



Ten Reasons Why You Should Consider Enterprise-Class Tape for Open Systems Storage

Analyst: David Reine

Enterprise-Based Storage Requirements

As we have seen over the past few years, storage requirements are exploding throughout the enterprise. Nowhere is this more evident than in the enterprise data center. Moreover, within the data center, requirements for Tier-3 storage in support of long-term archiving and also for data backup and recovery is placing a tremendous strain on enterprise resources, both human and financial. Last year (December 2010), The Clipper Group did an exhaustive comparison of the effects of both disk and tape on the enterprise budget, on a total cost of ownership (TCO) basis, comparing the two architectures¹. For disk, we used 2TB SATA drives, the most commonly used high-capacity disk storage unit. For tape we used LTO-5 technology², the most commonly used tape architecture, with an uncompressed capacity of 1.5TB, the highest capacity tape media, *at that time*.

However, since then we have seen two new tape drives introduced into the *enterprise-class tape tier*³: IBM's *System Storage TS1140* and Oracle's *StorageTek T10000C*. Both of these drives significantly raised the capacity ceiling from previous drives in the same families, IBM's *System Storage TS1130* and Oracle's *StorageTek T10000B*.

- The TS1130 has an uncompressed capacity of 1TB, while the new TS1140 has an uncompressed capacity of 4TB.
- Oracle's T10000B also had a 1TB capacity, with the new T10000C increased that to 5TB.

Based upon capacity alone, these new drives would appear to cast a very long shadow over the LTO-5 technology. However, capacity is definitely not the only factor that determines an enterprise decision on this tier of storage. There are many factors that go into this decision, including performance, reliability, and the TCO, any of which may be the most important factor.

Total Cost of Ownership Factors

First, let's be very clear: I am not talking about small or even medium-sized enterprises. This is about the largest data centers; the ones with mission- and business-critical tape libraries with many petabytes of data on – literally – thousands of data cartridges. These large data centers are using these

¹ See the issue of *Clipper Notes* dated December 20, 2010, entitled *In Search of the Long-Term Archiving Solution – Tape Delivers Significant TCO Advantages over Disk*, and available at <http://www.clipper.com/research/TCG2010054.pdf>.

² See *The Clipper Group Navigator* dated January 29, 2010, entitled *LTO Program Announces Next Gen Tape – LTO-5 Raises the Bar for Tier-3 Storage*, available at <http://www.clipper.com/research/TCG2010002.pdf>.

³ The *enterprise-class tape* nomenclature has its origins in tape for use with IBM mainframes. That still is one of the differences between enterprise-class tape and tape for *open systems*, which today is dominated by LTO. **What may be less obvious, and is the question being raised in this paper, is that enterprise-class tape also works with open systems, including in data centers without a mainframe.** It used to be somewhat clear cut. If you had a mainframe, you had enterprise-class tape. If you had only open systems, you would have open (LTO) tape. If you had both kinds of systems, you might have only enterprise-class tape or you might have both in your data center. Given that IBM, Oracle, and Spectra Logic tape libraries can contain cartridges of both enterprise and open tape types, having both in your library is worthy of consideration. There are differences in how these vendors accommodate both in the same library, but to the data center with many PBs of data, the operational and cost differences are not significant.

libraries for the long-term storage of daily, weekly, and monthly backups, along with serving as the primary storage target for most, if not all, of their enterprise archiving requirements. Some, but not all, of these data centers will be equipped with mainframes, but many will not have any. As a general rule, SMBs need not apply!

It goes without saying that enterprise-class tape has a higher acquisition cost than LTO for both the tape drives and for the media⁴. However, this does not mean that enterprise-class tape has a higher TCO per unit of storage. Enterprise-class tape delivers more in quantifiable values, such as capacity per cartridge and throughput. This, in turn, means shorter backup windows. With fewer slots and cartridges and potentially less floor space, the cost per TB/PB/EB tends to be reduced significantly, because fewer drives, slots, and cartridges will be needed. This brings us to reliability. First of all, if you have a mainframe, you already know about the reliability attributes of enterprise-class drives. They are worth every penny that you pay for them.⁵ In addition, if you have multiple spare drives (LTO or enterprise-class) installed, the reliability issue basically is significantly lessened or neutralized in terms of downtime.⁶

In addition, what's ahead has more to do with this than you might think. The current generation of enterprise-class drives already has a higher native capacity and delivers higher throughput than the planned *next generation* of LTO technology, *LTO-6*, which is slated to have 3.2 TBs per cartridge with a transfer rate of 210MB/second⁷. In addition, we can expect that the next generation of enterprise-class drives will have even greater densities three years from now, probably 50 to 100% more. That will put the next generation of enterprise-class drives at about 6-10 TBs uncompressed, at least.⁸ That's a lot more than the 3.2 TBs projected for LTO-6. Greater native density equates to fewer library slots, less floor space, and, most likely, fewer drives. In addition to these quantitative calculations, there is also the benefit of using what likely will be drives of higher quality and reliability. So the question comes down to TCO. If enterprise-class drives cost about the same per TB/PB/EB, and if the libraries are the same, and if the performance per dollar invested is about the same, which should you buy?

So, let's take a look at the TCO issues that go into any tape drive acquisition and the components that comprise it.

- 1. Drive acquisition cost** – The acquisition cost of the tape drive is relatively minor in comparison to the cost of the media required to store the data. We have noticed that the cost of an LTO-5 tape drive for installation in an enterprise library may be \$5K-\$20K less (per drive) than the cost of one of the new enterprise-class drives. However, because of the throughput advantages and larger capacities of the enterprise-class drives, you may need fewer drives. In that case, enterprise-class drives may end up costing less than the LTO-5 drives when the IT staff considers the numbers of drives required and the TCO involved in deploying them.⁹
- 2. Media acquisition cost** – The cost for a cartridge is not nearly as important as the cost per TB for the media. An LTO-5 cartridge may only cost ~\$75-\$100 while enterprise-class drive media may cost ~\$300 - \$450 each. The difference in cost/TB, however, is not nearly as significant. For LTO-5, the cost/TB is ~\$67/TB, based upon a media cost of \$100. The cost/TB for an enterprise-class cartridge is now in the range of about \$60 to \$100.¹⁰ While all drives allow the reuse of media for writing with the latest drive, some enterprise-class drives also enable the IT staff to reformat the previous-generation media to a higher density. This is a double bonus. You get to reuse old media and can store more capacity. However, the first bonus is truly the important one, as you usually can take advantage of the next generation drive's new features on existing media.

⁴ And, for IBM's frames that hold the media, there is a lesser density for enterprise frames than for LTO frames. This needs to be considered in the total cost of ownership for IBM's enterprise-class tape solutions.

⁵ But, of course, you had no choice but to use enterprise-class tape with your mainframes.

⁶ A drive can be considered a spare when it is above and beyond the number needed to handle the largest expected peak activity.

⁷ From the LTO roadmap: see <http://www.lto.org/technology/generations.html>. LTO-6 is likely to show up in 2013.

⁸ This next generation of enterprise-class tape might come in 2014.

⁹ The same logic applies to out-of-warranty maintenance. However, because maintenance usually is based on purchase price, the cost of maintaining an enterprise-class drive will be higher per drive than for LTO.

¹⁰ The cost for these new enterprise-class cartridges will go down, as they become more readily available. Both LTO and enterprise-class media go through a cost-reduction curve, as additional manufacturers begin to produce them.

3. **Number of slots needed** – With a capacity of 4 or 5TB today, the enterprise-class drive has a significant advantage over LTO-5, in terms of the smaller number of cartridges (and slots) needed, and therefore (potentially) a need for fewer library frames. As stated above, with a current capacity of 4 to 5TB, the enterprise-class drives already have a higher uncompressed capacity than the proposed LTO-6 cartridge, with a projected uncompressed capacity of 3.2 TB. The native capacity of the next generation enterprise-class drive is unknown, but today's enterprise-class drives will require only 30-37.5% of the slots required by LTO-5, ignoring compression, which tends to be somewhat greater on the enterprise-class drives.¹¹ We can only assume that the next generation of enterprise-class drives will be 50% to 100% greater. The number of cartridges required to hold petabytes of archived data today is significantly less than with LTO-5.
4. **Less floor space** – With significantly fewer cartridges, the data center will be able to support an even larger archive in less floor space, decreasing the number of frames needed to be deployed and potentially increasing the useful life of the physical plant, saving millions of dollars in projected construction costs.
5. **Throughput performance** – The throughput performance of an enterprise-class drive is in the 240 to 250MB/second range, while LTO-5 has a native throughput of 140MB/second. This will enable the data center to reduce the number of drives required, potentially lowering the TCO, due to lessened acquisition and maintenance costs. LTO-6 has a projected native transfer rate of 210MB/second, leaving the current generation of enterprise-class drives with a noticeable edge over the next generation of LTO technology. In addition, while we do not know the throughput for the next generation of enterprise-class drives, we do know that this generation has increased performance by over 50%, when compared to the previous generation.
6. **Other performance metrics** – Comparing the performance metrics for a variety of drive features is also revealing. The average file access time for LTO-5 is around 50 seconds for a 1.5TB cartridge. The average file access time for an enterprise-class drive is between 35 to 60 seconds for a full-length cartridge (4-5TB). This translates to 33 seconds/TB for LTO-5 and 9-12 seconds/TB for enterprise-class drives. The rewind time is also interesting, with a rewind time of 90-95 seconds for LTO-5 (1.5TB) and a rewind time 75-125 seconds for the much longer enterprise cartridges. These equate to significantly better operational performance for the enterprise-class media.
7. **Reliability** – Enterprise-class tape drive and cartridges historically have delivered higher reliability and more capability than other formats, resulting from a mainframe heritage where duty cycles are higher and such superior reliability is expected, and certainly is one reason why a higher acquisition cost for enterprise-class tape has been accepted. LTO-5 delivers more capability, in terms of capacity and write speed than LTO-4, and, for many data centers, was approaching the previous generation of enterprise-class drives in terms of reliability, with an MTBF of 250,000 hours at 100% duty cycle. The uncorrected Bit Error Rate (UBER) for enterprise-class drives has a value of up to 1×10^{-19} and continues to be better than that for LTO-5 at 1×10^{-17} . While this may not be a meaningful cost issue, it may be important, if you need to be certain that the data you write is going to be there when you need it, enterprise-class drives are about 100 times more reliable.
8. **I/O Interface** – LTO-5 drives come with both a 6Gb SAS interface and an 8Gb FC interface for automation. (They do not support iSCSI.) Enterprise-class drives come with up to an 8Gb FC interface in addition to FICON or ESCON for connection to a mainframe.¹² Your existing IT infrastructure may well dictate which direction you need to take. The question being raised in this paper is whether you should be using enterprise-class drives for open systems uses, which implies Fibre Channel connectivity. If you have mainframes and open systems, only enterprise-class drives offer both network connections.¹³

¹¹ While the compression algorithms in both LTO and enterprise-class drives are similar, mainframe data typically compresses at a higher rate than open systems data. Your mileage may vary based on your data and the fullness of your cartridges.

¹² This is one area where the approach to connectivity differs between IBM and Oracle. This may add to your TCO, depending on how you plan to handle ESCON/FICON and Fibre Channel in a mixed environment. For example, will you (by either desire or architectural necessity) have to dedicate certain enterprise-class drives to be used only for mainframes and only for open systems?

¹³ There is an exception. If you are only running Linux on IFLs in your mainframe, you don't necessarily need FICON/ESCON connectivity to disk and tape.

9. **Energy consumption** – The energy consumption of enterprise-class drives continues to go down given that fewer drives will be required. This factor also is relevant when comparing enterprise-class drives with LTO-5, based upon the number of drives required. However, the amount of energy consumed is inconsequential when compared to the energy consumed by disk in an archival environment. In addition, fewer frames and thus less energy also will be needed for an equivalent capacity of enterprise drives).
10. **Other Features** – While both LTO-5 and enterprise-class drives currently support both encryption and WORM, right now only LTO-5 fully supports the *Linear Tape File System*. While some enterprise-class drives are *enabled* to support LTFS, LTFS has not yet been updated for support of the enterprise-class drives. This software update is expected to be complete by 4Q11. If you need to deploy an application using LTFS immediately, then you will need to deploy LTO-5 drives and media. Enterprise-class tape drives tend to offer a more robust set of features than LTO drives, mostly designed to improve drive efficiency.¹⁴

Conclusion

From a pure capacity and performance standpoint, enterprise-class drives from either IBM or Oracle have distinct advantages over the commodity LTO-5 drives, not only today, but also for the foreseeable future. Obviously, this comes at a higher unit price, mostly in terms of a significantly higher acquisition cost per drive and per cartridge. However, from a TCO standpoint, the aggregate cost may not be any (or much) higher at all. In fact, depending upon your configuration and your environment, the TCO for enterprise-class drives could be lower.

From a functionality standpoint, LTO-5 has features and functions quite comparable to the enterprise-class drive features. In fact, the LTO technology of today already works today with LTFS, while we will only begin to see the changes required in LTFS for enabled enterprise-class drives by the end of 2011. From a reliability standpoint, enterprise-class drives have always been regarded as superior to commodity drives, with a higher data integrity rating.

If your decision is being based solely on the impact to your budget, do not fear the higher acquisition price of enterprise-class drives and media. **In the long run, enterprise-class drives could end up costing you less. You really need to think about this! Do the math!**



¹⁴ Examples of enterprise-class features are: Virtual Backhitch, Data Integrity Validation, Tape Tiering, In-Drive Reclaim, Hardware Assisted Search, etc.

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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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