LTO-7 Tape Introduced with Higher Capacity and Throughput

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Management Summary

In spite of the lower cost of gasoline, the trend still is toward smaller vehicles. It used to be that smaller vehicles always meant "less expensive," but no more, as electronics, safety, and convenience features drive up the prices. One way to describe this is "getting less for more." That surely is true on a cost per cubic foot or cubic meter basis. From an economics perspective, this seems to be taking us in the wrong direction. What many of us want is "more for less."

When it comes to storing data, getting more for less really rings true. There has never been a greater need for lower-cost, high-capacity Tier 3 storage. Analytics, Big Data applications and an explosion of large images and files from media, entertainment and healthcare industries (just to mention a few) are some of the driving forces that have created the need for the long-term retention of "just about everything," i.e., to preserve, protect and deliver valuable enterprise data. However, these applications do not necessarily have the requirement for the high-performance access provided by Tier 0 solid state devices, or even the performance of Tier 1 disk devices. You could put them on disk (Tier 2) but the need for both operational efficiency and cost effectiveness can be achieved with the Tier 3 deployment of high-capacity tape media as the vehicle for the long-term protection of valuable enterprise resources.

Over the course of the past two decades we have seen data centers of all sizes adopting, returning to, or expanding tape library facilities to preserve an ever increasing volume of data with low-cost tape. Keeping pace with the demands of these enterprise data centers has not been easy, but an increasing number of them have been meeting these requirements with the deployment of an open technology system called *Linear Tape Open*, or *LTO*, also called *Ultrium*. The first release of LTO (called "LTO-1" to connote first generation), was deployed in 2000 with cartridges containing up to 100GBs (gigabytes) of raw data, or 200GBs when a 2:1 compression ratio could be applied, with a data transfer rate of up to 40MB/second with compression. Since then, we have seen a series of generational updates every two-to-three years to boost the capacity and performance of this technology, as well as the inclusion of advanced functionality previously only available in so-called "enterprise tape devices", which culminated in 2012 with the release of LTO Generation 6 (LTO-6). LTO-6 has a remarkable capacity of 2.5TBs (yes, terabytes), with a compression ratio of 2.5:1 enabling the storing up to 6.25TBs of compressible data. In addition, LTO-6 has the throughput capability of 400MB/second (compressed), a tenfold increase over LTO-1. LTO-6 also has all of the functionality introduced in previous version: WORM, encryption, and partitioning in support of the *Linear Tape File System* (*LTFS*), which enables the applications and users to access files on tape as they would on disk. Unfortunately for the data center staff, it still costs too much and takes too long to store all that needs to be stored to meet storage demands that, for many, are doubling every 12-to-18 months.

Quite fortunately, the LTO Program now is ready to once again raise the ceiling on LTO technology with *LTO-7*. With a native capacity of 6TBs, LTO-7 can support up to 15TBs of compressible data and, with a native throughput

Exhibit 1 – Comparing LTO-7 Cartridges to Earlier LTO Generations

Ultrium Generation	Native/Raw Capacity (in TBs)	Raw Capacity Relative to LTO-7	Average Compression Ratio	Compressed Capacity (in TBs)	Compressed Capacity Compared to LTO-7	Raw Data Maximum Throughput (in MB/s)	Raw Data Maximum Throughput (in MB/s) Compared to LTO-7	Compressed Data Maximum Throughput (in MB/s)	Compressed Data Maximum Throughput (in MB/s) Compared to LTO-7
LTO-7	6.0	100.0%	2.5:1	15.00	100.0%	300	100.0%	750	100.0%
LTO-6	2.5	41.7%	2.5:1	6.25	41.7%	160	53.3%	400	53.3%
LTO-5	1.5	25.0%	2:1	3.00	20.0%	140	46.7%	280	37.3%
LTO-4	0.8	13.3%	2:1	1.60	10.7%	120	40.0%	240	32.0%

Source: LTO Program with Clipper Calculations

of 300MB/second, LTO-7 can store and retrieve compressible data at up to 750MB/second. (See Exhibit 1, above, for a comparison to earlier LTO generations.) To learn more about how LTO-7 can improve your data center efficiency while lowering the total cost of ownership of your IT infrastructure, please read on.

Why Tape Makes Sense

In today's data center environment, a great number of files (and other items stored) hardly ever are updated, or even accessed. However, they must be retained to meet government, industry, and competitive requirements, even though no one can predict their future access needs. For many data centers, tape has been the media of choice for long-term storage due to its lower cost, and – with the expected regular drumbeat of generational improvements in capacity and performance – will continue to be so.

The ever-increasing burden being placed on data centers by rapidly expanding storage requirements and the rising costs for administration, energy and floor space, make tape an even more attractive option than ever before. In fact, the costs associated with energy and floor space may be insignificant when compared to the fact that there simply might not be enough energy to expand your existing data center. What costs would you be facing if you were forced to build a new data center? I suspect that the bottom line would be in the millions.

While the access pattern for this amount of data may be irregular, the need to access it still exists. Whether it is for the occasional access to acquire new analytical insight for improving enterprise profitability or simply ensuring the executive board that all of their files have been preserved for regulatory purposes, enterprise applications and users must have access to each and every file or object. At one time, this

required data to be stored on disk for direct access, but now, with the availability of LTFS, files and objects stored on tape typically can be accessed within seconds and at a much lower cost than for disks. LTFS is a self-describing format for archiving data files and objects to tape, enabling users to make higher-level software changes without impacting their ability to access data.

This is where LTO-7 may come in to save your budget, and, perhaps, your job.

Lowering Costs with LTO-7

I don't know about you, but I just love it when a plan comes together, even more so when that plan comes in on time, and just in time to resolve a festering problem before it becomes a crisis. LTO-7 arrives with increased capacity thus reducing the number of cartridges required to protect your files/data, and, improves throughput to provide a faster access to that data. First, let's take a look at the advantages that the data center can achieve by upgrading from LTO-6 to LTO-7, but keep in mind that the story will be even more compelling if you still are storing data on LTO-4 or LTO-5.

With a native, or raw, capacity of 6TBs[1] and a compressed capacity of 15TBs, the data center can store 2.4 times the storage capacity on a single LTO-7 tape cartridge than they can with LTO-6 with a similar compression ratio. (As with all compression algorithms, your results may vary depending on the compressibility of your data.) What does this mean in terms of floor space or density? The data center can reduce the rack space holding off-line cartridges by 140% or reduce the number of frames for nearline access by a similar amount. With a

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[1] This capacity will be reduced slightly for cartridges formatted for LTFS, as the index takes up a little space.

native throughput of 300MB/second, an LTO-7-based tape library system can retrieve (and store) data almost 90% faster than a data center deployed with LTO-6 drives and cartridges (which have 160MB/second native speed). How much is that worth to your CxO? These numbers are significant, but not nearly as much as when you compare LTO-7 with LTO-5, which still is deployed widely in many enterprise data centers around the world, often under an "upgrade every other generation" policy. LTO-7's write and read performance improvement alone may be worth the decision to upgrade, even if it only is to be for newly written data.

In addition, LTO-7 has the capability to write-back one LTO generation, and read-back two LTO generations, enabling the data center to maintain the existing investment in LTO media, if it so desires. Thus, it isn't uncommon for data centers to upgrade drives and cartridges every two generations. If you are on LTO-5 or earlier, migrating from older generations to LTO-7 may make a lot of economic and operational sense. If you now are on LTO-6 and are experiencing a lot of data growth, switching now to LTO-7 also might make economic sense.

LTO-5 has a native capacity of 1.5TB with a compression ratio of 2:1[2], delivering up to 3.0TBs of capacity per cartridge. In comparison to LTO-5, LTO-7 has *four times* the raw capacity in native mode, and a whopping *five times* the capacity when compressed at a 2.5:1 compression ratio. In terms of performance, LTO-5 has a native throughput of 140MB/second, with a compressed throughput of 280MB/second. Thus, LTO-7 has *more than twice* the throughput of LTO-5 in native mode, and can process up to *2.5 times* that <u>when</u> compressed at the average ratio. You will have that CxO calling you to find out your secret!

Furthermore, take a look at the rate that enterprise data is expanding and extrapolate that out three years or six years. Even with these previously unheard of capacities for LTO-7, you could find yourself in similar hot water a few years into the future. However, here is where the track record of the LTO Program should provide an increased ceiling space for your data center. The official roadmap[3] for the LTO technology

for LTO-8 and LTO-9 are already on the drawing board, with a native capacity of at least 12.8TB for LTO-8 and 25TB for LTO-9. Breathe easy.

Conclusion

If your data center is currently using LTO technology, then the decision to upgrade to LTO-7 should be an easy one. You will significantly reduce the number of cartridges that you are maintaining (if you migrate data from older cartridges) and you will use fewer new cartridges and library slots for the new data coming in. At the same time, LTO-7 will improve the response time for all applications and file/data retrieval, as compared to previous generations of LTO.

If you are not currently using LTO tape for your long-term storage requirements, there is plenty of evidence that you should be. If your data center is concerned about the costs associated with spinning disk media, or simply wants to lessen the energy required and the space needed to house your data, LTO-7 may be the answer. Do yourself a favor and find out about the advantages available to your data center with LTO-7.

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[2] Compression/decompression is done in real-time by the LTO drive.

[3] See the LTO road map at http://www.lto.org/wp-content/uploads/2014/09/LTO_10GenChart_2014-e1410340087608.jpeg.

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