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Oracle StorageTek Tape Storage—A Clear Winner Over IBM

A Comparison of Oracle Versus IBM Enterprise Tape Storage Offerings

ORACLE

Executive Overview

After more than 40 years of leadership in tape and tape library solutions, Oracle's StorageTek offerings are still the clear winner. This paper compares Oracle's enterprise tape offerings to the latest IBM enterprise tape offerings and describes how Oracle's industry-leading capacity, performance and flexibility can help IT organizations manage complexity, control costs, and deliver on service level agreements.

The StorageTek tape product line includes the world's highest capacity tape drive along with enterprise and midrange tape libraries that offer 24x7 high-availability features as well as leading performance and security. The tape offerings are also part of an integrated hardware and software environment for tiered storage, enabling organizations to transparently migrate data between multiple layers of Oracle disk and tape storage.

When compared directly to the IBM TS3500 tape library and IBM LTO-5 and TS1140 tape drives, StorageTek tape offerings provide the following key advantages:

- Up to 34% lower acquisition costs and better TCO
  The high capacity and high performance of StorageTek T10000C tape drives enables Oracle to offer tape solutions that require fewer cartridges, drives, and libraries, thus reducing acquisition costs by up to 34%. The improved density also reduces floorspace requirements by up to 67% compared to a similarly configured IBM TS3500 library.

- Flexible scalability without disruption
  StorageTek libraries are designed to support real-time growth through capacity on demand, which means that libraries can be expanded without disruption to users and capacity is paid for only when it is used. The StorageTek SL8500 and SL3000 modular library systems both give customers the option to pre-install expansion frames with additional slots and then license this capacity as it is needed. Conversely, IBM requires organizations to take a library offline in order to add frames for new slots and requires up front purchase of most or all slots

within their frames. StorageTek SL8500 tape libraries can also be connected to other libraries without going offline, allowing the library to grow to 100,000 slots and 640 tape drives without causing a disruption in user or application access to the data.

- Faster performance for increased service levels
  The StorageTek T10000C tape drive offers 71% higher throughput than the IBM LTO-5 tape drive and roughly equivalent performance to the IBM TS1140 tape drive at a cost point that results in 38% better performance throughput per dollar for both IBM drives. The efficient design of the StorageTek tape libraries and faster robotics on the StorageTek SL8500 library also mean that less time is required for tape mounts and dismounts, resulting in better overall performance throughput. This enables Oracle customers to deploy tape library solutions that either cost less than IBM solutions while delivering the same performance, or deliver increased service levels and shorter backup and restore windows compared to an IBM configuration of similar cost.

- Best-in-class availability
  Oracle's StorageTek tape automation systems are well known in the industry as highly reliable products. The StorageTek SL8500 modular library system was the first library product in the industry to offer full redundancy across power, robotics, and library electronics subsystems. Its highly redundant design along with its support for non-disruptive serviceability has resulted in overall library availability of 0.99996. The StorageTek SL3000 modular library system also offers full redundancy of these three major subsystems and has an overall availability rating of 0.99992.

Up to 34% Lower Acquisition Costs and Better TCO

TCO is an important consideration when purchasing a tape solution because many enterprise archives require multiple petabytes of storage and continue to grow rapidly. IDC estimates that the total amount of digital information created and replicated will surpass 1.8 zettabytes (1.8 trillion gigabytes) in 2011[1]. Data growth often means that the archive solution must not only expand in terms of capacity, but also provide greater throughput to deliver more data to and from tape within the same time window.

To contain long-term storage costs, enterprises thus need solutions that offer both a low initial purchase cost and cost-effective expansion to meet future capacity and performance requirements. Ongoing costs such as data center floorspace, media purchases, energy consumption, and tape migration requirements should also be considered as factors in total cost of ownership for a tape library. Oracle tape solutions excel in all of these areas.

Analysis of Acquisition Costs

The cost of purchasing a large archive can be affected by both tape drive capacity and tape drive speed. A faster drive means that a tape library can meet application throughput requirements with fewer tape drives. Similarly, because larger capacity drives write more data on each cartridge, they enable a library to store more data in fewer cartridges and less data center floorspace.

Oracle's StorageTek T10000C tape drives offer 25% greater capacity than IBM's highest capacity and newest tape drive, the TS1140, as well as more than 3x the capacity of the IBM LTO-5 tape drive (Figure 1)[2]. This results in up to 34% lower acquisition costs for a StorageTek tape solution because fewer cartridges, drives, and libraries are required to meet the same performance and capacity requirements as an IBM solution.

[1] "IDC Digital Universe Study, sponsored by EMC," June 2011. Available at http://idcdocserv.com/1142.

[2] IBM TS1140 capacity at http://www-03.ibm.com/systems/storage/tape/ts1140/specifications.html. IBM LTO-5 capacity at http://www-03.ibm.com/systems/storage/tape/ts2250/specifications.html.

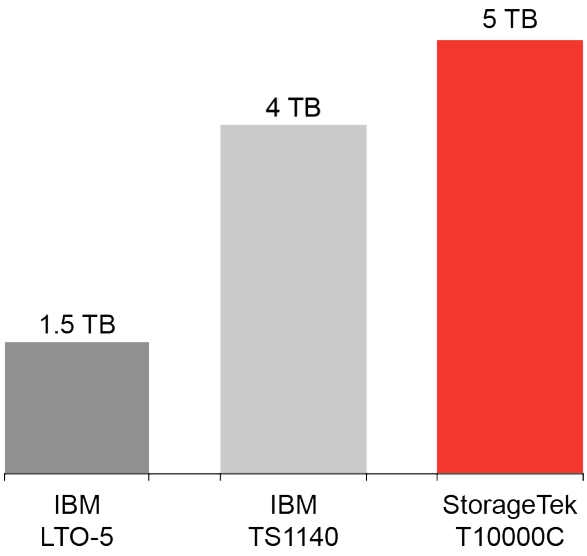

Figure 1. A comparison of StorageTek T10000C capacity versus IBM.

Tables 1 and 2 provide an analysis of pricing for two different sizes of archives. The configurations represented in Table 1 provide a capacity of 10 PB and those in Table 2 are configured for 20 PB. Because the StorageTek T10000C tape drive and the IBM TS1140 tape drive offer very similar performance, these two configurations also meet roughly the same application throughput requirements. The IBM LTO-5 tape drive, however, offers substantially lower throughput so its library (far right column in Table 1) must include more drives to reach the same throughput level as the other configurations as well as more cartridges to reach the same capacity.

The details of each configuration and its list prices are shown in the tables. As highlighted in Figure 2 after the tables, the Oracle configurations come out significantly lower in cost than IBM. Customers can pay as much as 51% more for an IBM tape library configured with enterprise TS1140 tape drives and as much as 25% more for an IBM library with LTO-5 tape drives.

TABLE 1. 10 PB TAPE LIBRARY PRICING COMPARISON

	STORAGETEK SL3000 WITH T10000C DRIVES	IBM TS3500 WITH TS1140 DRIVES	IBM TS3500 WITH LTO-5 DRIVES
NUMBER OF DRIVES	20	20	34
NUMBER OF CARTRIDGES	2,000	2,500	6,667
TOTAL LIST PRICE (LIBRARY, DRIVES, AND MEDIA)	$1,440,309	$2,155,197	$1,799,582
COMPARISON TO ORACLE	N/A	**50% higher**	**25% higher**

TABLE 2. 20 PB TAPE LIBRARY PRICING COMPARISON

	STORAGETEK SL8500 WITH T10000C DRIVES	IBM TS3500 WITH TS1140 DRIVES	IBM TS3500 WITH LTO-5 DRIVES
NUMBER OF DRIVES	40	39	68
NUMBER OF CARTRIDGES	4,000	5,000	13.334
TOTAL LIST PRICE (LIBRARY, DRIVES, AND MEDIA)	$2,792,898	$4,219,632	$3,483,567
COMPARISON TO ORACLE	N/A	**51% higher**	**25% higher**

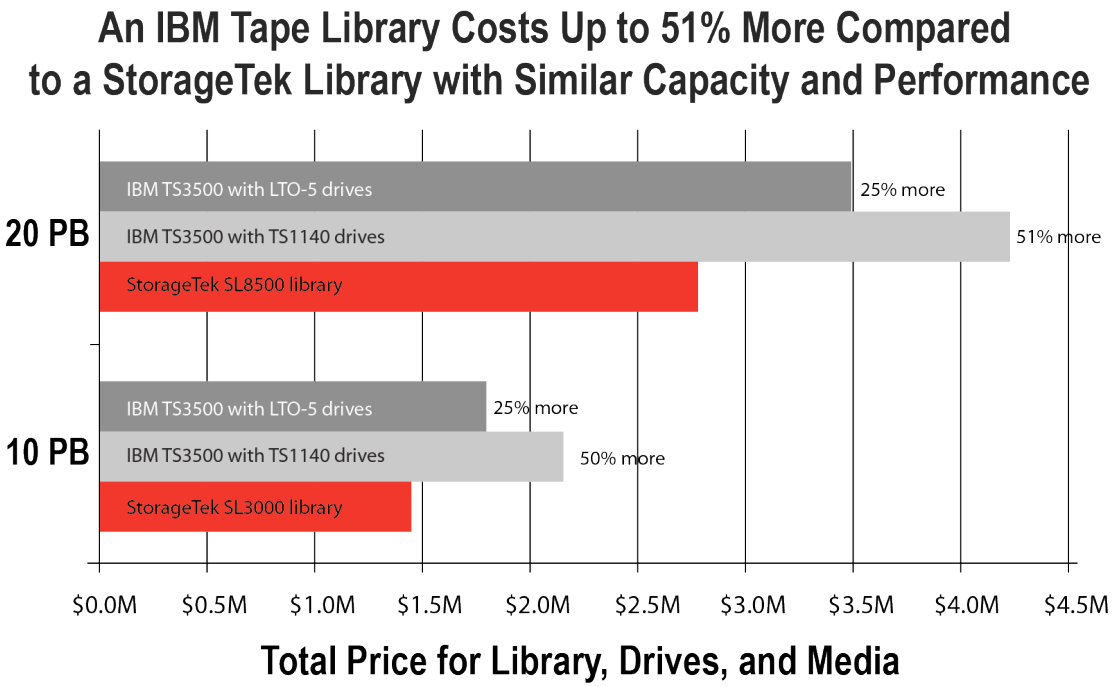

Figure 2. Pricing comparison for 10 PB and 20 PB archives.

36% Lower Costs for Drives and Media Helps Reduce Future Expansion Costs

Even when not considering the cost of the tape library itself, Oracle still comes out 36% lower in cost for drives and media for a 10 PB archive. As shown in Figure 3, the StorageTek T10000C tape drive is 30% lower in cost than the IBM TS1140 drive and StorageTek media costs are 40% less than IBM. In addition, 20% fewer cartridges are needed for the same capacity. Total savings for drives and media for a 10 PB archive thus comes out to 36%. This is an important factor to consider for archives that are expected to grow significantly over time.

	Drive List Price	Number of Drives	Drives Price	T10000C Advantage
T10000C	$30,000	20	$ 600,000	-30%
TS1140	$42,955	20	$ 859,100	

	Media List Price	Number of Carts	Media Price	T10000C Advantage
T10000 T2	$315	2,000	$ 630,000	-40%
TS1140	$423	2,500	$1,057,500	

			Solution Price	T10000C Advantage
T10000C solution			$1,230,000	-36%
TS1140 solution			$1,916,600	

Figure 3. StorageTek offers 36% savings even when considering only media and drive costs.

47% Lower Cost for Mainframe FICON Attach Tape Drives

StorageTek T10000C tape drives include all necessary hardware for attaching to FICON channels on IBM mainframe systems. By contrast, the IBM TS1140 tape drive requires an IBM Tape Controller Model C07 and two Dual Port FC HBAs for FICON attach. Total cost for the IBM Tape Controller Model C07 and two HBAs is $55,600 and this environment will support FICON attach for up to four IBM TS1140 tape drives. As shown in Table 3, using four StorageTek T10000C tape drives with FICON attach to a mainframe saves 47% compared to the IBM FICON attach configuration.

TABLE 3. COST COMPARISON FOR FICON ATTACH TAPE DRIVES

	STORAGETEK T10000C TAPE DRIVE	IBM TS1140 TAPE DRIVE	STORAGETEK ADVANTAGE
COST OF FOUR DRIVES	$120,000	$171,820	
TAPE CONTROLLER	N/A	IBM Tape Controller Model C07 $36,000	
2X HBA	N/A	2x Dual Port FC HBA $19,600	
TOTAL LIST PRICE	$120,000	$227,420	**SAVINGS OF $107,420 OR 47%**

A second important factor in the cost of mainframe-attached IBM TS1140 tape drives is that the controller required for the mainframe configuration consumes significantly more energy than the tape

drives. Thus the IBM configuration with a mainframe FICON channel is much more expensive to operate than a comparable StorageTek configuration. The Figure 4 shows the energy required to record a 10 PB mainframe archive with IBM versus StorageTek tape drives[3].

Energy Required to Record a 10 PB Archive

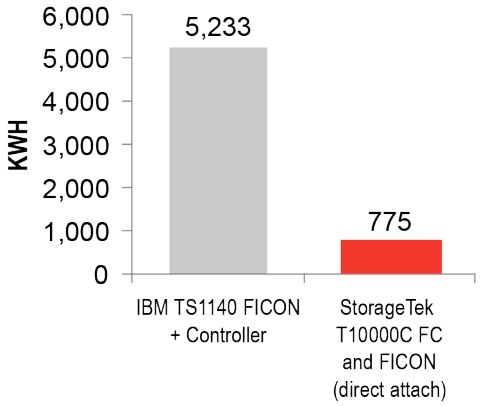

Figure 4. Comparison of energy required to record a 10 PB archive.

Up to 80% Less Floorspace

Greater density in a tape library means that more data can be stored in less floorspace, which translates to data center cost savings. The high capacity StorageTek T10000C tape drive enables StorageTek tape libraries to consume significantly less floorspace compared a compared to IBM tape libraries. Table 4 identifies the floorspace requirements for the 10 PB and 20 PB configurations described in the pricing analysis in Tables 1 and 2 above. As noted, the IBM libraries require 2x to 5x more floorspace than StorageTek tape libraries. In other words, StorageTek tape libraries can save up to 80% in floorspace to help reduce data center costs.

[3] Energy calculations are based on power consumption for four tape drives (and a controller for the IBM configuration) over the time period required to write 10 PB of data. Energy consumed by the IBM configuration is based on power requirements in product specifications on IBM's web site for the IBM Tape Controller Model C07 and TS1140 tape drive.

TABLE 4. FLOORSPACE COMPARISON

	STORAGETEK SL8500 WITH T10000C DRIVES	IBM TS3500 WITH TS1140 DRIVES	IBM TS3500 WITH LTO-5 DRIVES
FLOORSPACE (SQ FT) FOR 10 PB ARCHIVE*	44	135 **3.1x more than Oracle**	223 **5.1x more than Oracle**
FLOORSPACE (SQ FT) FOR 20 PB ARCHIVE*	114	223 **2.0x more than Oracle**	379 **3.3x more than Oracle**

* Note: Floorspace requirements include required service area.

Additional TCO Considerations

In addition to initial acquisition costs and floorspace requirements, the following subsections identify other costs that also need to be taken into consideration for understanding total cost of ownership.

Management Savings

Management of distributed tape libraries can be both time-consuming and costly, especially when there are multiple libraries, multiple backup applications, and multiple administrators. If not properly managed, tape library resources will be poorly utilized and total cost of ownership will rise.

Oracle helps organizations address these issues with centralized management using StorageTek ACSLS (Automated Cartridge System Library Software) Manager software. StorageTek ACSLS Manager software provides a single point of control for disparate, application-dedicated libraries. It offers the following advantages:

- Manage more with less through a centralized Web browser-based interface capable of managing more than 34 Exabytes of data
- Consolidate library resources, load-balance them, and fully utilize available storage capacity
- Improve data access and reduce costs related to outages with the StorageTek ACSLS HA solution, which provides dual-server, fault-tolerant protection and redundancy features
- Interoperability with the leading backup-and-recovery and HSM applications

A second major advantage that StorageTek modular library systems have when it comes to management is that their high capacity cartridges means that there are fewer libraries and cartridges to manage. Thus StorageTek offers a simpler environment to manage as well as a more efficient centralized storage operations model.

Media Reuse

Media reuse can also affect long-term costs. StorageTek enables customers to reuse media across two generations of drives at the full higher capacity. (The following section about flexible scalability provides further details on how media reuse is supported by Oracle.) By contrast, IBM only supports reuse at partial capacity on the IBM TS1140 drive and media reuse is not supported on the LTO-5 drive. Better utilization of media along with media reuse can mean that fewer cartridges are required, thus reducing media costs as well as reducing the size of library, which can save on data center floorspace costs.

Up to 62% Lower Cost to Connect Multiple Libraries

When archive data grows, sometimes a second tape library is required. Considering this as a potential future cost is prudent step when purchasing a tape library. IBM Library Connectors are almost double the cost of pass-through technology on the StorageTek SL8500 tape library. IBM Library Connectors cost $20,000 for each frame plus and additional $15,000 or $17,000 for the span between libraries depending on whether it's a short or long span. Thus IBM requires a minimum $55,000 investment to connect two libraries, or $110,000 if dual redundant connectors are desired.

Conversely, the minimum cost for a quad-redundant pass-through connection between two StorageTek SL8500 tape libraries is $41,516 a savings of 62% compared to a dual-redundant IBM library connection.

Flexible Scalability – Expand or Migrate Without Disruption

Large enterprise tape libraries often support up to 2,000 exchanges per hour and are in near continuous use. So, it's important to be able to add capacity without taking the library offline, enabling applications to continue processing with 24x7 access to the data.

Add Slots Without Taking the StorageTek Tape Library Offline

IBM requires organizations to take a library offline in order to add frames for new slots whereas Oracle customers can add either drives or slots while the library continues to operate by leveraging Oracle capacity on demand licensing. Both the StorageTek SL8500 and SL3000 tape libraries allow expansion frames for additional slots to be pre-installed with minimal up front cost and then this capacity can be licensed when needed. This allows non-disruptive growth of the library because installing licenses to use the additional capacity can be done without taking the library offline. IBM, on the other hand, requires up front purchase of most or all slots within their frames. In addition, IBM can only add slots to their base or High Density expansion frames in limited capacity increments.

Connect Multiple Libraries Without Going Offline

The StorageTek SL8500 tape library supports pass-through technology to connect up to 10 libraries in a single archive. Quad-redundant pass-through ports can be added without taking the existing library

offline. This non-disruptive scalability enables organizations to grow to 100,000 slots and 640 tape drives without ever having to take the library offline for an upgrade.

By contrast, adding an IBM Tape Library Connector to connect multiple IBM tape libraries requires taking the library offline to install a control card in the home and destination frames. The physical connectors and spans between the two IBM High Density frames in the two libraries must also be installed at this time.

Any Cartridge Any Slot

StorageTek tape libraries enable organizations to grow their library any way they need to grow because multiple types of drives and cartridges can coexist within the same library. Consolidating multiple formats in a single library not only saves cost, but it also makes it easier to migrate from old drives and cartridges to new ones such as the StorageTek T10000C tape drive. IBM tape libraries require specific frames dedicated to a single media tape. Therefore a single IBM library has limited potential for consolidating multiple tape formats. By contrast, both the StorageTek SL3000 and SL8500 tape libraries enable organizations to place any supported media type in any cartridge slot and any type of tape drive can be placed in any drive bay.

Media Reuse

Media reuse is important when upgrading to the next generation of drives to support archive growth. Oracle uses the exact same media for two generations in a row, allowing customers to reuse media with two generations of drives. In addition to having backwards compatibility where the new drives can read old media, the new generation of drives can write to the media used by the previous generation of drives at the full new capacity. For example, the T10000B drives can write to the same media as the previous generation T10000A drive and write at the full higher capacity of the T10000B drive, making upgrades significantly more cost-effective.

What this means for Oracle customers is:

- There is no need to buy new media when moving to the next generation of drives. The new drives will be able to write to the old media and take advantage of the full higher capacity of the new drive.
- Library density can be improved because writing to the old media at the new higher capacity will open up slots in the library.

IBM does not offer this capability. For example, when writing to a previous generation of JB/JX media, the IBM TS1140 tape drive can write 1.6 TB of capacity. While this is an increase over the capacity of the IBM TS1130 drive for JB/JX media, it is only 40% of the available capacity when using the newer JC/JY media in the IBM TS1140 drive[4]. Thus customers must either purchase new media or

[4] http://www-03.ibm.com/systems/storage/tape/ts1140/index.html.

live with lower utilization. Either way, it greatly reduces the return on investment from upgrading to the new drive.

Faster Performance for Increased Service Levels and Shorter Backup and Restore Windows

Rapid data growth is forcing greater performance requirements for archive systems. More data is being pushed out to archives where it can be stored and maintained at a lower cost. This means that archives must be able to write greater volumes of data to keep up with demand.

Another factor driving higher performance requirements for tape drives is database backup and restore windows. As databases become larger, greater read and write throughput speeds are required from the tape drives in order to execute backup and restore operations within the same time window. In some cases, backup and restore windows are even shrinking because of the increasing availability requirements for enterprise databases.

Tape Delivers Significant TCO Advantage Over Disk

An independent study by The Clipper Group reported dramatic savings by using tape solutions rather than disk for long-term archival of digital data. The study measured total cost of ownership (TCO) over a 12-year period to compare disk versus tape solutions. The study found that disk-based solutions cost an average of 15x more than tape-based solutions and use 238 times more energy. In fact, the energy costs alone for a disk-based solution approached the total cost (TCO) for tape[5].

Download the full report under the "White Papers" link at *http://www.oracle.com/us/products/servers-storage/storage/tape-storage/*.

Faster tape drives can enable shorter backup and restore windows without the added cost of disk-to-disk backup. (See sidebar.) Fast tape cartridge exchanges in tape libraries can also help provide good performance for non-mission-critical data when it is archived. This makes tape a cost-effective alternative to large disk farms in addition to being a more reliable means for maintaining data over long retention periods.

Oracle's high capacity and high performance tape drives and libraries can improve backup and restore throughput as well as increase service levels for applications that must access archived data. As described in the subsections that follow, Oracle offers superior price/performance with the StorageTek T10000C tape drive and faster cartridge retrieval with StorageTek tape libraries. A backup window scenario is also provided to illustrate how Oracle's StorageTek offerings enable organizations meet backup and restore windows at lower cost compared to IBM's offerings.

[5] "In Search of the Long-Term Archiving Solution—Tape Delivers Significant TCO Advantage over Disk," December 23, 2010.

38% Better Throughput per Dollar with the StorageTek T10000C Tape Drive

The StorageTek T10000C tape drive offers 71% higher throughput than the IBM LTO-5 tape drive at a price premium of only 25% more. Compared to the IBM TS1140 tape drive, the StorageTek T10000C tape drive offers nearly equivalent performance at a cost that is 30% lower than the IBM TS1140 tape drive. In both cases, the result is that the StorageTek T10000C tape drive offers 38% better throughput per dollar (Figure 5)[6].

The speed of the StorageTek T10000C tape drive is aided by a large write buffer and by tape accelerator features that help minimize tape back hitching. The 2 GB buffer on the StorageTek T10000C tape drive enables applications to keep transferring data during times when the tape is being mechanically repositioned. Since memory has become less expensive, it is now much more attractive to employ a large buffer such as this. The StorageTek T10000C tape drive 2 GB buffer is twice the size of the IBM TS1140 tape drive buffer and eight times the size of the IBM LTO-5 tape drive buffer[7].

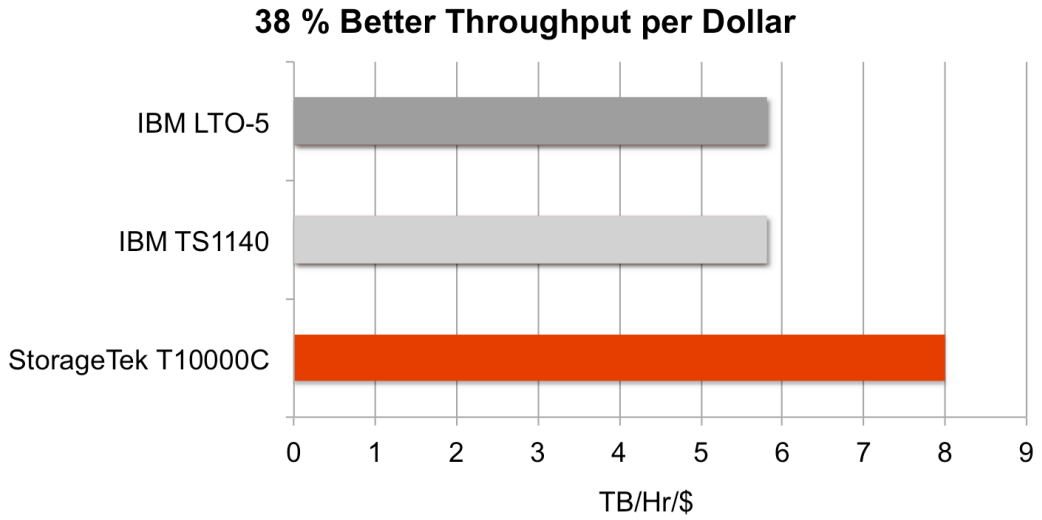

Figure 5. The StorageTek T10000C tape drive offers 38% better throughput per dollar than IBM tape drives.

Tape accelerator features that aid performance on the StorageTek T10000C tape drive include:

[6] Throughput rates for IBM tape drives were obtained from specifications on the IBM Web site, which identifies LTO-5 tape drive throughput at 140 MB/sec and TS1140 throughput at 250 MB/sec. These rates are converted to TB/hr/$ using prices of $42,995 and $23,940 for the IBM TS1140 and LTO-5 tape drives respectively. These list prices were obtained from publicly available sources on the Internet. The calculation of 8.0 TB/hr/$ for the StorageTek T10000C tape drive is based on its published throughput rate of 240 MB/sec and a list price of $30,000.

[7] The internal buffer size of 1 GB for IBM TS1140 tape drives and 256 MB for IBM LTO-5 tapes drives can be confirmed from online documentation available on www.ibm.com.

- File Sync Accelerator—To minimize back hitches, which can slow performance during writing of small files with synching, the File Synch Accelerator feature automatically activates and then stores data on nearby wraps to enable the tape drive to continue at full speed.
- Tape Application Accelerator (TAA)—For older mainframe applications that have not been fully tuned for newer tape equipment, improved data transfer rates can still be achieved by using the Tape Application Accelerator feature, which enables these non-modified legacy applications to run as if modified and tuned.
- Tape Label Verification Accelerator (TLVA)—Tape label verification performance is improved by up to 2.5x by reducing the number of back hitches required while reading and verifying the tape label.

StorageTek Tape Library Performance Advantages

Looking beyond tape drive performance, StorageTek libraries also have some performance advantages that affect overall throughput of the archive. The efficient design of the StorageTek tape libraries and faster robotics on the StorageTek SL8500 library mean less time is required for tape mounts and dismounts, resulting in better overall performance throughput.

One of the primary reasons that StorageTek SL3000 and SL8500 tape libraries provide faster cartridge retrieval than the IBM TS3500 library is that robot moves are shorter. The StorageTek centerline architecture puts the drives in the middle of the library, which results in an average robot move distance that is 33-40% lower than in the IBM TS3500 library. The IBM TS3500 library allows drives to be scattered throughout up to 16 different frames in the library. IBM TS3500 robots therefore must sometimes move from one end of the library to another to grab a cartridge and then go all the way back to put it in the drive. In StorageTek libraries, the maximum distance that a robot would need to travel to retrieve a cartridge is half the span of the library.

The StorageTek SL8500 library takes performance one step further with robotics that offer 2.5x more exchanges per hour than the IBM TS3500. The StorageTek SL8500 library supports up to eight robots per library versus two robots in the IBM TS3500. This means that the StorageTek SL8500 library can perform 4x as many cartridge retrievals at a time. The result is that overall throughput in terms of exchanges per hour is 2.5x greater than that of the IBM TS3500 library. In addition, the higher capacity of the T10000C tape drive means that fewer exchanges are needed per TB. Thus library performance as measured in TB/hr is boosted by an additional 25%, which is the capacity difference between the StorageTek T10000C and the IBM TS1140 tape drive. This difference would be more than 3x if the comparison were based on the IBM LTO-5 tape drive.

Another big difference between StorageTek libraries and the IBM TS3500 library is the ratio of cartridges to robots. Because IBM libraries have a high cartridge to robot ratio and a high drive to robot ratio, the robots can get backlogged with requests to retrieve cartridges, causing slow performance. In the IBM TS3500, one or two robots must service up to 20,000 cartridges and up to 190 drives. This means that requests can queue up waiting for an available robot.

IBM High Density frames can also cause a performance issue because multiple cartridges are stacked behind each other. This can make cartridge retrievals take longer because the robot may need to pull out multiple cartridges just to get to the one it needs. IBM's high-density design has thus traded off performance to achieve greater density. More High Density frames in the IBM TS3500 library also means fewer drives per cartridge, which again can reduce throughput for tape reads and writes when robot requests get queued up.

Up to 30% Lower Cost to Meet a Four-Hour Backup Window

To illustrate the value of faster performance, it's helpful to look at the cost required to build a configuration that can meet a specific backup window scenario. Table 5 provides a cost analysis for configurations designed to backup 20 TB of data in a four-hour window. The results are also graphically illustrated in Figure 6.

The calculations are simplified in that they are based solely on tape drive prices and performance rather than also considering the cost and performance of the library and media. As noted earlier, StorageTek library and media costs are lower than those of IBM, so adding these factors would have further increased the Oracle advantage.

TABLE 5. COMPARISON OF COST TO MEET A FOUR-HOUR BACKUP WINDOW

	IBM LTO-5 TAPE DRIVE	IBM TS1140 TAPE DRIVE	STORAGETEK T1000C TAPE DRIVE
DRIVE THROUGHPUT	140 MB/sec	250 MB/sec	240 MB/sec
NUMBER OF DRIVES REQUIRED TO ACHIEVE 5 TB/HR	10	6	6
DRIVE UNIT PRICE	$23,094	$42,955	$30,000
TOTAL COST TO MEET FOUR HOUR BACKUP WINDOW	$230,940	$257,730	$180,000
STORAGETEK ADVANTAGE	22%	30%	N/A

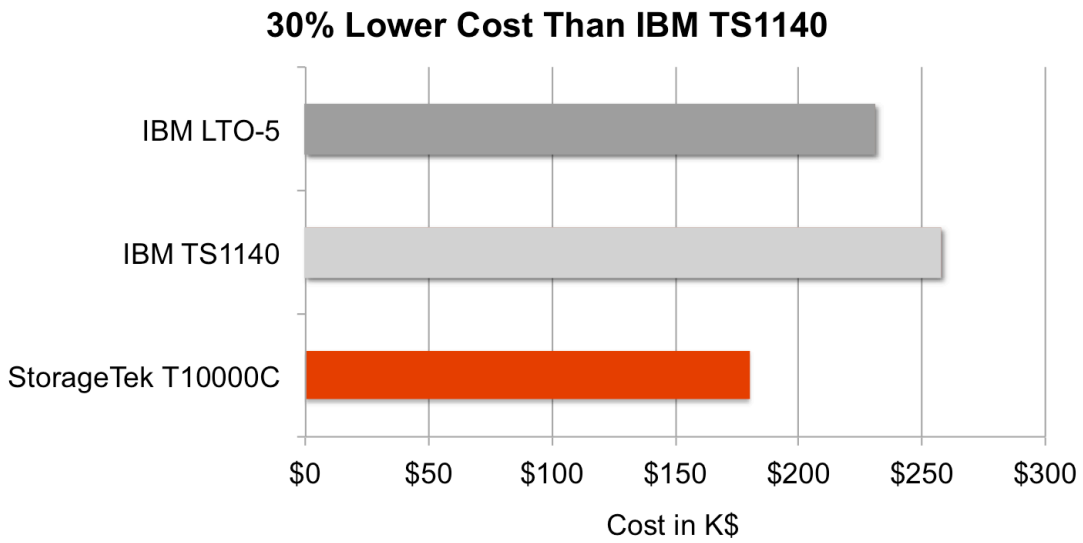

Figure 6. The StorageTek T10000C tape drive enables 30% lower cost for achieving a four-hour backup window.

Best-in-Class Availability

Oracle's StorageTek tape automation systems are well known in the industry as highly reliable products. However, data center operators are much less concerned with component reliability than with actual overall system availability and the integrity of their data. If an organization cannot backup or retrieve their data, or if the data contains bit errors, it makes little difference whether the system had a failure or is down for scheduled maintenance.

Library system availability can be vastly improved by adding redundancy to the key components or subsystems in a library. Redundancy adds a standby component that performs the function when the primary component fails. In many cases, a secondary or standby component can also allow the system to continue operating while another component is upgraded or replaced. The StorageTek SL8500 modular library system was the first library product in the industry to offer full redundancy across power, robotics, and library electronics subsystems. Its highly redundant design along with support for non-disruptive serviceability has resulted in overall library availability of 0.99996. The StorageTek SL3000 library system also offers full redundancy of these three major subsystems and has an overall availability rating of 0.99992.

Key availability features of StorageTek SL3000 and SL8500 tape libraries include:

- Active parallel redundant robots on each rail not only enable continued operation in the event of a failure, but also extend the life of the robots because each robot performs only a fraction of the cartridge retrievals required of the library.
- Redundant robotics and electronics may be serviced non-disruptively to library operations.
- Redundant electronics allows for automatic failover to a standby card without disruption.

- StorageTek tape library robotics grab the sides of the cartridge and lift it rather than hooking the cartridge and dragging it out of a slot. Grabbing and lifting the cartridge is gentler on the media and can lead to less wear and tear on the cartridge as well as less debris within the library.
- Quad-redundant, hot-attachable and serviceable pass-through ports attach at each rail level on the StorageTek SL8500 tape library. The pass-through ports can be added or serviced without disrupting library operations and redundant pass-through ports can continue to pass cartridges between libraries while a pass-through port is offline for service.
- The StorageTek T10000C tape drive offers expected availability of 150,000 drive loads and unloads, ensuring robust library operation in even the most demanding data centers.

Data Integrity and Tape Reliability

StorageTek Data Integrity Validation protects data against corruption while traveling along the data path. The StorageTek T10000C tape drive supports cyclic redundancy checks (CRCs) created at the host, then checked in the drive itself, allowing faster performance compared to tape drive systems that are depend on server software to check CRC codes. In addition to end-to-end data integrity validation whenever a record is read from a StorageTek T10000C tape, the CRC can be checked in the drive to verify integrity. The StorageTek T10000C tape drive also offers an outstanding uncorrectable bit error rate (UBER) of 1 x 10^{19}.

The media used in Oracle's StorageTek T10000C tape drive also offers some advantages. Small changes in the dimensions of a tape can affect the quality of data read back from the tape. StorageTek T10000 T2 media is the only media using Aramid substrates, which enable greater reliability by keeping tape width more constant. Magnetic tapes that use PEN substrate can change width appreciably more than those with an Aramid substrate.

Another key feature that improves tape availability and data integrity is the SafeGuide tape path in the StorageTek T10000C tape drive. The SafeGuide tape path protects tape reliability by using a longer tape path (18x longer than LTO) that reduces edge force and eliminates roller contact with the data side of the tape.

Conclusion

With industry-leading capacity, performance and flexibility, Oracle's StorageTek offerings are a clear winner over IBM tape technology. StorageTek tape offerings can help IT organizations:

- Reduce the cost of data archives with up to 34% savings on acquisition costs and lower TCO.
- Manage growth with unprecedented performance and non-disruptive scalability.
- Minimize risk with best in class data availability.

For more information about Oracle tape storage solutions, visit the Web sites in Table 6, or call +1.800.ORACLE1 to speak to an Oracle representative.

TABLE 6. WEB RESOURCES FOR FURTHER INFORMATION	
WEB RESOURCE DESCRIPTION	**WEB RESOURCE URL**
Oracle tape storage offerings	http://www.oracle.com/us/products/servers-storage/storage/tape-storage/index.html
StorageTek T10000C Tape Drive	http://www.oracle.com/us/products/servers-storage/storage/tape-storage/t10000c-tape-drive-292151.html
StorageTek SL8500 Modular Library System	http://www.oracle.com/us/products/servers-storage/storage/tape-storage/029139.htm
StorageTek SL3000 Modular Library System	http://www.oracle.com/us/products/servers-storage/storage/tape-storage/029140.htm
StorageTek T10000 Data Cartridges	http://www.oracle.com/us/products/servers-storage/storage/tape-storage/029155.htm

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Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com

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Hardware and Software, Engineered to Work Together