*Dec. 17ᵗʰ, 2015. The Tape Storage Council, which includes representatives of **BDT, Crossroads Systems, FUJIFILM, Frontier BV, Hewlett Packard Enterprise, IBM, Iron Mountain, Oracle, NCE Computer Group, Overland Storage, Qualstar, Quantum, REB Storage Systems, Recall, Spectra Logic, Tandberg Data, Turtle and XpresspaX** has issued the following memo to highlight the current trends, usages and technology innovations occurring within the tape storage industry.*

## Tape Reaches New Markets as Innovations Accelerate

*Tape's Continued Innovations Fuels New Markets and Use Cases*

**Abstract**

The tape industry continues to gain significant momentum as tape has firmly established its long-term role for effectively managing extreme data growth with new use cases. Both LTO (Linear Tape Open) and enterprise tape products continue to deliver unprecedented storage capacities per cartridge with the lowest total cost of ownership compared with all other existing storage solutions. Steady developments have made tape technology the most reliable storage medium available, now surpassing HDDs by three orders of magnitude in data reliability. As a result, tape is well positioned to effectively address many data intensive industries including cloud, entertainment, the internet, and high performance computing along with data intensive applications such as big data, backup, recovery, archive, disaster recovery and compliance. Disk technology has been advancing, but tape's progress over the last ten years has been even greater. Tape is now the most dynamic and sexy storage product on the market. If you don't believe it - just read on.
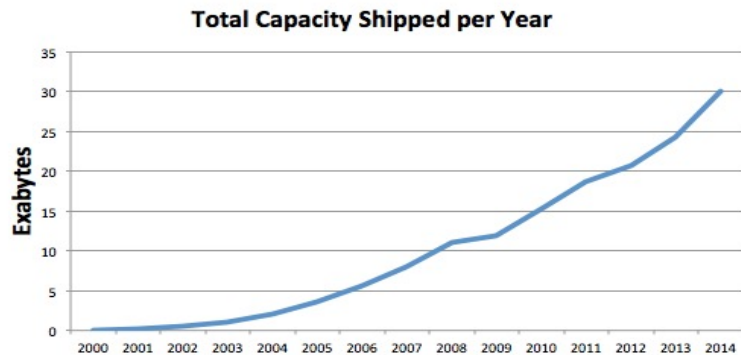
**The Growth in Digital Data Drives Tape Demand**

Demand for tape is being fueled by unrelenting data growth, significant technological advancements, tape's highly favorable economics, and the growing regulatory and business requirements to maintain access to data "forever." Tape continues to play a major role for backup and disaster recovery (see Google Gmail Outage demonstrates the importance of tape backups) in addition to effectively addressing many new large-scale storage requirements. Nasuni Corp predicts ~2.5 EB's (exabyte $1 \times 10^{18}$) of data are created each day and by 2020, we will see a 4,300 percent increase in annual digital data generation. The access frequency and long-term retention requirements of large portions of this data heavily favors tape as the most cost-effective storage solution. Major cloud providers are quickly realizing the value for implementing tape in their cloud infrastructure as the amount of data is escalating and storing less active data exclusively on HDDs becomes increasingly cost prohibitive. IDC indicates that Cloud IT infrastructure growth outpaces the growth of the overall IT infrastructure market and has grown by 25 percent in the past year.

Enterprise tape has reached an unprecedented 10 TB native capacity per cartridge with native data rates reaching 360 MB/sec. Enterprise tape libraries can scale beyond one exabyte as exascale storage solutions have arrived. Enterprise tape drive manufacturers IBM and Oracle StorageTek have signaled future cartridge capacities far beyond 10 TBs with no limitations in sight. When using the new LTO-7 format, open systems users can now store 240 Blu-ray quality movies on a single 6.0 TB native cartridge. The LTO roadmap has been

extended to LTO-10 which specifies a 48 TB native capacity or 8x more capacity than LTO-7. In the future, an LTO-10 cartridge will hold as many as 1,920 Blu-ray movies.

Approximately 5 million LTO drives and more than 280 million LTO tape cartridges have been shipped since the format's inception. As shown in the chart to the right, this totals over 100 EB of data protected using LTO technology and equates to more than 100 million miles of LTO tape media, exceeding the distance from the earth to the sun!

**Total Capacity Shipped per Year**



Source: **The LTO Program Technology Provider Companies** (TPCs)

**Key Announcements and Milestones - 2015**

Tape storage is addressing many new applications in today's modern data centers while offering welcome relief from relentless IT budget pressures. Key announcements and milestones were reached in the past year and include:

- March 9, 2015 The LTO® Program announced price per gigabyte is now less than one penny and that LTO-6 tape has reached another cost-per-gigabyte milestone of below a cent.  LTO storage can be as low as 0.8 cents per gigabyte or $8 per terabyte.

- April 9, 2015 Fujifilm Recording Media USA announced that in conjunction with IBM a new record in areal data density of 123 billion bits per square inch on linear magnetic particulate tape had been achieved. This density breakthrough equates to a standard LTO cartridge capable of storing up to 220 TB of uncompressed data, more than 88 times the storage capacity of the current LTO -6 tape. A tape of this size can preserve the human genome of 220 people on a single cartridge and is the highest capacity storage media ever announced, including HDD, Blu-ray disc and solid memory NAND flash. This marks the fourth time in less than 10 years that Fujifilm and IBM have combined to achieve record-breaking storage capacities on tape.

- April, 28 2015 IBM was assigned several tape patents. These patents represent significant innovations and improvements for high performance tape access and advanced reliability capabilities. Selected tape patents are listed below.
  For complete details see: http://www.latestpatents.com/ibm-patents-granted-on-28-april-2015/
  # (9,021,175) Reordering Access to Reduce Total Seek Time on Tape Media
  # (9,021,196) Writing Multiple Files Simultaneously to Tape
  # (9,060,414) Solid State Storage Media Cartridge
  # (9,019,653) High Density Timing Based Servo Format for use with Tilted Transducer Arrays
  # (9,019,654) Data Storage Tape with Random Access Data
  # (9,007,709) Optimum Tape Layout Selection for Improved Error Correction Capability
  # (9,013,827) Coarse Actuator Positioning Algorithm
  # (9,047,879) High Performance Cartridge Format

- September 14, 2015 [The LTO Program Technology Provider Companies](#), HP, IBM and Quantum, announced that the LTO Ultrium format generation 7 specifications are available for licensing by storage mechanism and media manufacturers. The new LTO-7 specifications more than double the LTO-6 native tape cartridge capacity from 2.5 TB to 6.0 TB, yielding capacities of up to 15 TB per cartridge when compressed at 2.5:1. Large files will also transfer more quickly with 300 MB/sec native drive data transfer rates, which translates up to 2.7 terabytes of data an hour per drive at 2.5:1 compression. The standard reliability measure for storage devices, Bit Error Rate (BER) – or bits read per hard error, has been increased two orders of magnitude to $1 \times 10^{19}$ bits read per hard error with LTO-7.

**Significant Technology Innovations Fuel Tape's Future**

Continued development and manufacturing investment in tape library, drive, media and management software has effectively addressed the constant demand for improved reliability, higher capacity, power efficiency, ease of use and the lowest cost per GB and TCO of any storage solution. Below is a summary of tape's value proposition followed by key metrics for each:

- Tape drive reliability has surpassed disk drive reliability
- Tape cartridge capacity (native) and data rate growth is on an unprecedented trajectory
- Tape has a much longer media life than any other digital storage medium
- Tape requires significantly less energy consumption than any other digital storage technology
- Tape storage has a much lower acquisition cost and TCO than disk
- Tape's functionality and ease of use is now greatly enhanced with LTFS software

*Reliability.* Reliability levels for tape are quickly improving and now exceed that of the most reliable disk drives by one to three orders of magnitude. The BER for both enterprise tape and LTO-7 tape is rated at $1 \times 10^{19}$, making the top rated tapes 1,000 times more reliable than the top rated HDDs at $1 \times 10^{16}$. By comparison $10^{19}$ or 10 quintillion (a billion billion) is the number of millimeters from here to the next closest star. The odds of a meteor landing on your house is one in 182 trillion (a million million) and the odds of winning Powerball are 1 in 292 million. In any case, these are huge numbers and the BER for tape is impressive; expect tape to achieve even higher levels of reliability going forward.

*Capacity and Data Rate.* LTO-7 cartridges have 6.0 TB native capacity, more than double the native capacity of the LTO-6 cartridge, and offer an impressive 87.5% native data rate performance boost to 300 MB/sec. Enterprise tape has reached 8.5 TB native capacity and 252 MB/sec on the Oracle StorageTek T10000D and 10 TB native capacity and 360 MB/sec on the IBM TS1150. Tape cartridge capacities and data transfer speeds are expected to grow at unprecedented rates for the foreseeable future with no fundamental technology limitations in sight.

*Media Life.* Manufacturer's specifications indicate that today's enterprise and LTO tape media has a life span of 30 years or more while a tape drive is typically deployed 7 to 10 years before replacement. By comparison, a typical disk drive is typically operational from 3 to 5 years before replacement.

*TCO Studies.* Tape's wide and sustainable $/GB and TCO advantage compared with other storage mediums makes it the most cost-effective technology for long-term data retention. Several tape TCO studies are publicly available and the results consistently confirm a significant TCO advantage for tape compared with disk

solutions for backup and archive applications. The studies show the TCO for HDDs typically range up 15x times higher than the equivalent capacity tape systems, while HDD energy costs typically range 20x or higher than tape.

**Software.** LTFS (Linear Tape File System) now offers three freely available software solutions for file management with the LTFS format: Single Drive Edition, Library Edition, and Enterprise Edition. As a testimony to the growing use of LTFS, a total of 29 companies are now LTFS partners. In addition, SNIA's Linear Tape File System (LTFS) Technical Work Group is focusing technical efforts on the development of an architecture that is related to the "on-tape" format for LTFS. Several HSM (Hierarchical Storage Management) products that migrate files and objects from the costliest storage devices to tape are readily available. Expect RAIT (Redundant Arrays of Inexpensive Tape) to gain momentum in order to capitalize on tape's superior data rates.

**New Use Cases and Innovative Solutions Bring Tape into the Game**

*Active Archives.* Tape's favorable economics are fueling increased interest in Active Archive solutions. An active archive provides a persistent online view of archival data using one or more archive technologies (tape, HDDs, and cloud storage) behind a file system. Active archive data can typically be shared using NAS and standard Windows or Linux file sharing protocols (CIFS / NFS) to easily store, search and retrieve data directly from the archive. The benefits of an Active Archive intelligent data management framework include:

- Scalability: Effortlessly add capacity and scale to petabytes of storage
- Lower Cost: Reduce TCO by matching media type to SLA requirements and optimizing storage infrastructure
- Ease of Use: File-level access to all of your data, all the time
- Compliance: Achieve regulatory retention requirements and reduce risk of non-compliance and data loss

*Tape as NAS Emerges.* The innovative Tape as NAS solution has gained traction and provides direct file access capability for data tape and integrates an LTO tape library with a front-end NAS for standard NAS (CIFS/NFS) mounts and LTFS to deliver the newest archive architecture. Data arrives at the NAS disk cache and is written to tape, files remain on disk cache until the cache is full, at which time the oldest files are reduced to metadata pointers only. File searches continue to see all files archived and only when a read request is received are files moved back from tape to disk cache and on to the user. A tape library as a NAS enables users to leverage familiar file system tools, and even drag and drop files directly to and from a tape cartridge, just like a disk-based NAS. Examples include:

- Crossroads Strongbox
- Fujifilm Dternity
- HPE Storever Tape as NAS
- IBM Spectrum Archive
- Oracle HSM
- Qstar Archive Manager
- Quantum Scalar LTFS and Artico
- Spectra Logic BlackPearl

***Storage Tiering Fully Embraces Tape.*** The increasingly popular tiered storage cost-reduction concept now fully embraces the tape tier (Tier 3) and allows a system administrator to define policies for data migration and retention to control the movement of petabytes of data and billions of files from more expensive Flash and HDD storage devices to less-expensive tape and cloud storage. By using tape libraries instead of disks for Tier 2 and Tier 3 storage, organizations can improve efficiency and significantly reduce costs.

***Tape in the Cloud Arrives.*** Tape is playing multiple roles in the explosive cloud data growth and becoming a key component of future cloud storage solutions. Tape is an effective way to move quickly large amounts of data to a cloud provider (or to seed the cloud). Instead of transferring large amounts of data across an Internet WAN connection for days or weeks, it can be copied to tape and sent to the cloud provider via an overnight truck. The same goes for Disaster Recovery. For large amounts of DR data, the cloud provider can send all requested data on tape, instead of a WAN, enabling users to recover their data more quickly on premises. Tape is playing a larger role in the cloud as cloud providers are using tape as part of their long-term storage services offering to relieve the TCO pressure from using HDDs exclusively for lower activity and archival data.

***Select Case Studies Highlight the Value of Tape and Active Archive Solutions.*** Several case studies listed below demonstrate the many new and innovative use cases for tape technology:
- [AZ Saint-Jan Brugge-Oostende](#) – Gains virtually limitless storage scalability with next-generation environment for archived medical data
- [Barrett-Jackson](#) – Cache is king for the world's number one car auction brand
- [Brain Farm](#) – Safeguards business critical content for making high-quality visionary action, adventure and lifestyle productions
- [Calgary Police Service](#) - Body camera video is stored on a highly scalable tiered storage solution
- [EVRY](#) – One of the largest IT companies in the Nordics builds a seismic data repository
- [FedEx](#) – Protects and stores training and instructional videos for more than 325,000 global team members
- [LIBR](#) – The Laureate Institute for Brain Research manages massive expansion of brain imaging data
- [The Whitehead Institute](#) – Leading molecular biology and genetics research institute is a key contributor to the 13-year Human Genome Project
- [University of Colorado Boulder](#) – Supports ground-breaking research with the pioneering PetaLibrary

### *Looking Ahead to 2016 and Beyond*
The role tape serves in today's modern data centers is expanding. IT executives and cloud service providers are addressing new applications that leverage tape for its significant operational and economic advantages. This recognition is driving continued investment in new tape technologies with extended roadmaps, innovations and exciting use cases. It is also expanding tape's profile from its historical role in data backup to one requiring cost-effective access to enormous quantities of stored data. With the exciting trajectory for future tape technology, many data intensive industries and applications already have or will begin to leverage the significant benefits of tape's continued progress. Clearly the innovation, compelling value proposition and new development activities demonstrate tape technology is not sitting still; expect this promising trend to continue in 2016 and beyond as more and more exabytes of data are stored on tape. The question "tape, so what" has been answered and has become "tape, what's next"? What lies ahead is exciting. Isn't it about time to take advantage of the many new tape innovations that make it so beneficial?