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December 10<sup>th</sup>, 2014. The [Tape Storage Council](#), which includes representatives of **BDT, Crossroads Systems, FUJIFILM, HP, IBM, Imation, Iron Mountain, Oracle, Overland Storage, Qualstar, Quantum, REB Storage Systems, Recall, Spectra Logic, Tandberg Data and XpresspaX** has issued the following memo to highlight the current trends, usages and technology innovations occurring within the tape storage industry.

## **Data Growth and Technology Innovations Fuel Tape's Future**

*Tape Addresses New Markets as Capacity, Performance, and Functionality Reach New Levels*

### **Abstract**

For the past decade, the tape industry has been re-architecting itself and the renaissance is well underway. [Several new and important technologies](#) for both LTO (Linear Tape Open) and enterprise tape products have yielded unprecedented cartridge capacity increases, much longer media life, improved bit error rates, and vastly superior economics compared to any previous tape or disk technology. This progress has enabled tape to effectively address many new data intensive market opportunities in addition to its traditional role as a backup device such as archive, Big Data, compliance, entertainment and surveillance. Clearly disk technology has been advancing, but the progress in tape has been even greater over the past 10 years. Today's modern tape technology is nothing like the tape of the past.

### **The Growth in Tape**

Demand for tape is being fueled by unrelenting data growth, significant technological advancements, tape's highly favorable economics, the growing requirements to maintain access to data "forever" emanating from regulatory, compliance or governance requirements, and the big data demand for large amounts of data to be analyzed and monetized in the future. [The Digital Universe study](#) suggests that the world's information is doubling every two years and much of this data is most cost-effectively stored on tape.

Enterprise tape has reached an unprecedented 10 TB native capacity with data rates reaching 360 MB/sec. Enterprise tape libraries can scale beyond one exabyte. Enterprise tape manufacturers IBM and Oracle StorageTek have signaled future cartridge capacities far beyond 10 TBs with no limitations in sight. Open systems users can now store more than 300 Blu-ray quality movies with the LTO-6 2.5 TB cartridge. In the future, an LTO-10 cartridge will hold over 14,400 Blu-ray movies. Nearly 250 million LTO tape cartridges have been shipped since the format's inception. This equals over 100,000 PB of data protected and retained using LTO Technology. The innovative [active archive solution](#) combining tape with low-cost NAS storage and LTFS is gaining momentum for open systems users.

### **Recent Announcements and Milestones**

Tape storage is addressing many new applications in today's modern data centers while offering welcome relief from constant IT budget pressures. Tape is also extending its reach to the cloud as a cost-effective deep

archive service. In addition, numerous analyst studies confirm the TCO for tape is much lower than disk when it comes to backup and [data archiving applications](#). See TCO Studies section below.

- On Sept. 16, 2013 [Oracle Corp](#) announced the StorageTek T10000D enterprise tape drive. Features of the T10000D include an 8.5 TB native capacity and data rate of 252 MB/s native. The T10000D is backward read compatible with all three previous generations of T10000 tape drives.
- On Jan. 16, 2014 [Fujifilm Recording Media USA](#), Inc. reported it has manufactured over 100 million LTO Ultrium data cartridges since its release of the first generation of LTO in 2000. This equates to over 53 thousand petabytes (53 exabytes) of storage and more than 41 million miles of tape, enough to wrap around the globe 1,653 times.
- April 30, 2014, [Sony Corporation](#) independently developed a soft magnetic under layer with a smooth interface using sputter deposition, created a nano-grained magnetic layer with fine magnetic particles and uniform crystalline orientation. This layer enabled Sony to successfully demonstrate the world's highest areal recording density for tape storage media of 148 GB/in<sup>2</sup>. This areal density would make it possible to record more than 185 TB of data per data cartridge.
- On May 19, 2014 Fujifilm in conjunction with IBM successfully demonstrated a record areal data density of 85.9 Gb/in<sup>2</sup> on linear magnetic particulate tape using Fujifilm's proprietary [NANOCUBIC™ and Barium Ferrite \(BaFe\)](#) particle technologies. This breakthrough in recording density equates to a standard LTO cartridge capable of storing up to 154 terabytes of uncompressed data, making it 62 times greater than today's current LTO-6 cartridge capacity and projects a long and promising future for tape growth.
- On Sept. 9, 2014 IBM announced [LTFS LE version 2.1.4](#) 4 extending LTFS (Linear Tape File System) tape library support.
- On Sept. 10, 2014 the LTO Program Technology Provider Companies (TPCs), HP, IBM and Quantum, announced an [extended roadmap](#) which now includes LTO generations 9 and 10. The new generation guidelines call for compressed capacities of 62.5 TB for LTO-9 and 120 TB for generation LTO-10 and include compressed transfer rates of up to 1,770 MB/second for LTO-9 and a 2,750 MB/second for LTO-10. Each new generation will include read-and-write backwards compatibility with the prior generation as well as read compatibility with cartridges from two generations prior to protect investments and ease tape conversion and implementation.
- On Oct. 6, 2014 [IBM](#) announced the TS1150 enterprise drive. Features of the TS1150 include a native data rate of up to 360 MB/sec versus the 250 MB/sec native data rate of the predecessor TS1140 and a native cartridge capacity of 10 TB compared to 4 TB on the TS1140. LTFS support was included.
- On Nov. 6, 2014, [HP](#) announced a new release of [StoreOpen Automation](#) that delivers a solution for using LTFS in automation environments with Windows OS, available as a free download. This version complements their already existing support for Mac and Linux versions to help simplify integration of tape libraries to archiving solutions.

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

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

**Reliability.** Tape reliability levels have surpassed HDDs. Reliability levels for tape exceeds that of the most reliable disk drives by one to three orders of magnitude. The BER (Bit Error Rate - bits read per hard error) for enterprise tape is rated at  $1 \times 10^{19}$  and  $1 \times 10^{17}$  for LTO tape. This compares to  $1 \times 10^{16}$  for the most reliable enterprise Fibre Channel disk drive.

**Capacity and Data Rate.** LTO-6 cartridges provide 2.5 TB capacity and more than double the compressed capacity of the preceding LTO-5 drive with a 14% data rate performance boost to 160 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 are expected to grow at unprecedented rates for the foreseeable future.

**Media Life.** Manufacturers specifications indicate that enterprise and LTO tape media has a life span of 30 years or more while the average tape drive will be deployed 7 to 10 years before replacement. By comparison, the average disk drive is operational 3 to 5 years before replacement.

**LTFS Changes Rules for Tape Access.** Compared to previous proprietary solutions, LTFS is an open tape format that stores files in application-independent, self-describing fashion, enabling the simple interchange of content across multiple platforms and workflows. LTFS is also being deployed in several innovative "Tape as NAS" active archive solutions that combine the cost benefits of tape with the ease of use and fast access times of NAS. The SNIA LTFS Technical Working Group has been formed to broaden cross-industry collaboration and continued technical development of the LTFS specification.

**TCO Studies.** Tape's widening cost advantage compared to other storage mediums makes it the most cost-effective technology for long-term data retention. The favorable economics (TCO, low energy consumption, reduced raised floor) and massive scalability have made tape the preferred medium for managing vast volumes of data. Several tape TCO studies are publicly available and the results consistently confirm a significant TCO advantage for tape compared to disk solutions.

According to the Brad Johns Consulting Group, a TCO study for an LTFS-based 'Tape as NAS' solution totaled \$1.1M compared with \$7.0M for a disk-based unified storage solution. This equates to a savings of over \$5.9M over a 10-year period, which is more than 84 percent less than the equivalent amount for a storage system built on a 4 TB hard disk drive unified storage system. From a slightly different perspective, this is a TCO savings of over \$2,900/TB of data. Source: Johns, B. "A New Approach to Lowering the Cost of Storing File Archive Information," [Brad Johns Consulting Group](#), April 2013.

Another comprehensive TCO study by ESG (Enterprise Strategies Group) comparing an LTO-5 tape library system with a low-cost SATA disk system for backup using de-duplication (best case for disk) shows that disk deduplication has a 2-4x higher TCO than the tape system for backup over a 5 year period. The study revealed that disk has a TCO of 15x higher than tape for long-term data archiving. Source: A Comparative [TCO Study: VTLs and Physical Tape](#), by ESG.

### **Select Case Studies Highlight Tape and Active Archive Solutions**

[CyArk](#) is a non-profit foundation focused on the digital preservation of cultural heritage sites including places such as Mt. Rushmore, and Pompeii. CyArk predicted that their data archive would grow by 30 percent each year for the foreseeable future reaching one to two petabytes in five years. They needed a storage solution that was secure, scalable, and more cost-effective to provide the longevity required for these important historical assets. To meet this challenge CyArk implemented an active archive solution featuring LTO and LTFS technologies.

[Dream Works Animation](#) a global Computer Graphic (CG) animation studio has implemented a reliable, cost-effective and scalable active archive solution to safeguard a 2 PB portfolio of finished movies and graphics, supporting a long-term asset preservation strategy. The studio's comprehensive, tiered and converged active archive architecture, which spans software, disk and tape, saves the company time, money and reduces risk.

[LA Kings](#) of the NHL rely extensively on digital video assets for marketing activities with team partners and for its broadcast affiliation with Fox Sports. Today, the Kings save about 200 GB of video per game for an 82 game regular season and are on pace to generate about 32-35 TB of new data per season. The King's chose to implement [Fujifilm's Dternity NAS](#) active archive appliance, an open LTFS based architecture. The Kings wanted an open source archiving solution which could outlast its original hardware while maintaining data integrity. Today with Dternity and LTFS, the Kings don't have to decide what data to keep because they are able to cost-effectively save everything they might need in the future.

[McDonald's](#) primary challenge was to create a digital video workflow that streamlines the management and distribution of their global video assets for their video production and post-production environment. McDonald's implemented the [Spectra](#) T200 tape library with LTO-6 providing 250 TB of McDonald's video production storage. Nightly, incremental backup jobs store their media assets into separate disk and LTO- 6 storage pools for easy backup, tracking and fast retrieval. This system design allows McDonald's to effectively separate and manage their assets through the use of customized automation and data service policies.

[NCSA](#) employs an Active Archive solution providing 100 percent of the nearline storage for the [NCSA Blue Waters](#) supercomputer, which is one of the world's largest active file repositories stored on high capacity, highly reliable enterprise tape media. Using an active archive system along with enterprise tape and [RAIT](#) (Redundant Arrays of Inexpensive Tape) eliminates the need to duplicate tape data, which has led to dramatic cost savings.

[Queensland Brain Institute \(QBI\)](#) is a leading center for neuroscience research. QBI's research focuses on the cellular and molecular mechanisms that regulate brain function to help develop new treatments for neurological and mental disorders. QBI's storage system has to scale extensively to store, protect, and access tens of terabytes of data daily to support cutting-edge research. QBI choose an Oracle solution consisting of

Oracle's [StorageTek SL3000](#) modular tape libraries with StorageTek T10000 enterprise tape drives. The Oracle solution improved QBI's ability to grow, attract world-leading scientists and meet stringent funding conditions.

### ***Looking Ahead to 2015 and Beyond***

The role tape serves in today's modern data centers is expanding as IT executives and cloud service providers address new applications for tape that leverage its significant operational and cost advantages. This recognition is driving investment in new tape technologies and innovations with extended roadmaps, and it is expanding tape's profile from its historical role in data backup to one that includes long-term archiving requiring cost-effective access to enormous quantities of stored data. Given the current and future trajectory of tape technology, data intensive markets such as big data, broadcast and entertainment, archive, scientific research, oil and gas exploration, surveillance, cloud, and HPC are expected to become significant beneficiaries of tape's continued progress. Clearly the tremendous innovation, compelling value proposition and development activities demonstrate tape technology is not sitting still; expect this promising trend to continue in 2015 and beyond.

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