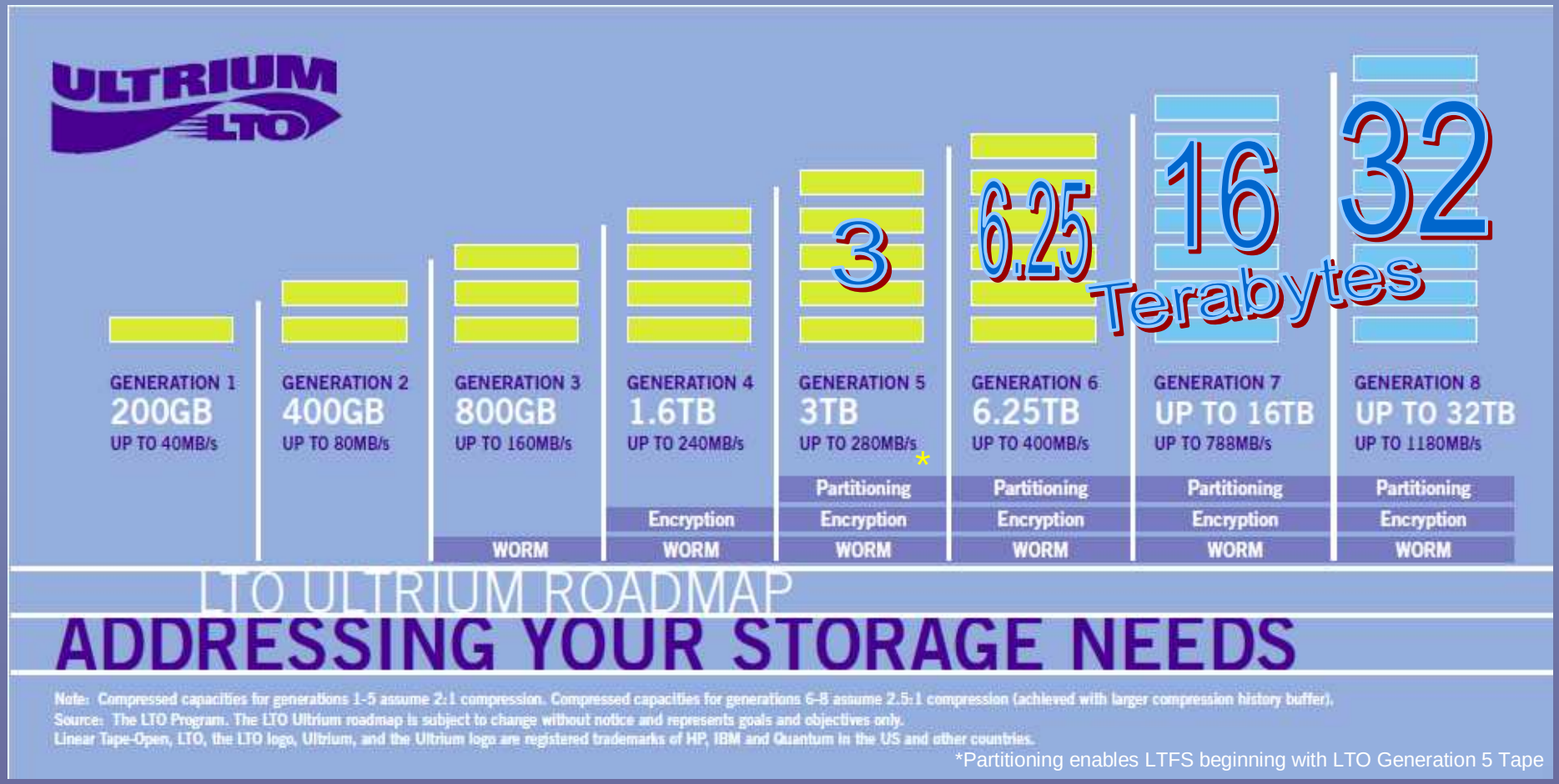
- **Business Need:**
  - •Large storage need (HD, Hoard all footage)
  - •SAN storage is expensive
  - •Removable HDs are fragile (~8% failure rate), limited shelf-life, expensive and take up excessive space
  - •On site and off-site copies are needed
  - •Video/data is BAMM's livelihood and must be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

- **Solution Results: LTO-5 Technology with LTFS**
  - •Effectively backed up 80TB of uncompressed 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

What the experts are saying!

- **Hot Storage for 2012! LTFS: "…opening up new new possibilities for incorporating tape into workflows and making archive easier" Storage Magazine**
- **LTO5 with its own File System: An Enabling Technology for Archive, Backup, Simple DR - even the Cloud**
  By Eric Slack, Senior Analyst, Storage Switzerland
- **LTO-5 and LTFS: Shaking the Pillars of Heaven**
  By Mark Ferelli, 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, 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, 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

LTO Ultrium Roadmap to the Future



- ✓Over 4M LTO Tape Drive Shipments
- ✓Over 200M LTO Cartridge Shipments

LTO-6 Specifications – Big Data Preservation

- **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 it's free!

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

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

3- Format and mount an LTO-5 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 tape!

Addresses the needs of industries with rich media such as:

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

LTFS

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Learn about LTO technology at: www.trustlto.com

New LTFS White Paper by MTMP at www.ultrium.com

Learn about LTFS, see LTFS Videos and User Stories at: www.ultrium.com/LTFS

Tape $aves

LTO Tape Can Save Your Costs - Energy - Data - Company - Job

Come to the LTO Program Booth for a Live LTFS Demo