Robotic Zoning in a TFinity ExaScale Tape Library

Table of Contents

Abstract:

While customers have been purchasing the Spectra® TFinity® ExaScale Tape Library since its inception with dual robotics, the system had not been fully optimized for performance with HPC Software platforms. By adding robotic zoning and some pre-planning on drive and tape locations, both robots can be used simultaneously during production activities while still providing the full redundancy of dual robotics as each gets to every tape and drive location.
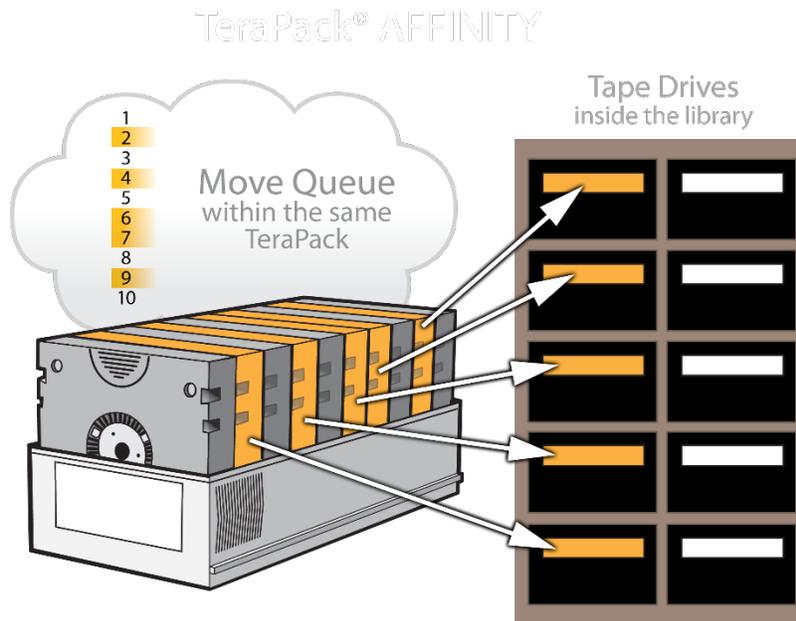
Operation:

The TFinity ExaScale comes equipped with two robots and can be configured with multiple exporters so that several operations can be processed in parallel. This has the potential to double the library's bandwidth. However, since both robots travel along the same horizontal axis within the library, this performance increase requires each robot to operate on its own half of the library. If not, the robots waste time sitting idle while each waits for the other to move out of the way.
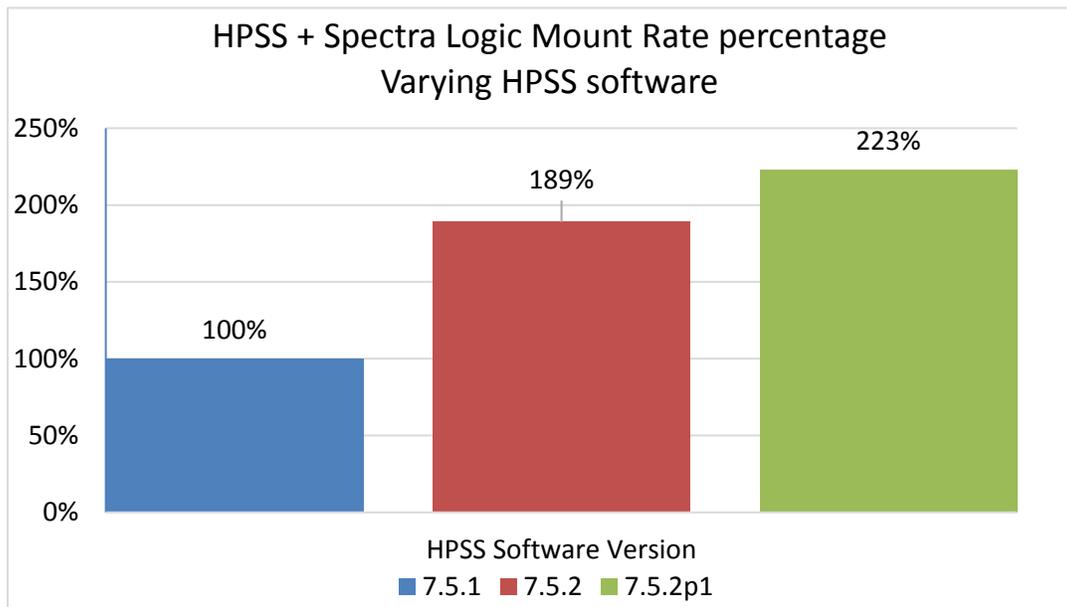
One method of keeping the robots separate is to use two partitions. All the drives from one partition are placed on the right half of the library, and all the drives from the other partition are placed on the left half. Media is placed in the appropriate half of the library based on its partition. This ensures that all moves take place entirely within a single half of the library and can be performed in parallel. As long as both robots are operational, the library will perform all moves in parallel. If either robot requires maintenance, the library continues to perform moves on both sides with the available robot. The downside to this approach is that drives cannot be shared between the two partitions. If one partition has many recall requests going to tapes, but the other does not, then one half of the library will be so busy it won't be able to keep up with all the reads, while the drives on the other side of the library will be sitting idle.

For customers who do not wish to partition their storage, a new Spectra tape library feature called "zoning" allows for similar operations within a single partition. When zoning is enabled, the status of each element (drives and slots) includes a "zone" which indicates the side (left/right) of the library the element is currently on. This allows the host to select zone 0 drives for mounting zone 0 tapes, and vice versa. As long as moves do not cross zones, all moves can be performed in parallel. The software package can maintain two work queues, one for each zone. Work from the top of each queue is sent to the appropriate interface. As long as work is available on both queues, the library performs at twice the speed of a single robot library. See the diagram on the next page.
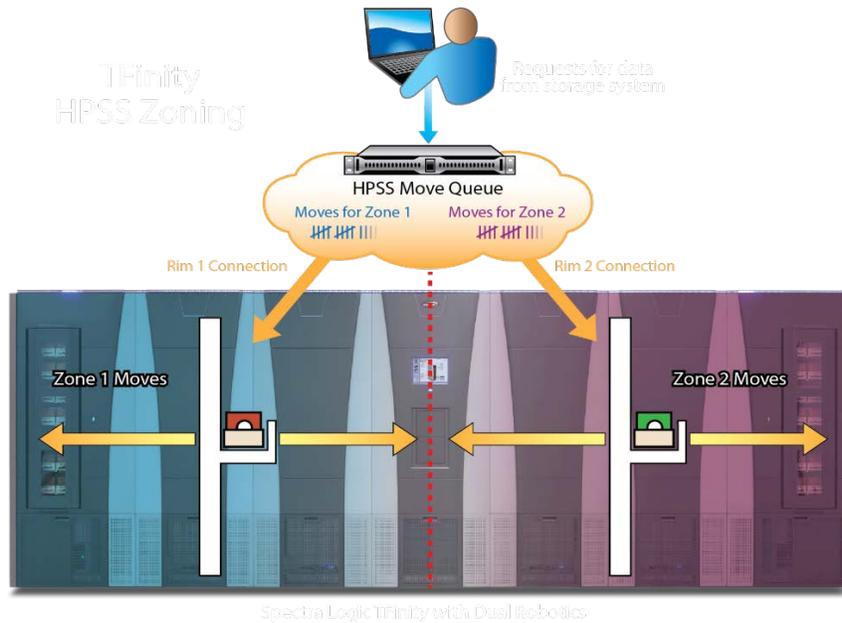
Spectra Logic has collaborated with the engineers at HPSS and at DMF to optimize the zoning functionality with the TFinity ExaScale tape library. Changes were also made to each software package so that the tape barcode can be associated with the corresponding TeraPack® barcode in which the tape resides. This allows HPSS or DMF to sort the move queue for each zone so that tapes from the same TeraPack can be loaded in order into drives, which further increases robotic mount performance.

**HPSS + Spectra Logic Mount Rate percentage
Varying HPSS software**

(Bar chart showing mount rate percentages by HPSS Software Version)

- 7.5.1: 100%
- 7.5.2: 189%
- 7.5.2p1: 223%

X-axis: HPSS Software Version
Legend: ■ 7.5.1 ■ 7.5.2 ■ 7.5.2p1

Testing has shown that when zoning and other optimizations focused on performance are enabled within HPSS, the robotic mount performance can be doubled compared to testing against older HPSS software with no TFinity performance optimizations.

The section below gives more detail regarding the changes made to the Read Element Status responses. Please see the Spectra Tape Series Libraries SCSI Developer's Guide (https://support.spectralogic.com/documentation/user-guides/tape-scsi-developer.pdf)for a complete description of the Read Element Status command and response.

1. For Drive, Storage and Import/Export elements, if the SValid bit is not set, then the Source Storage Element Address field will be used to convey the zoning information. A 0h value in the least significant bit of the Source Storage Element Address field will signify the left mover zone, and a 1h value in the least significant bit of the Source Storage Element Address field will signify the right mover zone.
2. The SValid bit will never be set for Storage Elements.
3. The SValid bit will never be set for Import/Export Elements.

4. The following data will be appended to the Storage Element Descriptor and the Import/Export Element Descriptor.

Bit/Byte	7	6	5	4	3	2	1	0
n	Protocol Identifier (0)				Code Set (2h)			
n+1	PIV (0)	Reserved	Association (0)		Designator Type (0)			
n+2	Reserved							
n+3	TeraPack Barcode Length (10h)							
n+4 … n+19	TeraPack Barcode							

TFinity ExaScale:

Proven by the largest data users in the world, Spectra's TFinity ExaScale Tape Library offers a highly flexible hardware architecture and a revolutionary management interface, helping customers achieve the ultimate in data preservation. The TFinity ExaScale can expand up to 44 frames or 53,000 tapes in a single library.

TFinity ExaScale Tape Library delivers many advantages: component redundancy, high-performance dual robotics, industry-leading storage density, extreme scalability, energy efficiency, ease of management, integrated encryption and enduring reliability and service.

About Spectra Logic

Spectra Logic develops data storage solutions that solve the problem of short- and long-term digital preservation for business and technology professionals dealing with exponential data growth. Dedicated solely to storage innovation for nearly 40 years, Spectra Logic's uncompromising product and customer focus is proven by the adoption of its solutions by industry leaders in multiple vertical markets globally. Spectra enables affordable, multi-decade data storage and access by creating new methods of managing information in all forms of storage—including archive, backup, cold storage, private cloud and public cloud. To learn more, visit www.SpectraLogic.com.