



The Impact of LTO-7 on The TCO of Long-Term Storage

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Management Summary

The rapid development of technology in all fields has created a dilemma for the consumer, in both personal and professional activities. Basically, every consumer must put a stake in the ground when he/she determines that the product being acquired meets all of the requirements to satisfy all of their needs for the foreseeable future. Nowhere is this more evident in both the personal and professional arenas than in the acquisition of a personal computer (or tablet or smartphone), either for the home or the office. History has shown us that Intel, Samsung and other manufacturers make regular improvements, often many times a year, usually bestowing more functionality and performance into the processor than existed yesterday, but probably not as much as will be available in six months or a year. You can be sure that soon after acquiring your new device, some new development will bring instantaneous buyer's remorse. Nonetheless, you do have to put a stake in the ground at some point.

The same is true for every enterprise data center that needs to meet the rapidly expanding requirements for long-term storage in terms of both capacity and performance while keeping the total cost of ownership (TCO) of the IT infrastructure within tightly controlled budgetary limitations. In order to assist the data center staff in achieving their profitability goals, in July The Clipper Group published its latest in a continuing series of bulletins comparing the TCO for archiving data on disk subsystems to the TCO of using tape libraries¹. At that time, we calculated the average TCO of tape libraries using enterprise-class tape and the then latest open systems tape technology, LTO-6. Unfortunately, this turned out to be about two months prior to the announcement of the availability of the latest generation of open systems tape technology from the LTO Program, LTO-7². **LTO-7 provides the data center with an increased native capacity per cartridge, from 2.5 TBs to 6 TBs, and increased native performance, from 160MB per second to 300MB per second, when compared to LTO-6. These are significant improvements.**

Given that each complete TCO analysis tends to take us at least half a year, we wanted to provide some interim guidance, so we have revisited our 1H2015 tape library calculations in order to determine the impact of the availability of LTO-7 on the TCO of the typical enterprise-level long-term storage infrastructure.

¹ See the issue of *The Clipper Group Calculator* dated July 15, 2015, entitled *Continuing the Search for the Right Mix of Long-Term Storage Infrastructure – A TCO Analysis of Disk and Tape Solutions*, which is available at <http://www.clipper.com/research/TCG2015006.pdf>.

² For a quick overview of the details of LTO-7, see *The Clipper Group Navigator* entitled *LTO-7 Tape Introduced with Higher Capacity and Throughput* dated September 14, 2015, and available at <http://www.clipper.com/research/TCG2015007.pdf>.

Publisher's Note: This is an update to Clipper's *Calculator* TCO report published on July 15, 2015, (and referenced in footnote #1 below). The earlier report follows this one, starting on the sixth page. You really need to read both parts to understand our updated findings.

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In order to do an update without redoing the whole study, we had to make some unilateral pricing assumptions (in addition to increasing the capacity and performance to LTO-7's specifications).

- First, we assumed that the cost of an LTO-7 tape drive would be 15% higher than that of an LTO-6 drive. Because many tape library vendors were involved in the original study, we just multiplied their previously-disclosed LTO-6 drive list price by 115%.
- Second, we needed to increase the price paid for each LTO-7 cartridge. Whereas we assumed that each LTO-6 cartridge would cost \$50, we assumed that each LTO-7 cartridge would cost about \$86 on average during the first three-year cycle, as described in the July report. (We tested for other cartridge pricing assumptions, as will be explained shortly.)

In a nutshell, when compared to the library configurations in our July study (which were dominated by LTO-6 configurations), LTO-7 further reduces the average cost of storing a terabyte of data on tape for the long term by a little bit, thus improving the advantage of tape libraries over disk-based solutions that we found earlier this year. Do recognize that what is said in this update is built upon the many assumptions and explanations made in the July report. Thus, these should be considered together as a single report. For more of the details on the LTO-7 update, please read on.

Quick Summary of Conclusions in Clipper's July 2015 Archiving TCO Report

In our July *Calculator* bulletin, which reported on the TCOs that were calculated during the first half of 2015, we found that the average TCO for disk-based solutions was 6.18 times that for tape library solutions. This was determined by modeling the costs of equipment (including cartridges), maintenance, floor space, and energy over a forward-looking nine-year period and was based on list pricing for the equipment and maintenance that we received from the vendors participating in that study. There was a notable exception – the cost of the tape cartridges was priced at what we thought was the high end of street pricing, because cartridges tend to be available from several sources about six months

after their first availability. The many details and assumptions are presented and discussed in that report (which begins on page 6 of this consolidated PDF).

It is worth noting that the average TCO for tape libraries included configurations with both enterprise-class and LTO-6 cartridges and tape drives. As we reported in July, LTO-6 was “getting long in the tooth” as it had been available for several years and was due for its next generation later this year. As mentioned earlier, LTO-7 arrived this month, much earlier than we expected. So, while LTO-6 with a native capacity of 2.5TBs per cartridge was a drag on the average TCO for tape libraries, **LTO-7 with a 6TB native capacity helps bring down the average TCO for tape libraries.**

The Effect of LTO-7 on the Bottom Line

To determine the effect that LTO-7 will have on our prior modeling, we increased the cost of LTO-7 drives by 15% over the list price of LTO-6 drives provided earlier this year by the participating tape library vendors. This is our estimate based upon prior announcements. However, because our business scenario requires a small number of drives, even if the price was doubled, it would not have had a noticeable effect on the average TCO per terabyte stored.³

However, the opposite was true when it came to cartridges. With each LTO-7 cartridge having 140% more native capacity than LTO-6, many fewer cartridges will be required, which in turn means that many fewer library slots (and frames) will be required. This reduces the cost of the equipment, maintenance, floor space and energy⁴ for these frames, which all go to improving the bottom line.

Unfortunately, cartridges tend to be priced according to capacity and availability. Thus, based on capacity alone, you should expect the price to go up about 140% (LTO-7 over LTO-6) because the capacity went up by 140%. That would mean going from the \$50 that we used for LTO-6 cartridges in the July study to \$120 for LTO-7 cartridges. But there is more going on here.

³ Yes, we adjusted the number of drives to be procured over the nine-year study period. Since the number was either the same or fewer, no additional frames were needed to house the required number of LTO-7 drives.

⁴ Some of the frames in the study do not carry a direct maintenance cost, as the maintenance is calculated differently than “by the box”.

Exhibit 1 — Clipper's Sensitivity Testing for the Price of LTO-7 Cartridges

Tape Library Configurations Deployed with Enterprise Drives or	Average Cost Per LTO Cartridge Over 3-Year Cycle	Average Total Cost for Equipment and Maintenance (across LTO and enterprise tape)	Percentage of TCO for Media (across both LTO and enterprise tape)	Resulting Average Disk:Tape Ratio (for both LTO and Enterprise Tape Configurations)	Remark
LTO-6	\$50.00	\$2,403,443	23%	6.18	from the July report
LTO-7	\$50.00	\$2,134,920	20%	6.95	
LTO-7	\$85.84	\$2,208,661	23%	6.72	calculated to model the increasing volume of arriving new data over the 3-year cycle
LTO-7	\$100.00	\$2,237,795	24%	6.63	
LTO-7	\$120.00	\$2,278,945	25%	6.51	
LTO-7	\$150.00	\$2,340,670	27%	6.34	

Note: Enterprise cartridges were priced at \$270 each in all of the scenarios.

Source: The Clipper Group

At the launch of a new generation of drives and cartridges, the new-generation cartridges tend to be scarce and usually available from only one manufacturer. That tends to jack up the price somewhat. Thus, we first went with a \$150 price per cartridge, shown in the last row in the table in Exhibit 1 above.

However, that is not the right price to use when looking over a three-year cycle, because almost all of the cartridges purchased will be acquired after the first six months (when the cartridges will be priced highest), because of the 55% per year growth rate for new data presumed by our model. So we did a sensitivity test for a variety of average prices, with LTO-7 cartridge pricing from \$50 to \$150. Exhibit 1 shows what we found.

Here are our interpretations.

- All of the disk:tape average TCO ratios (the column in red) are better when they included LTO-7 than with LTO-6. However, they are not that much better.
- Do remember that the average TCO for tape libraries includes configurations with either enterprise or LTO drives and cartridges. While the average TCO that included LTO-6 and enterprise tape solutions (the row highlighted in light blue) was increased by LTO-6 (i.e., enterprise tape cost less per terabyte than LTO-6, so LTO-6 raised the average), the average with LTO-7 now is held back by the higher-cost per terabyte enterprise tape configurations.
- While it is clear that we tested some round numbers (\$50, \$100, \$120, and \$150 per LTO-7 cartridges), we think the best answer is in the row highlighted in yellow – but where did \$85.84 come from? As described in the July report, data is assumed to grow at a rate of 55% per year. What this means is that each year, there is a lot more data to write than in the previous year. Thus the volume of data is weighted toward the end of each three-year cycle, which corresponds to the currency of a generation of tape (according to our assumptions). If one was to assume that the price when LTO-7 was announced was \$150 per cartridge and that it fell to \$50 per cartridge in the third year and was weighted by the volume of data each year, the average comes out to be \$85.84 per cartridge over the three-year cycle that we modeled. Round this up to \$86, if you like, as this is what we will reference below.
- With an average price of \$86, the disk:tape TCO ratio for tape libraries including LTO-7 is 6.72, which is almost a nine percent improvement over the LTO-6-included ratio of 6.18. That is good but not great news, as it always would be better if there was a significant improvement in the TCO per terabyte. However, it does mean that there is good reason to move to LTO-7, especially if you are now writing LTO-5, as many are. If you are short on floor space and writing a lot of new data, moving to LTO-7 from LTO-6 might make a lot of sense, especially if you need to

get the data written more quickly. Remember, that this is not an all-or-nothing proposition. You can start with a small number of LTO-7 drives while retaining most if not all of your prior generation drives.

5. You need to understand what changing to LTO-7 from LTO-6 did to our model. When LTO-6 was assumed for the first three-year cycle, we assumed LTO-7 and LTO-8 for the second and third cycles. Now with LTO-7 in the first cycle, we have LTO-8 and LTO-9 in the later cycles. This means that the specifications for each cycle get increased, according to the LTO Program's roadmap.⁵ Thus, more is at play here than what is available at the outset of the 9-year study period.
6. Be aware that averages can be deceiving in that they hide the wide range of TCO variations across the many tape library vendor configurations and enterprise/LTO drive permutations that were included in our model. For some vendors, enterprise tape might cost less than LTO-7 per terabyte stored. You've got to push the vendors from whom you have solicited proposals to give you multiple configurations to consider, especially if you do not have a strong requirement to buy either enterprise or LTO tape solutions.
7. Be aware that the latest generation of enterprise tape has higher specifications than does the latest generation of LTO, even though they now are the older tape technology. This includes maximum capacity, write speeds, compression ratios, reliability, etc. You need to understand your requirements and carefully see what configurations best can satisfy your needs (in addition to focusing on the cost per terabyte).

All Things Not Considered

This update is not a complete redo of the earlier study. It just answers the question of LTO-7's effect on the average tape library TCO that was presented in that study. While doing this analysis certainly was more than a quick-and-dirty calculation, it is an estimate and contains many nuances, as discussed. We did not redo the modeling on enterprise-tape-based libraries nor on disk-based solutions. That would have taken many months and we wanted to publish some guidance now and not early next year.

⁵ See the LTO road map at http://www.lto.org/wp-content/uploads/2014/09/LTO_10GenChart_2014-e1410340087608.jpeg.

However, many variables are at play here and redoing the study most likely would have resulted in more disk-solution vendors deploying 8TB drives and making them affordable for six years (instead of three, as discussed in the July report). While this no doubt would put more data in less space while consuming less electricity per terabyte, it does not address the likely higher cost per terabyte for deploying 8TB disk drives, which might retard the improvements in the average TCO for disk-based solutions.

Conclusion

For the purpose of archiving a lot of data, the cost advantage of tape over disk cannot be ignored. The availability of LTO-7 just makes the tape library solution a little less expensive and thus even less costly per terabyte than disk-based solutions. That was the burning question, and it has been answered by the methods described herein.

Don't forget that the decision almost certainly isn't about tape or disk (all tape versus all disk) but about the right mix of each for your specific requirements. No doubt, some of your archived data will need to reside on disk, but this means that most of it probably could be put on tape. You need to do your own analyses. Hopefully, the two reports (this one and the one published in July) give you a good place to start. The rest is up to you. Better get to it, before you write a few more petabytes into your archive!



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