The Tape Renaissance

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The magnetic tape data storage industry has withstood numerous challenges from its own past performance, from the HDD industry, and mainly from those who are simply uninformed about the major transformation the tape industry has delivered. Early experience with numerous non-mainframe tape technologies were troublesome and turned many data centers away from using tape in favor of HDDs. Mainframe tape technology was more robust. Many data centers still perceive tape as mired in the world of legacy tape as a result. However, this view is completely out of date.

The Legacy Tape Era

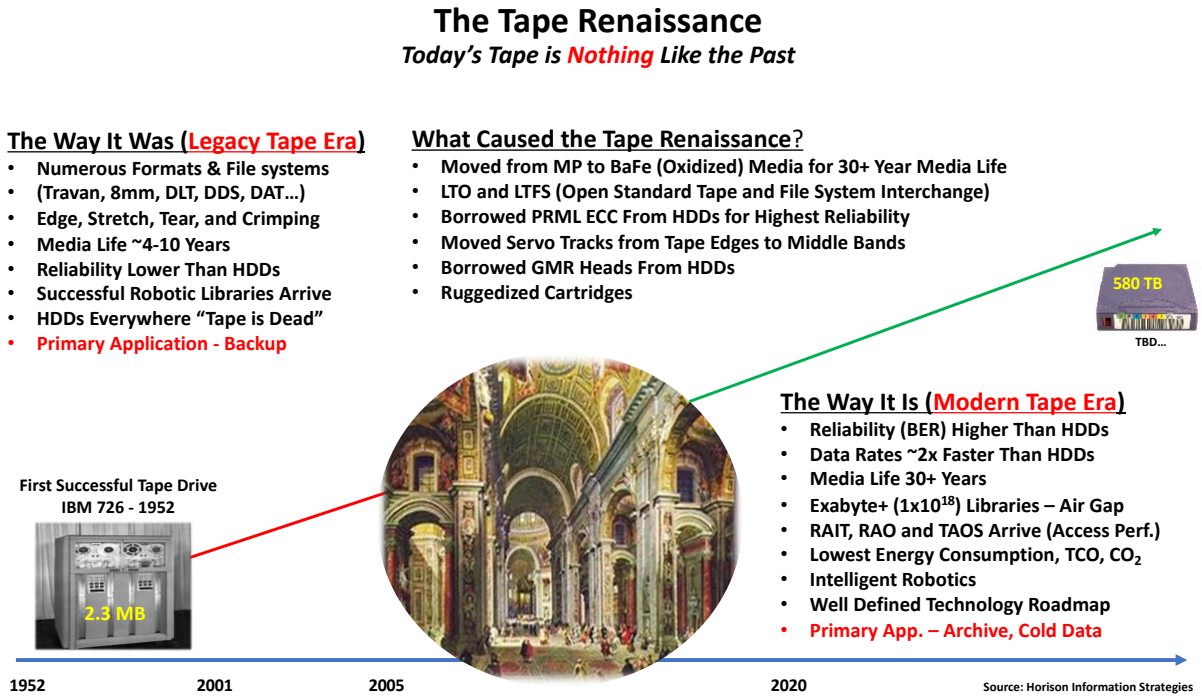
The tape problems of the past were numerous and resulted in time-consuming reliability and management issues. Edge, stretch, tear, cartridge load problems and crimping were common. The servo tracks were written on the edge of the tape media and dropping a cartridge often meant damage to the servo leaving a non-readable tape. Metal particle (non-oxidized) media life was typically 4-10 years before concerns about re-readability arose. As the issues persisted, the HDD industry took advantage of these concerns and actively pronounced “tape is dead”.

The Tape Renaissance Changes the Game

The advent of LTO (Linear Tape Open) from the LTO consortium marked the beginning of the tape renaissance. LTO was originally developed in the late 1990s as an open standard alternative to the numerous proprietary magnetic tape formats that were available at the time. Today, Hewlett Packard Enterprise, IBM, and Quantum comprise the LTO Consortium, which directs development and manages licensing and certification of media and mechanism manufacturers. The original Ultrium LTO-1 version tape system was released in 2000 with a 100 GB native cartridge capacity.

The LTO program borrowed many key technologies from the HDD industry fueling the transformation and the renaissance was underway. Tape error recovery and reliability was greatly enhanced with PRML (Partial response maximum likelihood) ECC (Error-correcting code) which converts a weak signal from the head of a magnetic disk or tape drive into a much stronger digital signal. Servo tracks were moved to the middle of the tape from the edges improving track following while avoiding any potential damages to the servo if the cartridge was dropped.

GMR (Giant Magneto Resistive) read/write heads, a mainstay with HDDs, were implemented in tape and were superior to conventional MP (Metal Particle) heads because they are more sensitive and can detect much weaker and smaller signals further improving reliability. Barium ferrite (BaFe) media arrived with LTO-6 and offered greater capacity, superior performance, and much longer archival life compared to legacy metal particle (MP) tape. Barium ferrite media is oxidized and has a media lifespan of 30 years or more and provided for much higher recording densities. Beyond barium ferrite, strontium ferrite (SrFe) is in the labs promising even higher capacities and recent laboratory demonstrations by FujiFilm and IBM indicated a record areal density of 317 GBPSI (gigabits per square inch) yielding a 580 TB cartridge is attainable. The modern tape era has arrived.



The Modern Tape Era

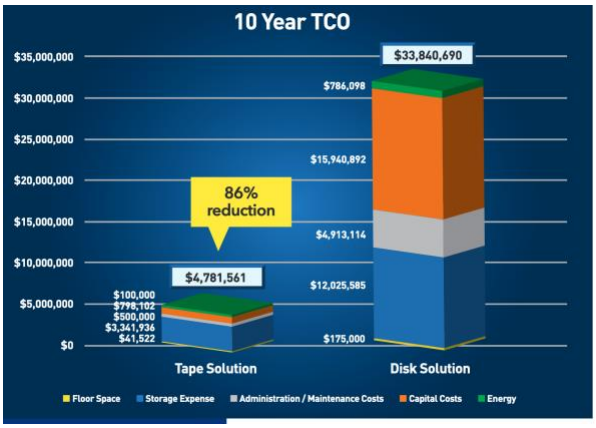
The reliability changes engineered from the tape renaissance vaulted tape into the top spot in storage device reliability with a BER (Bit Error Rate) of $1x10^{19}$ for LTO, three orders of magnitude more reliable than HDDs at $1x10^{16}$. Tape data rates have reached 400 MB/sec. on the latest TS1160 20 TB enterprise drive, more than twice the data rate of most HDDs. INSIC projects tape data rates to be as much as 5x greater than HDDs by 2025. Robotic tape library capacities have exceeded one exabyte ($1x10^{18}$) capacity.

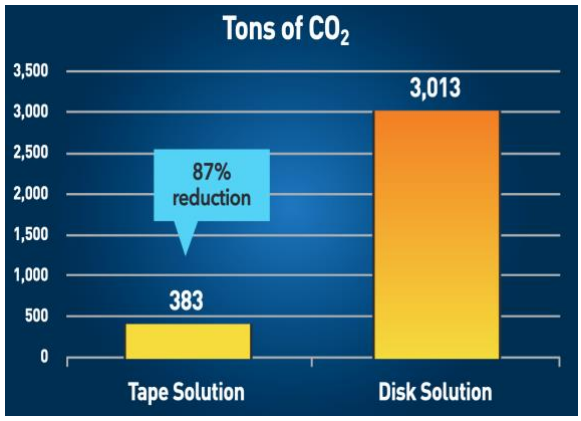
Tape is a sequential access device however the access time to the first byte of a file and data rates have seen major improvements. Tape performance optimization and acceleration techniques including RAO (Recommended Access Order – enterprise tape) and TAOS (Tape Based Access Order System – LTO tape) generate the best access order to minimize physical tape movement times between files. RAIT (Redundant Arrays of Independent Tape) provide higher aggregate data rates by striping files across multiple drives for parallel data transfer while offering fault tolerance for higher availability.

Tape continues to be the greenest (lowest energy consumption) of all storage technologies and compelling industry studies suggest the 10-year tape TCO is 86% lower than disk and the tape carbon footprint is 87% lower than disk.

Energy and CO_2 Reduction Using Tape

Key Tape Benefits





Ex: Assume 10 PB of cold data disk growing at 35% per year for 10 years.

Use the publicly available Total Cost of Ownership (TCO) tool from the LTO Consortium.

The tape TCO is 86% lower than the disk TCO.

Storing the inactive data on tape storage produces 87% less carbon dioxide.

Source: Brad Johns Consulting Reducing Data Center Energy Consumption and Carbon Emissions with Modern Tape Storage.

On Sept. 9, 2020 the LTO Program technology provider companies, Hewlett Packard Enterprise, IBM Corp. and Quantum Corp., announced the specs of LTO Ultrium format gen 9 (LTO-9), which were made available for licensing. LTO-9 will have 18 TB native and 45 TB compressed capacity per cartridge with a 400 MB/sec. transfer rate. LTO-9 delivers a 2.5:1 compression ratio, available since LTO-6, with backward read and write compatibility with the previous generation of LTO-8 cartridges. Compared to LTO-8 at 12 TB and 360 MB/sec., LTO-9 delivers a 50% increase in capacity and an 11% faster data transfer rate. In the 20 years since inception, native LTO cartridge capacity has increased 180 times.

Fighting the cybercrime epidemic has become a major problem for most data centers and tape can play a key role in its prevention. The Tape "Air Gap" is an electronically disconnected copy of data that prevents cybercrime disasters from getting to all your backup copies. You can take advantage of an electronic air gap between your backup server and backup tape storage by ensuring that backup copies are not accessible via any network or electronic connection. Most tape cartridges typically reside in library racks meaning they are offline well over 95% of the time and they are protected by the air gap and therefore are not electronically accessible to hackers.

Bottomline: Where is your perception of tape? If it is still mired in the out of date legacy era, it's time to update that perception and prepare to take advantage of the many benefits tape can bring to your storage infrastructure. The benefits of the renaissance are compelling - tape is ready for the enormous storage challenges ahead.