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Navigating Information Technology Horizons℠
Published Since 1993 Report #TCG2014019 October 30, 2014

IBM Plays Leap-Frog with Oracle — IBM's TS1150 Captures the Tape Capacity Crown

Analyst: David Reine

Management Summary

A history of past success is by no means a guarantee of future success. This is proven time after time in the sports world where a team on top basks in its glory, does not improve in the off-season, and then fails miserably in the following season. In such a case, invariably, the team that finished just behind the leaders goes out and improves to the best of their ability (and the restrictions of their budget) and in hope of being triumphant in the following year. This is equally true in the commercial world; take Nokia for example. At one time the far and away leader in "feature" cell phones, Nokia failed to push their technology to new limits, and lost ground to lower-cost manufacturers. Then, by failing to see the handwriting on the wall regarding the transition to smartphones, Nokia had to leave the cell phone business.

In the data center, any number of vendors compete for their fair share of the enterprise IT budget, not only in terms of application servers, but also for the storage of their expanding data on both disk and tape and even into the cloud. Clearly, the era of Big Data means data aplenty. There are several vendors – including IBM, Oracle, and SpectraLogic – that offer automated tape libraries capable of housing both *LTO* drives (a.k.a "open systems tape" and sold under the brand of *Ultrium*) and *enterprise* drives (a.k.a. "proprietary tape") targeted at those data centers typically more concerned about capacity per cartridge, throughput speeds, reliability, and availability, but also historical compatibility and cost. Other tape library vendors try to succeed with just open systems tape libraries, typically going after the small- and medium-sized tape storage market with LTO. Quite clearly, there are more providers of LTO tape than enterprise tape but, even here, there are just two suppliers for the enterprise tape drives, IBM and Oracle, each forcing the other to push its technology to new capacities and capabilities, all while continuing to lower the total cost of storing a petabyte of data. (Spectra Logic uses IBM's enterprise drives.)

IBM and Oracle (and the latter's tape predecessors Sun and STK) have been playing leap-frog for decades with the capacity and throughput of enterprise tape. We have detailed many of these evolutions in Clipper reports over the years. In 2011, IBM announced a 4-TB (uncompressed capacity) drive, the *TS1140 Tape Drive*[1], while just last year, Oracle announced an 8-TB drive (also uncompressed), the *T10000D Tape Drive*[2]. Competition, and the growing storage capacity demands of *Big Data*, have led to rapid advances not only in enterprise tape capacity, but also throughput. In the latest jump, IBM recently announced the *TS1150 Tape Drive*, with an uncompressed capacity of 10 TBs, a 150% increase in capacity over its prior generation. Tape (both enterprise and LTO) just continue to get better and better, while disks have struggled to grow 50% in the same two-year time frame. To learn more about the IBM TS1150 and how it can protect your investment in existing data center infrastructure and lower your total cost of ownership, please read on.

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[1] See **The Clipper Group Navigator** entitled *IBM's New Enterprise Tape Extends Data Retention Capabilities and Lowers the Cost of Data Protection* dated June 6, 2011, and available online at http://www.clipper.com/research/TCG2011021.pdf.

[2] See *Oracle's StorageTek T10000D Further Reduces the TCO for Storing Data on Tape* in **The Clipper Group Navigator** dated September 12, 2013 and available at http://www.clipper.com/research/TCG2013017.pdf.

The Role of Tape in the Enterprise Data Center

One thing that we know today with certainty: the volumes of data being stored, especially *Big Data* being preserved and used for analytics of all sorts, continues to spike upwards, with no end in sight. The requirement to preserve and protect that data for immediate retrieval – and for years to come – persists. In fact, for many if not most enterprises the requirement for additional storage is doubling every 12-to-18 months; unfortunately the budget to support it remains about the same or is being reduced.

Which media is best for the preservation of files and long-term data is a question that has been given significant coverage in The Clipper Group's bulletins over the years. In the past two years alone, we have looked at many aspects of using tape in the enterprise data center.

- In March 2013, we explored the competitive advantages of enterprise tape versus the newest version of open systems tape (*LTO-6*) and drew the conclusion that enterprise tape has a clear advantage over LTO-6 in terms of capacity and performance and is very competitive with the LTO solution in terms of TCO.[3]
- In May 2013, we published an extensive total cost of ownership (TCO) study comparing disk and tape solutions for archiving, which showed many resounding advantages for tape.[4]
- In July of this year, we looked again at the advantages of using tape and reiterated our conclusions based upon the rapid advancements being made in tape technology.[5]

From a usage and reliability standpoint, enterprise tape was and has continued to be a clear victor. In the inimitable words of Mark Twain (sort of): *Despite what you may have heard from the purveyors of disk arrays, reports of the death of tape have been greatly exaggerated.*

In fact, the role of tape in the preservation of files and archives, especially for long-term storage, has never been greater.[6] *Tape is thriving*. With tape re-entrenched within the enterprise data center, **the question moves from *"Should we use tape?"* to *"Which tape should we use?***

Many advocates of tape have been impressed with the open systems qualities, capacity, performance, and reliability of *LTO* tape drives and media. However, in a growing number of enterprise data centers, LTO tape does not have the scalability, throughput, and reliability needed and offered by enterprise tape.

The newest enterprise tape offering is from IBM, which has persevered for decades to climb steadily through what had been perceived to be capacity ceilings. Its new offering is the *IBM TS1150 Tape Drive* – with a native capacity of 10 TBs.

IBM TS1150 Characteristics

IBM TS1150 tape technology provides the data center with enterprise-class reliability, with an MTBF of 237,000 hours and a bit error rate that IBM claims is 1000 times more reliable than other technologies. It also boasts both the highest tape capacity and highest tape drive data throughput rate, while, at the same time, protecting the investment that many enterprise data centers have made in earlier *TS1140* technology. By enabling the data center to store more data, and retrieve it faster, the TS1150 can support high-performance computing and resolve many data management issues surrounding the volume of data cartridges being supported. The TS1150 technology has an outstanding set of features, as highlighted in Exhibit 1, at the top of the next page.

The *IBM 3592 Advanced data tape cartridge for the TS1150* now provides up to 10 TBs of native (uncompressed) capacity, 25% more than the Oracle T10000D (with a native capacity of 8 TBs), and four times the capacity of an LTO-6 cartridge (with 2.5 TBs of native capacity). The same 10-TB capacity applies to the IBM 3592 Advanced WORM[7] cartridge, which becomes

[3] See The Clipper Group Captain's Log entitled *Enterprise Tape for Archival Storage? – Why This Just Might Make Sense* dated March 31, 2013, and available online at http://www.clipper.com/research/TCG2013005.pdf.

[4] See the issue of The Clipper Group Calculator dated May 13, 2013, entitled *Revisiting the Search for Long-Term Storage – A TCO Analysis of Tape and Disk*, and available at http://www.clipper.com/research/TCG2013009.pdf.

[5] See the issue of Clipper Notes dated July 5, 2014, entitled *Is Tape the Best Low-Cost Technology for the Preservation of Data?* and is available at http://www.clipper.com/research/TCG2014015.pdf.

[6] Of course, there's a role for rotating disks and flash storage. If data needs to be made available instantly (think a second or less), then tape is not the answer. But if a minute is tolerable or the amount of data is vast, tape usually makes a lot of sense, especially when the cost of storing and retrieving data is considered.

[7] WORM=Write Once Read Many. For more on WORM, see **The Clipper Group Navigator** entitled *IBM Adapts 3584 Tape Library for ILM - 3592 Drive adds WORM Option* dated May 9, 2004, and available at http://www.clipper.com/research/TCG2004048.pdf.

Exhibit 1— TS1150 Technology Features

- **Speed Matching** – The TS1150 has 12 read/write speeds to enable the drive to stream data from slower hosts, improving throughput and reliability;
- **Read Ahead** – The TS1150 has a larger buffer to read ahead and cache up to 2,000MB of compressed data for better performance in "short-hop" file locate operations;
- **High Resolution Tape Directory and Virtual Backhitch** – This improves the performance of small file reads/writes while reducing wear on the tape media;
- **Backwards Compatibility** – This feature enables the TS1150 to read/write to a TS1140 cartridge and reformat that cartridge to a 7 TB capacity; and
- **Linear Tape File System** (**LTFS**) – LTFS allows users to organize and search tape media with the same access methodology as a hard disk, thus simplifying the storage and retrieval of files on tape.

Source: IBM

a necessity in any environment governed by regulations to guarantee the unaltered authenticity of the data being stored.

The TS1140 cartridge can be reformatted from a current capacity of 4 TB to a new capacity of 7 TBs, a 75% increase for free, protecting the enterprise investment in current technology by enabling the reuse of existing TS1140 media.[8] IBM also provides a shorter, smaller capacity, and lower-cost cartridge providing fast access to up to 2 TBs of data. This is 25% more than the 1.6 TBs available on Oracle's T10000D "Sport" cartridge. The TS1140 short (economy) media also can be reformatted to the TS1150 format, thus increasing its capacity from 500GB to 900GB and providing faster access to your data than with a full-length data cartridge.

The IBM TS1150 provides the enterprise with a high-performance, flexible data storage device with information security courtesy of AES-256 bit encryption that works with IBM's *Security Key Lifecycle Manager* and WORM for advanced data integrity. The TS1150 can be used to increase library density while maybe reducing or slowing the need for more floor space, and can help optimize the utilization of tape drives because it holds more data per cartridge, thus potentially reducing infrastructure requirements.

The TS1150 drives can be shared between IBM mainframes, *Power Systems* servers, and a heterogeneous mix of open systems x86 platforms. Additionally, the TS1150 helps to protect an enterprise's investments in IBM tape automation by providing compatibility with existing libraries, including the *IBM TS3500*[9] and the new *IBM TS4500*[10], enabling scalability to – literally – petabytes of storage. In addition, IBM also has made available an option to upgrade existing IBM TS1140 tape drives to TS1150.

The TS1150 continues to support LTFS for direct, drag and drop simplicity for access to files stored on tape, thus enabling a fast and easy way to gain access to the data center's growing (in number and volume) collection of files, thus helping satisfy today's requirements for scalability in capacity and performance. IBM's *Linear Tape File System Enterprise Edition* (*LTFS EE*) gives organizations an easy way to use cost-effective IBM tape drives and libraries within a tiered storage infrastructure by keeping track of which file is on which tape cartridge.

With an average file access time of 40 seconds, the TS1150 drive can locate and retrieve the desired file at the same speed as the TS1140, even though more data can be stored on a TS1150-formatted cartridge, This average is faster than for LTO-6 tape drives (at 47 seconds) or for Oracle's *T10000D* (50 seconds). With a native data transfer rate of up to 360MBps (uncompressed), the TS1150 can deliver data from tape faster than ever before, a great benefit for today's cloud, mobile, and social media users. This compares quite favorably with the data transfer rate of the TS1140, the previous generation of IBM's enterprise drive, which maxed out at 250 MBps and just about matching the Oracle *T10000D* at 252 MBps. In fact, this is 45% faster than the TS1140 and 125% faster than the throughput of LTO-6 at 160 MBps. This significant

[8] However, the reformatting is destructive in that it writes over what was there before, so any resident data must be relocated prior to the reformatting process.

[9] See **The Clipper Group Navigator** entitled *Big Data Requires Big Storage - IBM Increases TS3500 Capacity – Again!* dated October 25, 2012, which is available at http://www.clipper.com/research/TCG2012024.pdf.

[10] See **The Clipper Group Navigator** entitled *Controlling the TCO of Long-Term Storage – IBM Introduces the TS4500 Tape Library* dated July 21, 2014, and available online at http://www.clipper.com/research/TCG2014016.pdf.

improvement in throughput enables the data center to reduce the number of drives required to meet service levels while also reducing the energy consumption level two ways: first, when compared to the T10000D (50W compared to 90W)[11] and, second, by reducing the number of drives required. The TS1150 also has a faster load/ready time than the TS1140, improving to 11 seconds from 16 seconds, and a faster locate/search speed that delivers an improvement of about 25%.

When you incorporate data compression into the equation, the effective transfer rate increases to up to 700 MBps for the same maximally compressible data, i.e., with the same 3:1 compression ratio as used on the TS1140.[12] Of course, this is variable based upon the nature of the data being compressed; your results may vary, which is why we choose to focus on the native (uncompressed) rates most of the time. The TS1150 also promotes flexibility, with the capability to read and write TS1140 tapes in native format as well as when reformatted to denser TS1150 format.

What does all of this mean to the enterprise data center?

First, in a fully configured IBM TS4500 Tape Library, with a base frame (*L25*) and the maximum three *S25* high-density frames in a single string, the TS4500 can support up to 3550 enterprise cartridges, probably using fewer TS1150 drives (than TS1140 or other drives) because of the TS1150's higher throughput. This helps to control infrastructure TCO, and often lessens energy requirements and labor costs.

This maximum configuration yields the highest density in TBs per square foot and the lowest energy utilization per TB stored. With 3:1 compression in place, each full-sized TS1150 cartridge can contain up to 30 TBs of data, for a total capacity of 106,050 TBs, or 106 PBs in a four-frame TS4500 Library.[13]

A single frame TS4500 Library can support up to 5.5 PB of native storage capacity in a 10 square foot area, more than three times more capacity than the IBM TS3500 when compared to a single TS3500 frame and same number of drives.

In addition, the new TS1150 drive's dramatic increase in transport throughput (44%) over the TS1140 drive might enable the data center to deploy fewer drives to achieve the same volume of data reads and writes.

Without knowing your existing configuration or requirements, all we can do is ask: *How many PBs can you deploy today per square foot? How much can you save in floor space charges? How much is it costing you to store a TB on tape (or disk)?* Given the new capacity and performance characteristics of the TS1150 drives and cartridges, it seems clear that moving up to TS1150s can lower the TCO of your long-term storage infrastructure and reduce the fear that an expanding storage requirement will force you to build a new data center, no doubt at what would be a cost of additional millions to your IT budget. That is worth investigating, isn't it?

Conclusion

With the thirst for more storage capacity, especially to retain more analytical information (Big Data), the amount of long-term storage in your enterprise data center is expanding by leaps and bounds, no doubt seemingly without control. Now, it behooves IT management to assume that control, to reduce both in terms of cost per terabyte stored and floor space consumed. One way to do that is by deploying the densest storage infrastructure that can provide the performance, scalability, flexibility, security, and reliability that your enterprise requires.

As we have seen in the past, tape continues to be the best, low-cost answer for your long-term and large-scale storage needs. Tape continues to provide the data center with the features and qualities needed for the data center staff to rein in the uncontrolled proliferation of storage costs within the enterprise. **Whatever you are using tape for or are considering, the TS1150 simply makes most situations better.** If all of these requirements sound familiar, IBM may have the best solution with it TS1150 tape drives and cartridges.

With the TS1150, IBM has reclaimed the capacity and performance leadership usurped by Oracle last year. It may be worthwhile (again) to rethink what the latest in high-capacity, high-performance enterprise tape can do for you. Check it out!

[11] It should be noted that LTO-6 has an energy consumption of only 27W. Tape solutions are very energy efficient when compared to spinning disks.

[12] The increased transfer rate is achieved by an increase in the buffer size from 1KB to 16KB.

[13] A fully configured TS4500 with one *L25* (base frame) and three *S25* high-density frames occupies only 40.05 square feet, the same as the TS3500.

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About the Author

David Reine **is a Senior Contributing Analyst for The Clipper Group.** Mr. Reine specializes in enterprise servers, storage, and software, strategic business solutions, and trends in open systems architectures. In 2002, he joined The Clipper Group after three decades in server and storage product marketing and program management for Groupe Bull, Zenith Data Systems, and Honeywell Information Systems. Mr. Reine earned a Bachelor of Arts degree from Tufts University, and an MBA from Northeastern University.

- ***Reach David Reine via e-mail at dave.reine@clipper.com or at 781-235-0085 Ext. 123. (Please dial "123" when you hear the automated attendant.)***

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