

How to Migrate Off Oracle[®] Tape Libraries

Investment Protection for Drives & Media



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How to Migrate Off Oracle® Tape Libraries

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Tape: Past, Present, Future

In 1969, four former IBM employees started Storage Technology Corporation – Jesse Aweida, Juan Rodriguez, Zoltan Herger, and Tom Kavanagh. While startups are common today, they were somewhat revolutionary in 1969. The four felt that IBM was missing a significant market opportunity in tape and based on the early success of the company, later renamed StorageTek, they were right. That revolutionary spirit and approach led to the development of some outstanding technology and established Boulder County as the “Silicon Valley” of tape storage.

The company’s history had ups and downs, including three years in Chapter 11 bankruptcy, but StorageTek’s tape technology efforts were largely successful. In 2005, when it had reached \$2.1B in revenue, Sun Microsystems purchased the company, and five years later, in early 2010, Sun Microsystems was acquired by Oracle Corporation. Those acquisitions have proven fateful for the StorageTek® SL150, SL3000, SL4000 & SL8500 tape libraries (now referred to as the Oracle® StorageTek® SL150, SL3000/SL4000 & SL8500) and the Oracle® T10000 tape drives often found in the Oracle® StorageTek® SL8500. The now End of Life of those technologies has led to the creation of this white paper. In the rapidly advancing world of technology, a failure to develop is a failure to survive.

Roughly four years before Storage Technology was founded, Gordon Moore observed that the number of transistors per square inch in dense integrated circuits had doubled every year since their invention. “Moore’s Law” predicted that this rate of advancement would continue into the foreseeable future. A decade later, he revised the forecast to doubling every two years. Moore’s Law is probably one of the most quoted predictive laws used in technology and has also been applied to other fields. It makes the point that technology advances at a somewhat predictable pace, but exceptions exist. Often, certain technologies “leapfrog” ahead while others fall behind. Tape technology shows interesting examples of that.

The only tape technologies in broad use today are LTO, IBM® TS Tape Technology and Oracle’s T10000 Tape Technology. LTO seems to be the most reliable of these technologies when it comes to adhering to Moore’s law with a longer track record, relatively consistent release dates, and capacity/performance increases.

Drive	LTO1	LTO2	LTO3	LTO4	LTO5	LTO6	LTO7	LTO8	LTO9
Year	2000	2003	2005	2007	2010	2012	2015	2017	2021
Capacity	100GB	200GB	400GB	800GB	1.5TB	2.5TB	6.0TB	12TB	18TB
Performance	20MB/s	40MB/s	80MB/s	120MB/s	140MB/s	160MB/s	300MB/s	360MB/s	400MB/s

IBM's TS Tape Technology (3592) is next in line for historical data as it's in its 7th generation.

Drive	3592	TS1120	TS1130	TS1140	TS1150	TS1155	TS1160	TS1170
Year	2003	2005	2008	2010	2014	2017	2018	2023
Capacity	300GB	700GB	1TB	4TB	10TB	15TB	20TB	50TB
Performance	40MB/s	100MB/s	160MB/s	250MB/s	360MB/s	360MB/s	400MB/s	400MB/s

Oracle's T10000 Tape Technology has less historical data, is currently in its 4th generation, and is somewhat different in that it's in its 3rd generation of ownership, having started as StorageTek®, bought by Sun Microsystems in 2005, then acquired by Oracle® in 2010.

Drive	T10000A	T10000B	T10000C	T10000D	T10000E
Year	2006	2008	2011	2013	Never
Capacity	500GB	1TB	5TB	8TB*	N/A
Performance	120 MB/s	120 MB/s	240 MB/s	252 MB/s	N/A

When one averages the performance and capacity progression of each tape family separately, it shows something close to what one might expect using Moore's law, but when comparing the different tape technologies to each other, a very different "take-away" becomes apparent.

It is now widely known that the Oracle® 10000 "D" tape technology is the last drive in the series, and their tape development program has been canceled and this tape technology has reached the 'End-of-Life' status. With no release of the next generation T10000 "E" tape drive, users are forced to migrate from that technology. Unfortunately, this does not bode well for Oracle's SL8500 tape library either. Although enterprise tape drives such as Oracle's T10000 have historically accounted for only a small portion of worldwide shipment of tape drives, the sale of those drives has accounted for a large share of global tape drive revenue. It would seem to be a considerable loss for Oracle's overall tape storage group.

Oracle's SL8500 tape library development is finished. Oracle's SL3000 has also arrived at end-of-life status and has been replaced with the Oracle® SL4000. The Oracle® SL4000 brings minor improvements and has reached the end of development. Since development stopped, so did the hope of increased performance and capacity, as would be predicted by Moore's Law.

This also becomes problematic for Oracle's SL8500 users who have deployed LTO tape technology. As other open system users of enterprise tape leave the Oracle® SL8500 platform, and the revenue stream diminishes, higher support costs and fewer support options typically follow. This will be covered further in the following section of this paper. Many users of Oracle tape technology are exploring options for migration – the subject of this paper.

Does End of Development Force Migration?

Lack of continued development in and of itself does not force the hand of users to migrate from the affected technology. There are, however, many challenges that occur along with discontinued development.

Advances in complementary technologies can no longer be incorporated or taken advantage of. Tape media is constantly advancing in density and longevity. New tape drives continue advancements, not only in density and performance but also in reliability. Current LTO-8 and LTO-9 tape drives now match the bit error rate of the Oracle® T10000D at 1×10^{-19} and the current IBM® TS Tape Technology drives surpass the Oracle drives in bit error rate at 1×10^{-21} . Versatile new tape interfaces such as SAS are now widely available and enable other interfaces like Ethernet for tape systems. Be it improved reliability, performance, versatility, density, or some combination of all, these new technologies will not be available for a dying technology platform.

Important to keep in mind that these new technologies not only offer the improvements listed above but also help to drive down the prices of existing technology – as long as that existing technology is still considered viable in the market. For those technologies left behind, there is a reverse relationship between age and price. The price of discontinued technology often stagnates at its current market price or even increases. Spare parts and drives will become essential for ongoing support, and, without continued manufacturing, will most likely increase in cost. This brings up the greatest challenge of keeping a dying technology on the data center floor – the challenge of support.

Unfortunately, when technology enters into the first stages of end-of-life, we often see manufacturers go into what is referred to as “harvest mode.” As the investment in development ceases, seemingly, profitability would rise. But new product revenue also ceases. There is only one place to turn in order to “harvest” a revenue stream and that is support. There are many tell-tale signs indicative of an organization’s harvest mode operations. Support becomes more rigid, support personnel are reduced, and surprisingly, support prices are increased. Often, only limited support contracts are available as then End of Support date draws near.

With no official announcement by Oracle of discontinued development in their Oracle® SL3000, Oracle® SL8500, or Oracle® T10000E products, we’ve already seen signs of a product line in harvest mode, and this is the view of many customers who have experienced substantial increases in support costs with a disproportionate decline in service flexibility and value.

Customers report that service agreements through Oracle are now only available by full-year commitment with full payment in advance versus monthly or quarterly invoicing. Further rigidity has been reported in the service levels offered - only one service level is available versus the many service level agreements offered by StorageTek and even under Sun ownership. The world-class support provided by StorageTek was often emulated by the companies that followed, taking note of how to support, interact with, and treat their clients. Seemingly, that has all but disappeared under Oracle. A previous employee recently quipped that StorageTek used to have as many service technicians based in New York City alone as Oracle now has established throughout the United States.

There are many Oracle® SL8500 libraries being used in mainframe environments. Those mainframe environment users won’t have the option of using LTO tape technology as there is no FICON interface or mainframe compatibility, and they will most likely move to the IBM® TS Tape Technology, which Oracle tape libraries do not support. The loss of mainframe users will lead to further maintenance revenue declines, likely resulting in additional layoffs and investment

reductions. What is sometimes optimistically referred to as “harvest mode” by some manufacturers is more often referred to as a “downward spiral” by those affected.

Migration Options and Considerations

Significant migrations from an existing technology require a clear plan and hands-on support from the new manufacturer you’ve selected to replace the older technology. Fortunately, when migrating from an Oracle tape library, a user will have many viable options and can take advantage of advancements in the greater density and higher efficiency offered by modern tape library design.

Spectra is the only manufacturer of tape libraries capable of utilizing all three major tape technologies available today: LTO, IBM® TS Tape Technology, and Oracle® T10000 Tape Technology. Spectra’s patented robotics, referred to as the High Performance Transporter (HPT), is designed to select, mount, remove and transport all three models of tape through its TFinity® ExaScale Tape Library. Spectra is also the only manufacturer, besides IBM, able to integrate the IBM® TS Tape Technology into its libraries. This integration offers an excellent alternative to the Oracle® T10000 tape for those wishing to continue with enterprise tape technology. Spectra libraries supporting LTO or IBM® TS Tape Technology include the Spectra T950 and TFinity. Please note that Spectra libraries are not available for the mainframe environment.

Former leaders and developers from StorageTek, now long-standing members of the Spectra engineering teams, include Jon Benson, former Vice President and General manager for tape at StorageTek, currently Vice President and General Manager of Engineering at Spectra, and David Trachy, one of the original creators of the ACSLS software at StorageTek, now Sr. Dir. of Advanced Development at Spectra. Under the direction of Spectra CEO Nathan Thompson, Spectra leadership has long seen the need for a single tape library that will allow for the use of all major tape technologies. With this, the former “vendor lock-in” seen with many alternative tape solutions can easily be overcome.

This deep industry leadership and commitment to continued R&D, combined with vast experience in conversions of the StorageTek/Sun/Oracle tape libraries, have allowed Spectra to lay out multiple migration paths for many of those facing the challenges involved with large tape library migration. The remainder of this paper focuses on the hardware and software options and migration approaches that user’s should consider.

Hardware Options: Migration of Tape Drives

To ensure investment protection of the user’s current hardware, Spectra will transfer existing LTO or Oracle’s T10000 tape drives from an Oracle®SL150, Oracle®SL3000, Oracle® SL4000, or Oracle® SL8500 to a Spectra TFinity ExaScale library. As mentioned above, the Spectra TFinity ExaScale will support these drives as well as the IBM® TS Tape Technology drive. By migrating the Oracle® T10000 tape drives and tapes into a Spectra TFinity ExaScale, many new options for migration can be explored. Users of LTO tape technology have an even more extensive selection of tape libraries to migrate to as all Spectra tape libraries support LTO. The Oracle LTO tape drives can be transferred to the Spectra Stack, T950, or TFinity for future use. Any tape drive used in library automation requires a “sled” to mount into the library. The sled performs power regulation and controls electronics. Spectra will re-sled existing customer drives to allow them to operate in a Spectra library.

Note: LTO drives used in the Oracle® SL3000 and Oracle® SL8500 may have been originally manufactured by IBM or HP. IBM drives can migrate directly into a new Spectra sled. HP drives will be replaced with new or reconditioned IBM LTO drives. Any LTO-5 and newer LTO tape drives can be migrated into the Spectra Stack tape library. No LTO tape drives are manufactured by Oracle.

Hardware Options: Tape Libraries

The Spectra Stack:

(For LTO tape drives)

The Spectra Stack is a smart choice for users opting to migrate from an SL150, SL3000, or SL400. Starting at 6U with 80 slots and up to 6 HH or 3 FH tape drives, the rackmount Spectra Stack can grow to fill a full 42U rack and contain up to 560 LTO tapes, 21FH or 42 HH tape drives. The Stack offers over 10PB of native capacity and accomodates LTO-9. Full specifications are included in the appendix of this white paper.



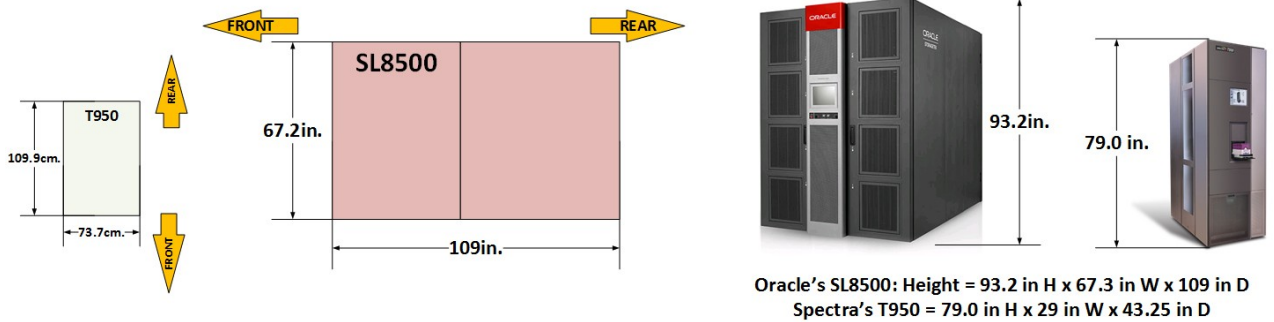
The Spectra T950:

(For LTO or IBM® TS Tape Technology)

The Spectra T950 allows users to choose LTO or IBM® TS Tape Technology Drives. Users requiring additional capacity will find the density and expandability of the Spectra T950 an excellent fit in the data center and an affordable way to expand to over 380PB (1.1EB compressed). Existing Oracle LTO drives can be migrated to the Spectra T950. It's an excellent choice for those who do not wish to follow a “soft migration” path from Oracle® T10000 tape drives, as will be outlined in the following sections. It's also a strong option for those who only run LTO drives in their current Oracle® SL3000 or Oracle® SL8500 libraries. The T950 library expands from a single frame to a total of 8 frames. Full specifications are included in the appendix of this white paper.



Footprint comparison between Spectra T950 and Oracle's SL8500 – base frame only



The Spectra TFinity ExaScale:

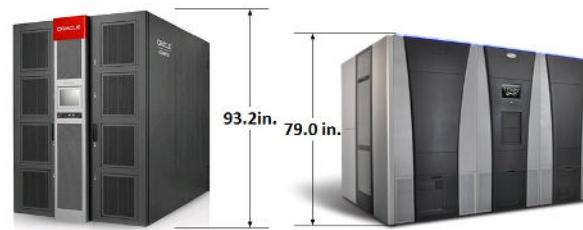
(For LTO, IBM® TS Tape Technology, or Oracle's T10000 Drives)

The Spectra TFinity ExaScale Tape Library offers the largest array of migration options due to its incorporation of existing Oracle® T10000 tape drives along with either LTO and/or IBM® TS Tape Technology Drives. It is the only three-way, mixed-media tape library available. This state-of-the-art tape library system offers the greatest flexibility, largest scalability, and highest performance of all the Spectra libraries. It's an excellent choice for those requiring both great capacity and tremendous performance. LTO and T10000 drives can be migrated from SL3000, SL4000 and SL8500 libraries into the TFinity. The system comes standard with dual robots and is expandable from 3 to 45 frames, making it the only single tape library to expand to more than an exabyte of data storage. Full specifications are included in the appendix of this white paper.

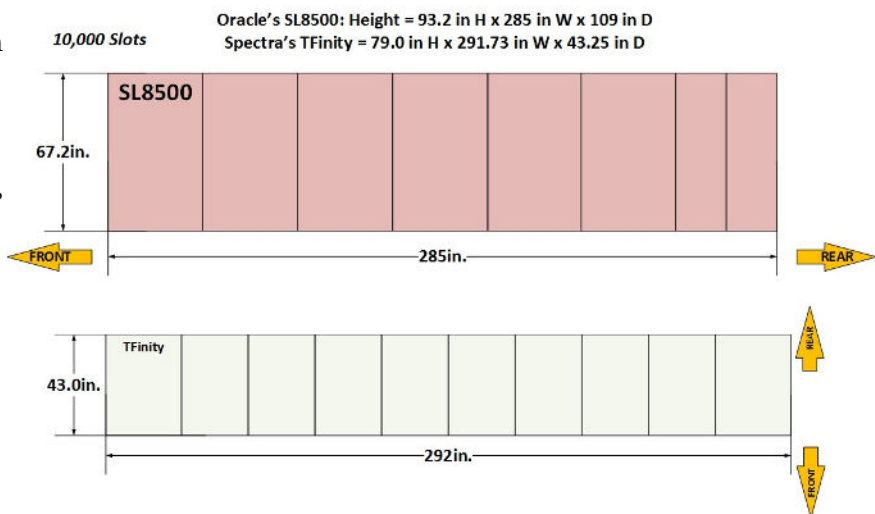


Footprint comparison between Spectra TFinity ExaScale & Oracle's SL8500 - base frame only

The figure to the right shows the Oracle® SL8500 footprint and the Spectra TFinity ExaScale footprint on the right based on a 10,000-slot configuration.



The Spectra tape library selected will be the first step in shaping your migration path. Migration options are covered in the following section. Regardless of the unit selected, users will see immediate savings in power, footprint requirements, greater media selections, and a long future roadmap for each of Spectra's tape libraries. In the words of Robert Louis Stevenson, "Don't judge each day by the harvest you reap but by the seeds that you plant."



Spectra's Professional Services team is experienced and well-versed in decommissioning Oracle libraries. It offers extraction of existing libraries, installation of Spectra libraries, and migration of existing tape drives into the new Spectra library. Proficient, fast, and affordable, our professional services team will provide complete statements of work and quotes upon request. No payment is required for services or products until the hardware conversion is complete.

Migration Paths

Which data tapes need to be migrated and which do not?

Most users of Oracle's SL150, SL3000, SL4000, or Oracle's SL8500 will have a vast number of tapes, not only in the library but also archived – onsite, offsite, or both. It would be ideal to simply have all data stored on old media to be converted to the new media. But in many cases, this is not necessary, or for that matter, practical. It may be helpful to determine which data sets need to be migrated before deciding the technology required for the migration. Ideally, users can categorize to some extent which media will be migrated and which will not. Media aging out in the near future ("near future" being defined by the user) should be allowed to age out and removed from the migration pool. Some data sets are highly likely never to be accessed again on one end of the

spectrum and data sets which are very likely to be recalled on the other end. Below is a general categorization of parameters to consider when embarking upon migration and calculating both the time and resources which will be required.

1. Active Archives

We use the term “active archive” to refer to archived data that has a high likelihood of being accessed in the future and also has a significant retention life.

- a. The tapes which hold this type of archived data are the highest priority for migration, either soft or hard (explained in the following section).
- b. Active Archive tapes will hereinafter be referred to as “high-touch” media.

2. Backup Tapes

- c. New backups will immediately be directed to the new library.
- d. In most instances existing backup tapes are never migrated to the new library. In some instances, approximately 90 days’ worth of backup sets may be migrated.
- e. Backup tapes with hereinafter referred to as “no-touch” media.

3. Compliance Archives

- f. Definite expiration date.
- g. User usually has a long window for finding and recalling.
- h. We are suggesting it *not* be migrated if lifespan is down to <3 additional years.
- i. If not migrated to new media, the user will require at least one drive for the duration of the compliance retention period which is compatible with the media set retained.
- j. Compliance archive tape will hereinafter be referred to as “low touch” media.

Migration Paths: Library, Drive, and Media

Below we will describe three scenarios for migrating from Oracle’s SL150, SL3000, L4000, or Oracle’s SL8500. This specifically addresses the migration from the library as well as the possibility of migrating existing Oracle® T10000 or LTO drives and media directly into the new Spectra library. Software considerations around ACSLS, Commercial ISV solutions and Encryption will be addressed in following sections.

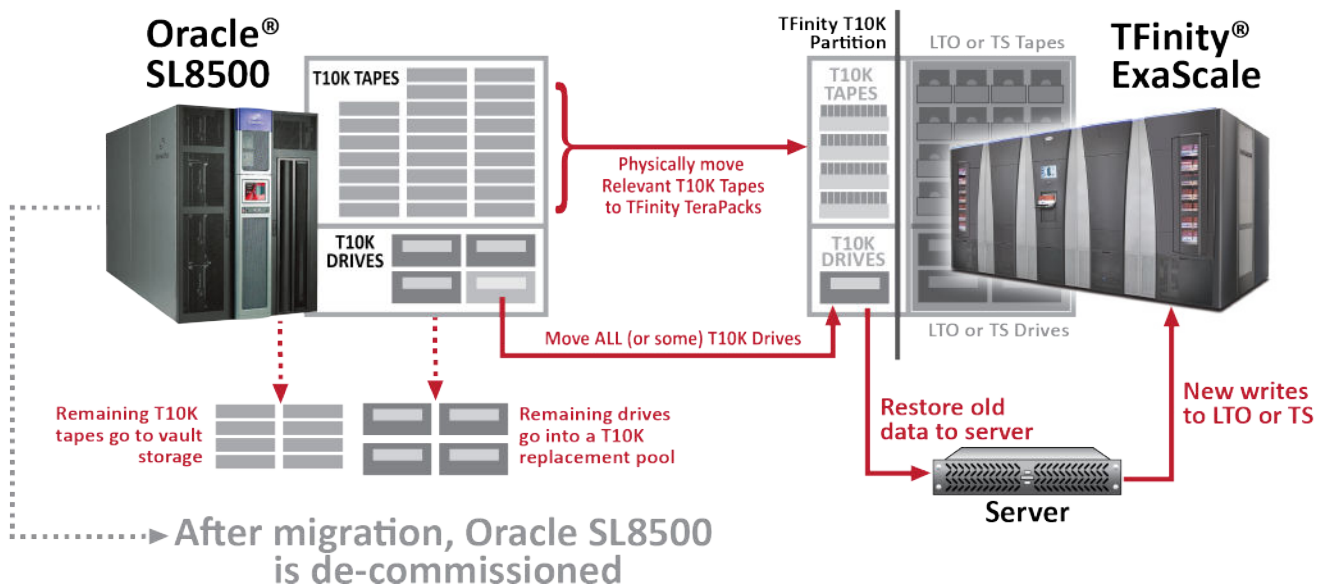
Migration 1: Soft Migration

Overview – A “soft migration” refers to the ability to move existing Oracle® T10000 tape media directly from the existing Oracle library into a Spectra TFinity ExaScale library. The ISV or data manager will be directed to the new library, an inventory will be conducted, and media sets will be available for restoration if needed. All new data writes will be performed to the new media (LTO or IBM® TS tape) within the Spectra TFinity ExaScale library. This also requires at least one Oracle® T10000 tape drive be migrated to the Spectra TFinity ExaScale Library. The advantage of this

process is that existing media can be accessed for reads from the new library without ever having been migrated to a new media type. This approach would be ideal for those who wish to immediately decommission their Oracle library. Further details are outlined below.

Replacement Library – A soft migration requires the use of a Spectra TFinity ExaScale tape library. As mentioned earlier, it is the only non-Oracle library capable of integrating the customer’s existing Oracle® T10000 tape drives and Oracle® T10000 media. High-touch Oracle® T10000 media, as defined above, would be moved from its existing library to the Spectra TFinity ExaScale. Low-touch and no-touch media could be moved to the Spectra TFinity ExaScale or stored in vault or offsite storage. In most cases all, or the majority, of the Oracle® T10000 tape drives would be moved to the Spectra TFinity ExaScale library as well. Those Oracle® T10000 drives not installed in the Spectra TFinity ExaScale would be retained as replacement spares for problematic drives. The same process can be followed for those migrating from an Oracle library with LTO drives. The Oracle LTO tape drives can be integrated into their new Spectra Stack, T950, or TFinity and then existing LTO media can be imported and read in the new Spectra tape library,

Scenario 1 - Soft Migration



There are several advantages to this approach. First and foremost, existing Oracle libraries could be decommissioned as soon as the installation is complete or as soon as the existing Oracle libraries expire from support. This lends tremendous savings in support, power and footprint costs.

Secondly, there is no immediate “hard migration” of media from its current Oracle® T10000 tape cartridge/format to the new LTO or IBM® TS tape cartridges. Hard migration is defined as restoring the contents of a data tape to primary storage and then backing that data up again to the new media of choice. As information is recalled from older tapes, it will then naturally be backed up or archived, according to existing backup/archive schedules, to the new media.

In this scenario, it is still recommended to perform hard migration of tapes in the background as

time allows. While Oracle® T10000 media could be left in the Spectra TFinity ExaScale indefinitely, we recommend minimal writes to this media. The less the Oracle® T10000 drives are used, the longer their life for recall. For all practical purposes, this would be a read-only archive. All new writes should be directed to the new IBM® TS or LTO Tape Drive Technology.

Support for the Oracle® T10000 drives will depend on the existing drive pool owned by the user. Eventually that drive pool should be reduced to zero either through attrition or completion of all media migration required.

Using the Oracle® T10000 tape drives for read-only will certainly assist in lengthening the longevity of that drive pool. Support for the new Spectra TFinity ExaScale tape library, Spectra tape drives (LTO or IBM® TS) and all other aspects of the new system will be covered by Spectra's Support, which covers a wide range of offerings and SLAs for any user situation.

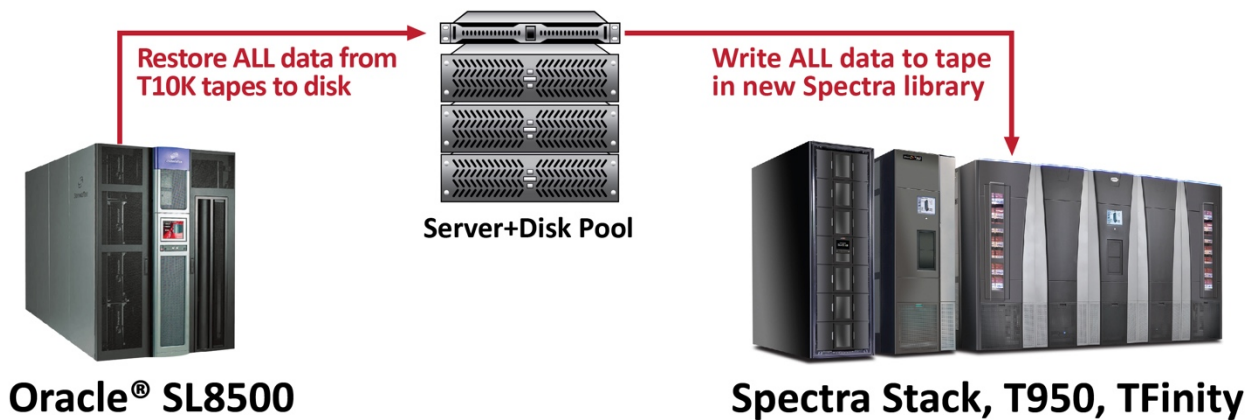
Migration 2: Hard Migration

Overview – As mentioned above, a hard migration refers to restoring data from existing backup and archive tapes and then backing it up to the newly selected tape library and tape media. One might also refer to this as a “traditional” migration. Because no existing tapes will be maintained within the new library, there's no need to move existing tape drives from the Oracle library to the Spectra library. This allows for a wider array of choices in the new library selected. This process does require the retention of the Oracle library until all tapes selected for migration are migrated from Oracle® T10000 tape media to the new media of choice. This migration approach would not allow the Oracle libraries to be immediately decommissioned, but the goal of this approach would be to achieve decommissioning of the Oracle hardware as soon as possible. The third and final migration approach below will have a similar approach but with a different goal.

Replacement Library—Any model of Spectra library can be used; the Spectra Stack supports LTO Technology, the T950 tape library supports either LTO or IBM® TS Tape Technology, and the Spectra TFinity ExaScale tape library will support both LTO and IBM® TS Tape Technology. Each of these solutions is described above under Hardware Options, and complete specifications are included in the appendix of this white paper.

Under a traditional or hard migration, the Oracle libraries and Spectra libraries will run in tandem. Typically, any new writes would be directed to the Spectra library and any restores from older media would be recalled from the existing Oracle library. Restored data will naturally be backed up or archived, according to existing backup/archive schedules, to the new library and media. Hard migration of selected media will continue until completed, at which point the Oracle libraries will be decommissioned.

Migration Scenario 2 - Hard Migration



Support for the Oracle libraries and drives will be determined by the current support contract in place with Oracle. Support for the new Spectra library, Spectra tape drives (LTO or IBM® TS) and all aspects of the new system will be covered by Spectra's Support, which covers a wide range of offerings and SLAs for any user situation.

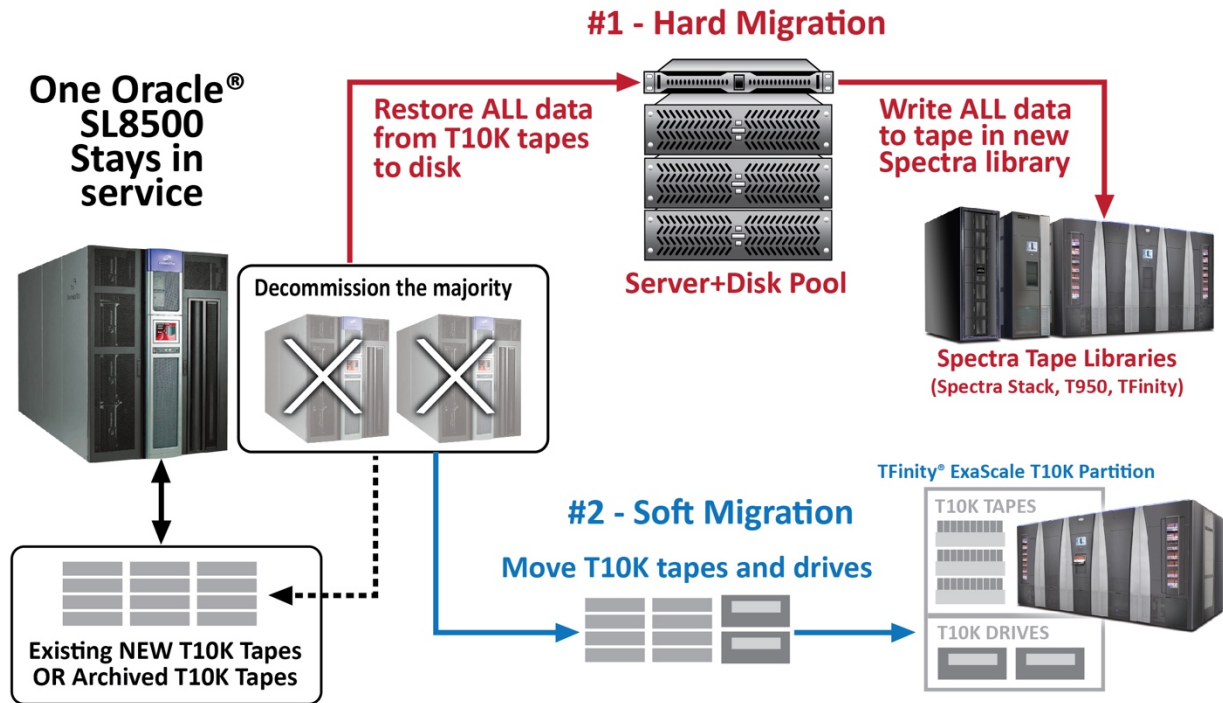
Migration 3: Dual Operation / Migration

Overview – The first two migration approaches have the goal of decommissioning Oracle libraries immediately or as soon as possible. A dual operation migration is aimed at decommissioning some number of Oracle libraries while maintaining one or some number of these libraries for an ongoing amount of time determined by the user. This involves some elements of both migration process one and migration process two above.

We see this approach commonly deployed in mixed mainframe/open system environments in which Oracle libraries will be maintained for mainframe operation (not supported by Spectra). Customers who have a significant amount of unused Oracle® T10000 media may choose to maintain at least one Oracle library until all new media is consumed before doing a complete migration but want to minimize their Oracle footprint. For these reasons or some other specific or narrowly defined purpose, the dual operation migration would make sense. The goal would be to minimize the number of Oracle support contracts required, free floor space within the data center, take advantage of newer technology, significantly decrease cost, or a combination of all, while still maintaining some Oracle footprint on the data center floor.

Replacement Library – This process typically requires the use of a Spectra TFinity ExaScale tape library. As mentioned earlier, it is the only non-Oracle library capable of integrating the customer's existing Oracle® T10000 tape drives and Oracle® T10000 tape media. In order to minimize the Oracle footprint, some amount of decommissioned Oracle libraries will have their media and tape drives moved to one or more Spectra TFinity ExaScale tape libraries.

Scenario 3 - Dual Operation Migration - Hard or Soft



This approach allows for both soft migration and/or hard migration. Support as outlined under both of those options will apply here as well.

Software Considerations: ACSLS, Automated Cartridge System Library Software

ACSL: Tape library interface and tape cartridge/tape drive coordination

In migrating away from ACSLS, it's important to understand why ACSLS was created and what purpose it serves today. Dave Trachy, one of the lead architects of ACSLS, explained it this way:

“StorageTek tape libraries were doing very well in the IBM mainframe market. ACSLS was designed to allow StorageTek products to be sold into the open system markets. There were two main design goals for ACSLS. The first goal was to connect an open system to an automated tape library. The original funding for ACSLS came from a government agency that wanted to be able to robotically move tape cartridges to tape drives from their Cray systems computers. Keep in mind this was already being done in the IBM mainframe world. The connection to tape was handled by a special component written by SDK that ran on the MVS operating system, obviously not available to CRAY or other open systems.

The second goal was to orchestrate which drive would be selected for a particular tape mount. The StorageTek tape libraries expanded by connecting multiple libraries together via “pass-through”

ports. You can pass a tape from one library to another. You could have 16 of the old and 24 of the new StorageTek tape libraries daisy chained together like this. If the system didn't provide a means for a tape mount to occur in the same library as that of the cartridge to be mounted, you could literally send the tape cartridge from the first library in the chain all the way to the last library before mounting it in a drive. Obviously, that would have resulted in unacceptable performance.

Again, the mainframe guys have already taken care of that with a piece of SDK software called HSM that worked in conjunction with the MVS operating system to "influence allocation" of the tape drive selected for reading/writing a specific tape cartridge. This software would influence the drive selection of MVS such that the first drive to be selected for loading a tape would be one of the drives in the same library as the tape to be mounted. If all the drives were busy in that library, then drives in the next library over would be selected and so forth. Getting back to ACSLS, it needed to be able to do the same thing for CRAY – influence drive allocation.

Halfway through the project, we found that there was demand for this capability outside of the supercomputer space (CRAY) and as such, we reworked the government contract so that we could sell the product to others. We were able to get all the major open system computer manufacturers of the time to write clients for the ACSLS, including DEC, UNISYS and SUN.

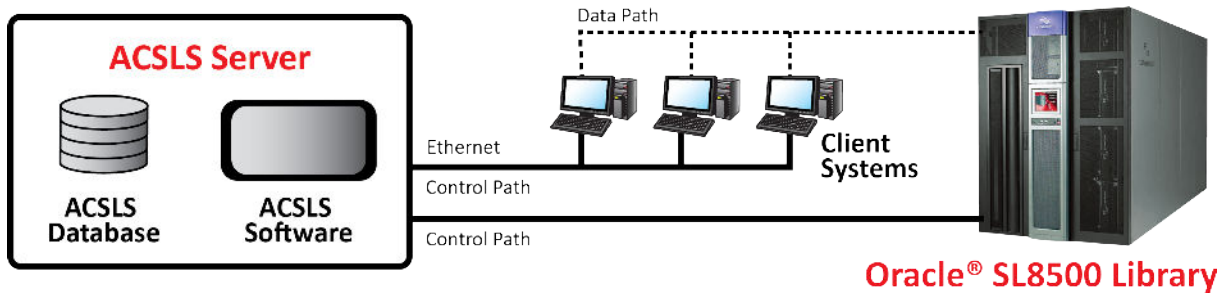
ACSLs is still used in the Oracle® SL8500 libraries today for the same reason – allocating which drive to use for loading a particular tape cartridge. The Oracle® SL8500 doesn't have a modern SCSI interface, so backup or archive applications require an ACSLS server in order to support the Oracle® SL8500.

The problem that was present in old StorageTek libraries was compounded in the Oracle® SL8500, as not only does drive allocation need to occur at the library; it now had to occur at the row. In order for the Oracle® SL8500 tape library to perform anywhere close to specifications, cartridges on rows need to be assigned to drives on the same row. If this were not done, even in a single Oracle® SL8500 library complex, each mount would require an average of moving over one column. This would quickly lead to the elevators that move cartridges from one column to another becoming the bottleneck of the system. Robots would be sitting idle, waiting for the reservation of an elevator for the next operation.

Even with ACSLS being used, an additional problem arises as workloads are not necessarily distributed across rows. For example, if a job requires the mounting of many cartridges from a single row, and there are not enough drives on that row to handle that job, then a similar issue with the elevators will occur. To minimize the impact of this, StorageTek recommends that customers purchase more drives than required for the given workload.

In a way, ACSLS was a way to cover weaknesses in the Oracle® SL8500 design. Modern tape libraries, whereby each cartridge can be mounted into any drive at relatively the same performance, have eliminated the need for all of this.”

David Trachy's observations point to two important aspects of utilizing automated tape libraries – interface to the library itself and cartridge/drive coordination. ACSLS was created to handle these two functions before the rich offerings of commercially available backup and archiving software we have today were available. It runs an Oracle database and requires one or more dedicated servers.



Modern libraries expand via expansion frames and have eliminated the need for the complexities of multi-column robots and elevator design. Spectra libraries are a perfect example of that in that they allow access from any cartridge to any drive at roughly the same performance level, thereby avoiding the problems mentioned above. This allows for better drive utilization, which lowers the number of drives required. The backup/archive applications (referred to as “ISVs” for Independent Software Vendors) are perfectly capable of directing cartridge/drive allocation.

These ISVs play an important part in opening the options users have in today’s data centers. Since commercial ISVs all have SCSI interfaces, the ISV applications that Oracle® SL8500 customers are using today can simply be directed to “direct connect SCSI” libraries without the need for ACSLS. Spectra tape libraries are supported by all major ISVs. Following is a partial list of ISVs and the vertical markets they are most typically associated with.

Media & Entertainment

Avid
 CatDV
 eMAM
 Etere
 EVS
 Grass Valley

Imagen
 ipv
 Marquis
 Masstech
 DIVAChive
 Pnix Media
 reachENGINE
 SGL FlashNet
 Spectra RioBroker
 StorageDNA

Suitecase TV
 Tedia
 Tiger Technology
 Vidispine
 Vizrt
 XenData

HPC

Arcitecta
 Atempo Time Finder

Fujitsu ETERNUS CS
 Globus
 HPSS
 IBM Spectrum Protect

QStar
 SAM-QFS
 HPE DMF
 Versity

General Backup

Archiware
 Arcserve
 Arkeia
 BackBone
 CA ARCserve
 CA BrightStor

CommVault Simpana
 EMC Networker
 Grau Archivemanager
 HPE DataProtect
 IBM Spectrum Protect
 LXI
 NL Technology
 Syncsort

Veeam

Veritas Backup Exec
 Veritas Netbackup

Data Archivers/Browsers

CyberDuck
 Spectra EON Browser

Komprise
 Spectra StorCycle

Video Surveillance

Axxon
 Hautespot
 Milestone
 OnSSI



Miscellaneous Functions of ACSLS

ACSL: Library Partitioning

The design of modern libraries has all but eliminated the complexities of partitioning libraries into multiple virtual libraries. Rather than using command language to define partitions and being forced to release and reassign all assets every time a new partition is created, most modern libraries allow these functions to be done via a Graphical User Interface (GUI) and don't require existing partitions to be rebuilt from scratch when new assets (additional tape cartridge slots or tape drives) have been added or removed. Spectra's BlueScale® library management software (covered in the next section) allows users to identify available assets to be partitioned and create or edit partitions in a few "clicks" of the GUI. Since BlueScale is built into the library controller, no additional servers, software or maintenance agreements are required – significantly reducing both initial investment and ongoing cost of ownership.

ACSL: Scratch Pools

Scratch pools refer to a universal pool of new or recycled tapes (scratch tapes), stored in the tape library, and ready for use when needed. This feature is typically used when multiple ISV applications are running against the same tape library or library complex. Once an application claims a tape, the tape is associated with that application and not available for use by other applications. This is a convenient process for introducing new media but not necessary for the efficient distribution of blank tapes. The simplicity of creating partitions within modern tape libraries varies by manufacturer, but most state-of-the-art tape automation provides for multiple partitions and ISV applications monitor available tapes by partition.

ACSL: Custom Scripting

For users who have written unique, custom scripts for ACSLS, one challenge of migration away from Oracle tape solutions will be either rewriting those scripts for the new tape library or selecting one of the many commercial ISV applications to replace those scripts. In either case, at least one Oracle tape library will be left in place for recall only until the existing tapes are migrated or aged out.

For those who choose to write custom scripts for a Spectra tape library, Spectra libraries support a secure XML command interface for control, configuration, and reporting. A full discussion of the XML command interface is beyond the scope of this white paper, but full documentation on the XML interface can be downloaded from the Spectra Support Portal

<https://support.spectralogic.com/documentation/user-guides/tape-xml.pdf>

There is also an easy-to-use Python 3 API that can be found on Github, which makes using the SML interface much easier to implement. <https://github.com/LLNL/slapi>

Following is a partial list of the standard XML commands that can be used for library reporting:

- **Diagnostic Log Retrieval**
 - Generate and retrieve an Auto Support Log
 - Retrieve individual component log sets
- **Component Inventory**
 - List of Controllers

- List of Drives
- **Inventory Audit**
 - Initiate an inventory audit
 - Compares the database inventory to the inventory discovered by a barcode scan
 - Listing of current tape cartridge inventory
 - Initiate an inventory import or export session
- **Import/Export/Exchange Media**
 - Allows for import/export of media via the Spectra library bulk TeraPack® Access Port (TAP)
 - Import/export TeraPacks (magazines of 10 LTO or 9 IBM® TS tapes)
 - List of all occupied magazines and cartridge locations within a given partition
- **Control/direct Media Lifecycle Management (MLM)**
 - MLM records and reports on over 40 pieces of information regarding media and its use
 - List all MLM settings and enable/disable by setting
 - Set alerts for various thresholds or warnings relating to media use/performance
 - Control Data Integrity Verification (DIV) time periods to run or block out
- **Library Configuration**
 - Retrieve the current library configuration settings
 - Set the library configuration
 - Retrieve or set MLM configuration
 - Create, list, edit, and delete partitions
- **Library Status**
 - Retrieve status of robotics
 - Retrieve robot utilization
 - Retrieve system log messages

Custom XML commands can be implemented for customers who have specific needs for programmatic access to library functions. One simple example comes from a customer who had multiple Spectra libraries and wanted to be able to collect firmware versions from all libraries – Display Current Firmware Versions:

The syntax of the command:

```
<IP-Address>/gf/package.xml?action=displayCurrentFirmwareVersions
```

So with a real ip:

```
172.16.0.20/gf/package.xml?action=displayCurrentFirmwareVersions
```

The output:

```
<package>
<packageName>BlueScale12.6.45.3-20151121F</packageName>
<allComponentsUpToDate>yes</allComponentsUpToDate>
```

```

<component>
<name> LC OS</name>
<currentVersion>100.7.45.0</currentVersion>
<packageVersion>100.7.45.0</packageVersion>
</component>
<component>
<name> LC Server</name>
<currentVersion>4.15.46.6 </currentVersion>
<packageVersion>4.15.46.6 </packageVersion>
</component>
<component>
<name> FR1/PCM </name>
<currentVersion>4.15.46.1 </currentVersion>
<packageVersion>4.15.46.1 </packageVersion>
</component>
... </package>

```

Spectra regularly works with individual users to accommodate custom requests via XML.

Spectra Logic libraries also support SNMPv2 with a Spectra Logic Enterprise-specific MIB. This MIB defines both managed objects and trap messages. The Spectra SNMP Agent, if enabled, will send SNMP Event Notification messages for every system message that appears on the system console. Spectra libraries support sending system messages to a centralized syslog server using the standard syslog protocol.

Of course, commercial applications are available for virtually every aspect of data management in all major vertical markets, from Media & Entertainment to Finance to HPC to Genomic Research to Federal Government and on. For those who choose to migrate to a commercially available ISV application, one advantage will be to further “future-proof” data for future migrations. This is especially true of applications that support Linear Tape File System (LTFS). LTFS is supported on both LTO and IBM® TS Tape Technology. It can be implemented at the application level (depending on the application selected) or at the library interface level, exemplified by the Spectra® BlackPearl® Converged Storage System.

Software Considerations: Spectra BlueScale®

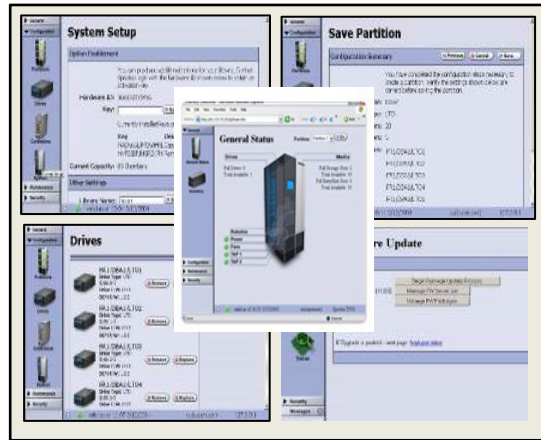
The backup/archive applications produced by Independent Software Vendors are a powerful aspect of protecting data and orchestrating the interface and movement of automated tape libraries, but they aren’t a complete solution in and of themselves.

Spectra’s BlueScale software provides powerful management and reporting on a range of aspects critical to successful data management. BlueScale runs on all Spectra tape libraries, from our smallest library unit, the Spectra Stack tape library, through our largest enterprise library, the Spectra TFinity

ExaScale, providing a common user interface and feature set across the entire line of Spectra libraries.

Spectra's many built-in management and reporting features simplify the management and monitoring of your library. These include Media Lifecycle Management, Drive Lifecycle Management, Library Lifecycle Management, Drive Performance Monitoring, Power Consumption Monitoring through the EnergyAudit feature, and others. A partial list of Spectra's BlueScale features follows:

- Remote Library Controller
- Configuration
- Remote Management
- Shared Library Services
- Assisted Self Maintenance
- Global Spare
- Drive Throughput Indicator
- Power Monitoring
- Auto Support
- Encryption Key Management
- Data Integrity Verification
- Media Lifecycle Management
- Drive Lifecycle Management
- Library Lifecycle Management
- BlueScale Vision



Virtually all of these features are included in all Spectra libraries free of charge. While a complete description of BlueScale's simple yet powerful interface is beyond the scope of this whitepaper, that information is available upon request.

Software Considerations: Encryption

Spectra libraries offer multiple encryption solutions to choose from. Spectra is the only library manufacturer to offer encryption key management fully embedded in the tape library. This avoids the cost and complication of requiring additional servers, applications, support agreements, etc. Spectra's BlueScale software offers two versions of encryption key management – BlueScale Standard Encryption Key Management and BlueScale Professional Encryption Key Management. Standard Encryption is offered with all libraries as a function of BlueScale, free of charge.

For more complex environments, Spectra also offers externally managed encryption solutions. Our Spectra Key Lifecycle Manager (SKLM) is often selected when multiple libraries or data centers are being managed from a single area. This does involve a server for hosting but allows additional feature sets. Our SKLM solution is FIPS, KMIP, and IKEv2-SCSI compliant. A few of the additional features found in SKLM are more extensive audit trails, key grouping, assigning a single key per tape if desired, separate key states and other features that target policy-based management. Spectra libraries also support Enterprise Secure Key Manager (ESKM) and other encryption key management systems that utilize a KMIP interface.

Software Considerations: HSC

As mentioned earlier, Spectra tape libraries are not available for the mainframe environment.

Summary

The only task more daunting than a full or even partial migration of any large data repository and its associated library systems is the task of maintaining a system that is coming to the end of its development life. As the associated costs for parts and service increase and the quality of support decreases, it's difficult to justify isolating data management from the cost savings and technological improvements of modern tape automation.

Cost savings are a powerful motivator, and they're easily quantifiable, but they're still only part of the advantage of a migration. Migration offers the opportunity to re-evaluate size needs in a library, ensure the new system is "migration friendly" for future migrations, and ensure the partner you select to work with fits the business goals, ethics and direction of your own organization.

This whitepaper is a high-level overview of product options and considerations in migration. Yet again, that is only part of the equation. Spectra's over 40 years in the storage industry give us not only the experience and perspective that our customers rely on but also a track record we invite you to investigate. We partner with some of the largest data centers in the world and take our commitment to customers as seriously as we take the development of our solutions.

Having been involved in many large data migration projects, we understand that each migration situation will have unique aspects and caveats to plan through. Spectra would like the opportunity to visit your site, at no charge, to discuss and outline a migration plan which can be used as a blueprint for moving forward with state- of-the-art, modern technology.



IBM® TS1170
Tape Drive Technology




IBM® LTO-9
Tape Drive Technology



Oracle's T10000D
Tape Drive Technology

Appendix

	Spectra Logic TFinity Tape Library			
	Minimum Configuration	50 Slots, 1 Tape Drive (Three Frames)		
	Maximum Configuration	LTO: 56,400 Slots, 144 Tape Drives (45 Frames) Enterprise: 42,930, Slots, 144 Tape Drives (45 Frames)		
	Technology Supported	LTO, TS11xx Technology, T10000		
	Robotics	Dual		
	Slot Licensing	LTO: Increments of 10 Enterprise: Increments of 9		
	Frame Types (45 Maximum)			
	Base Frame (Required)	LTO	12 Drives	920 Slots
			24 Drives	800 Slots
		Enterprise	24 Drives	594 Slots
	Media Expansion	LTO	-	1300 Slots
		Enterprise	-	990 Slots
	Drive Expansion (Up to 5)	LTO	12 Drives	1010 Slots
			24 Drives	890 Slots
		Enterprise	24 Drives	675 Slots
Service Bay*	LTO	-	500 Slots	
	Enterprise	-	378 Slots	
<p>*Service Bay may be configured as a Bulk Service Bay, retaining the listed slot capacity but also allowing for up the import/export of 140 tape cartridges.</p>				
<p>BlueScale Management:</p> <p>The Spectra TFinity includes the powerful BlueScale management suite as a standard feature. BlueScale includes many reporting and management tools, such as:</p> <ul style="list-style-type: none"> Hardware Health Monitoring Library Lifecycle Management Media Lifecycle Management Drive Lifecycle Management EnergyAudit Syslog Reporting Capacity-On-Demand Auto-Support Logs BlueScale Encryption 				





Spectra Logic T950 Tape Library			
Minimum Configuration	50 Slots, 1 Tape Drives (Single Frame)		
Maximum Configuration	LTO: 10,080 Slots, 120 Tape Drives (8 Frames) Enterprise: 7,614 Slots, 120 Tape Drives (8 Frames)		
Technology Supported	LTO, TS11x0 Technology		
Robotics	Single		
Slot Licensing	LTO: Increments of 10 Enterprise: Increments of 9		
Frame Types (8 Maximum)			
Base Frame (Required)	LTO	12 Drives	920 Slots
		24 Drives	800 Slots
	Enterprise	12 Drives	684 Slots
		24 Drives	594 Slots
Media Expansion	LTO	-	1300 Slots
	Enterprise	-	990 Slots
Drive Expansion (Up to 4)	LTO	12 Drives	1070 Slots
		24 Drives	890 Slots
	Enterprise	12 Drives	810 Slots
		24 Drives	675 Slots

BlueScale Management:

The Spectra T950 includes the powerful BlueScale management suite as a standard feature. BlueScale includes many reporting and management tools, such as:

- Hardware Health Monitoring
- Library Lifecycle Management
- Media Lifecycle Management
- Drive Lifecycle Management
- EnergyAudit
- Syslog Reporting
- Capacity-On-Demand
- Auto-Support Logs
- BlueScale Encryption



 	Spectra Stack Tape Library		
	Minimum Configuration	10 Slots, 1 LTO Tape Drive	
	Maximum Configuration	560 Slots, 42 HH LTO Tape Drives 560 Slots, 21 FH LTO Tape Drives	
	Technology Supported	LTO	
	Robotics	Single	
	Slot Licensing	LTO: Increments of 10	
	Frame Types		
Spectra Stack	LTO	Base	80
		Expansion (up to 6 Expansions)	80
<p>BlueScale Management:</p> <p>The Spectra Stack includes the powerful BlueVision management suite as a standard feature. BlueVision includes many reporting and management tools, such as:</p> <ul style="list-style-type: none"> • Hardware Health Monitoring • Media Lifecycle Management • Syslog Reporting • Capacity-On-Demand • Auto-Support Logs • BlueScale Encryption 			

About Spectra Logic Corporation

Dedicated solely to data storage innovation for more than 40 years, Spectra Logic helps organizations modernize their IT infrastructures and protect and preserve their data with a broad portfolio of solutions that enable them to manage, migrate, store and preserve business data long-term, along with features to make them ransomware resilient, whether on-premises, in a single cloud, across multiple clouds, or in all locations at once. To learn more, visit www.spectralogic.com.

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