StorageTek SL8500 Modular Library System

Best Practices

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StorageTek SL8500 Modular Library System Best Practices

E24482-01

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Summary of Changes

Date	Revision	Description
October 2011	E24482-01	New part number
		Added new sections
		Changed ExLM to LCM
		Updated figures
		Updated footers
		Global updates

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Preface

This document contains best practices for the optimization of Oracle's StorageTek SL8500 Modular Library System along with recommendations about how to improve the overall performance of the library.

A minimum level of SL8500 3.98b Firmware is required.

Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/support/contact.html or visit http://www.oracle.com/accessibility/support.html if you are hearing impaired.

1

Overview

This document is written for Oracle customers that are interested in planning for, purchasing of, and using the SL8500 modular library system, as well as Oracle Sales and Support.

Minimum Software/Firmware Levels

The following *minimum* levels of library firmware and library software are assumed:

- SL8500 3.98b Firmware
- ACSLS

  The minimum release is ACSLS 7.1 with PUT0701. ACSLS 7.3.1 and 8.0.2 maintenance levels are more current and are required for some features.
- Enterprise Library Software (ELS) - formerly HSC, VM/HSC, SMC, VTSS etc

  The minimum release and maintenance level is NCS/HSC 6.2 with L1H146X (VM) or L1H146Y (MVS) PTFs installed. Enterprise Library Software (ELS) 7.0 and 7.1 are more current releases.
- Library Content Manager (LCM) - formerly ExLM

  A minimum of ExLM 6.2 is required. Library Content Manager (LCM) 7.0 and 7.1 are more current releases.

Terminology and Usage

The following terminology is used throughout this document and mean the same unless otherwise noted:

- SL8500 modular library system, SL8500 library, SL8500, or just “library.”
- Media, cartridges, tape cartridges, volumes, tape volumes, or just tapes.
- Rail (hardware) and library storage module or LSM (software).
- Library complex (hardware) and ACS (software).

  Note – An ACS can contain multiple libraries joined by pass-thru ports within a complex.
- Slots (hardware) and cells (software).

- Tape drives, transports, tape transports, and just “drives.”

Related Publications

The following list contains the names of publications that provide additional information.

TABLE 1-1 Publications

Software Publications
ACSLS 7.3.1 and 8.0.2 Administrator’s Guide
HSC 6.2 Operator’s Guide
HSC 6.2 Systems Programmer’s Guide
Configuring HSC and VTCS 7.0, 7.1
Managing HSC and VTCS 7.0, 7.1
ELS 7.x Command, Control Statement and Utility Reference
NearLine Control Solution (NCS) 6.1 Installation Manual
ELS 7.x
Virtual Tape Control System Installation and Configuration Guide
LCM Installation Guide
LCM Quick Reference
LCM System Administrator’s Guide
Hardware Publications
SL8500 User’s Guide
SL8500 Systems Assurance Guide

2

SL8500 Architecture

The architecture of the SL8500 library uses *multiple*, high-performance, robots to provide redundancy and availability.

The robotic system consists of 4 or 8 *HandBots* that work in *parallel* to achieve an increase in throughput—or cartridge exchange rates—by allowing *each* robot to operate independently. Servicing of multiple mount requests can occur at the same time to improve performance.

Continuous availability through library management, such as the HSC component of Enterprise Library Software (ELS), hereafter known as HSC, or Automated Cartridge System Library Software (ACSLS) provides *near continuous operation* and *dynamic configuration utilities* that allow you to change configurations without interruption to the library.

Consolidation and *drive sharing* combine valuable resources, such as the tape drives, with the high density of the library to save floor space, yet maximize capacity.

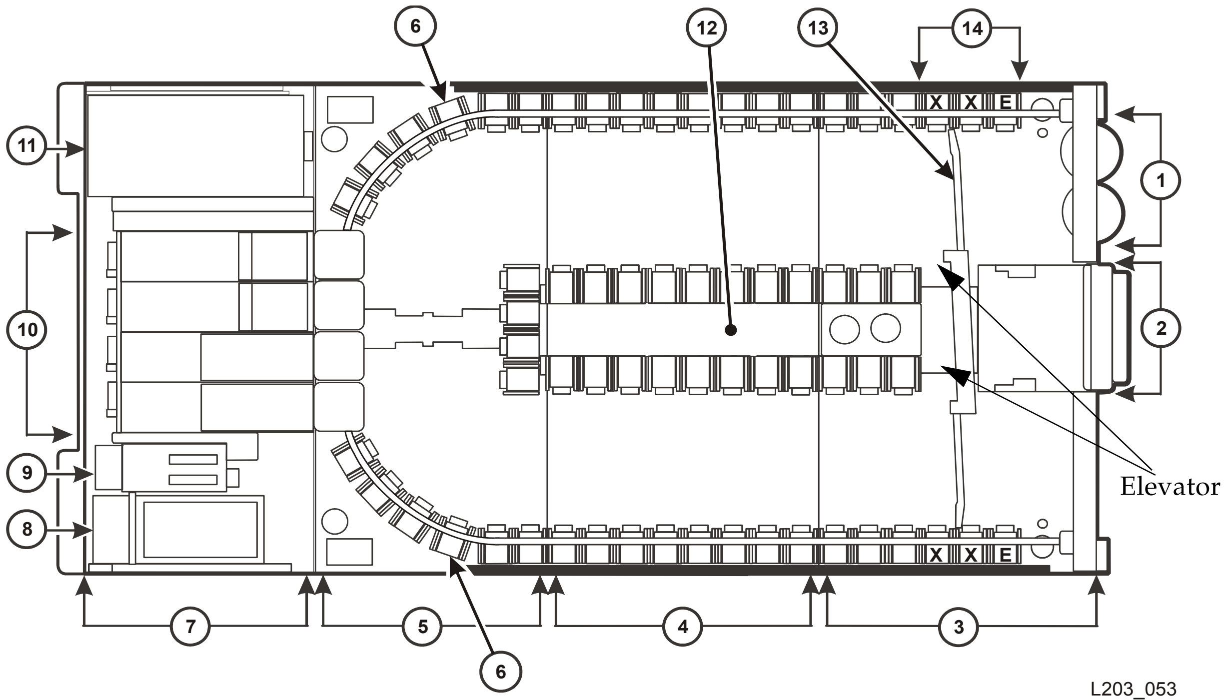
Near-zero downtime with the use of redundant components wherever possible for very high availability. HandBots, tape drives, power supplies, controller and tape drive processor cards, and pass-thru ports can be replaced while the SL8500 continues to operate.

Queuing of requests during temporary library outages by ACSLS and HSC occurs automatically. When the library or tape drive is available again, the requests are automatically retried, avoiding the requests failing during temporary outages.

Modules

FIGURE 2-1 on page 20 shows a view of the library with an example of each type of module and the location of certain components.

FIGURE 2-1 Library Modules



1. “Cartridge Access Ports” on page 37
2. Facade—may contain up to 2 operator panels (Keypad and the SLC - StorageTek Library Console) The two elevators (vertical pass-thru) are located behind the operator panels.
3. Customer Interface Module (**CIM**)—only **1** module per library.
4. Cartridge Expansion Module (**CEM**)—up to **5** modules per library.
5. Robotics Interface Module (**RIM**)—only **1** module per library.
6. Pass-thru Ports—columns 6 and –6. See “Pass-thru Ports” on page 33 for more information.
7. Drive and Electronics Module (**DEM**)——only 1 module per library
8. AC Power and Electronics Control Modules
9. DC Power supplies—can have up to 24 modules per library
10. Tape drive bay—holds up to 64 tape drives
11. Accessory racks
12. Inner wall cartridge slots
13. Service Safety Door
14. Reserved Capacity Slots
    - E = End stop
    - X = Diagnostic cartridges

TABLE 2-1 Module Descriptions

Module	Description
Customer Interface Module (CIM)	The customer interface module is the first module in the library and measures 95.25 cm (37.5 in.) deep. This module contains: • 648 data cartridge slots (see "Library Walls, Arrays, and Slots" on page 23). • 198 slots for diagnostic and cleaning cartridges. • 24 end slots (eight 3-slot arrays) for targeting and drop-off cells. • One LED display and keypad Touch screen operator control panel (*optional* feature). • Two load sharing DC power supplies. • One service safety door for maintenance activity (*optional* feature). • One standard. • Two elevator assemblies that can transfer up to four cartridges from one rail to another.
Storage Expansion Modules (SEM)	The SL8500 library can accommodate up to *five* storage expansion modules (callout #4). Each expansion module: • Increases the depth of the library by 95.25 cm (37.5 in.) • Adds 1,728 customer usable *data* cartridge slots per expansion module (see "Library Walls, Arrays, and Slots" on page 23)
Robotics Interface Module (RIM)	The robotics interface module (callout #5) is the next module and measures 76.2 cm (30 in.) deep. This module contains: • 800 data cartridge slots (see "Library Walls, Arrays, and Slots" on page 23) • Pass-thru ports (see "When defining pass-thru ports:" on page 33) • One of two robotic configurations (see "Robotic Architecture" on page 30)
Drive and Electronics Module (DEM)	The drive and electronics module (callout #7) is the last module in the library and measures 76.2 cm (30 in.) deep. This module contains the: • AC power distribution units • Electronics Control Modules (up to 2 for the Redundant Electronics feature) • Load sharing DC power supplies • Accessory racks • Slots for 1 to 64 tape drives • *No slots* for data cartridge storage

Capacities

Capacity for the SL8500 uses Capacity on Demand and RealTime Growth to allow you to instantly increase and activate capacity without disruption.

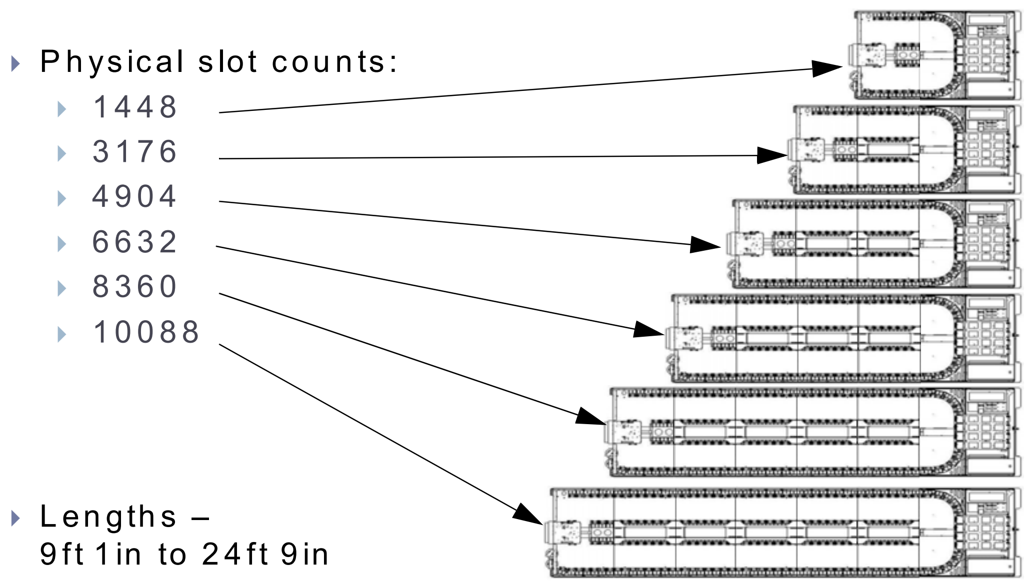
Slot upgrade part numbers provide the capability to increase the amount of activated capacity in the library (Capacity on Demand).

With RealTime Growth, physical capacity can be *pre-installed* and then activated when and as needed.

Expansion Modules and Library Capacities

Adding expansion module increases library capacity by 1,728 slots per module.

FIGURE 2-2 Expansion Modules and Capacities



Slot Count (Capacity)	**Expansion Modules**
1448	Base Module only - No expansion modules.
3176	• With One expansion module
4904	• With Two expansion modules
6632	• With Three expansion modules
8360	• With Four expansion modules
10088	• With Five expansion modules

The SL8500 delivers exceptional value in these ways:

- Scale non-disruptively at your pace and pay only for what you need with RealTime Growth capability and Capacity on Demand.
- Design storage the way you really want it. The library does not dictate your choices.

- The SL8500 includes Any Cartridge Any Slot™ capability and the flexibility, which allows you to select any physical slots in the library as active slots.

RealTime Growth Capability

RealTime Growth offers:

- Advance installation of expansion modules
  - Install extra physical capacity during the initial install
  - Pay for it when you are ready to use it; it is already installed
- Quick and easy growth
  - Non-disruptive growth in capacity
  - No physical library components required for growth
  - Eliminates many internal procedures

RealTime Growth also includes the capability to add pass-thru ports dynamically while the library is operating.

Capacity on Demand

Capacity on Demand is a non-disruptive and optional feature that allows you to add capacity to the library using previously installed, yet not active slots.

Non-disruptive Capacity Changes

Changes to active capacity result in minimal disruptions to library operations.

With the SL8500 library, you can increase active capacity without stopping host jobs or having host connections go offline. When you increase or decrease the capacity, the library goes offline only momentarily and then comes back online automatically.

Library Walls, Arrays, and Slots

The library has two types of walls with arrays and slots that hold cartridges:

- *Inner* walls—consist of 14-slot arrays
- *Outer* walls—consist of 13-slot arrays with space for the robotic rails

Cartridges are placed in slots and lie flat, hub-side down, parallel to the floor. To prevent slippage, cartridges are held within their slots by the cartridge retention feature.

Aisle space between the inner and outer walls is limited to 0.5 m (18 in.). Because of this, entry into the library should be limited.

Understanding SL8500 Internal Addresses and HLI Addresses

If you need to physically locate a cartridge, you need to convert between the drive or cell address reported by ACSLS or HSC and the address used by the library.

The library firmware and the Host Library Interface (HLI) used by ACSLS and HSC, addressing schemes are explained below. You can use the SL Console to translate between the library and HLI addressing schemes as explained in "Translating Addresses Using the Library Console" on page 27.

The HLI addressing has five components (A,L,P,R,C) representing ACS (aka library complex), LSM, Panel, Row, and Column. The HLI hosts (ACSLS and HSC) use this addressing scheme to represent library component addresses. HLI is zero-based (0), with no negative numbers.

The library internal address is a five-digit comma-separated value (L,R,C,S,W) representing Library, Rail, Column, Side, roW, *viewed from inside the library facing the drive bays*. This addressing scheme is used by the firmware and internal communications to represent all devices and locations within the library. The library addresses are one's-based (1) and use negative numbers.

- Library: The number of the library, within a complex, Library 1 or the library numbered from left to right - facing the CAP end.
- Rail: Rails are numbered top down from 1 – 4 with rail 1 being on top.
  - Each rail is considered a separate library storage module (LSM).
  - LSMs are numbered 0 – 3 (top down).
- Column: Indicates the *horizontal* location of a tape cartridge referenced from the inside of the library facing the drive bay at the rear of the library forward, where:
  - +1 is just *right* of the center of the drive bay
  - -1 is just to the *left* of the center of the drive bays

  Column numbering is consecutive—the first columns that contain tape cartridges are +3 and -3 and continue forward to the front access doors.

  > **Note –** The library uses column addresses to calculate robotic moves, where moves to the right increment the column number, and moves to the left decrement the column number.

- Side: Indicates the inner and outer walls, or left and right HandBots in a redundant configuration.

Walls:	Outer wall = 1	Inner wall = 2
HandBots:	Left HandBot = 1	Right HandBot = 2

- Row: Is the location of a tape cartridge and consecutively numbered from the top (1) down (13 outer wall and 14 inner wall).

TABLE 2-2 Addressing Descriptions

<table>
<tr><th>HLI–PRC</th><th>SL8500</th><th colspan="2">Description</th></tr>
<tr><td>ACS</td><td>Library</td><td colspan="2">Number of the specific library in a library complex (ACS).
Note: An ACS contains multiple SL8500's in a library complex.</td></tr>
<tr><td>LSM

LSM 0
LSM 1
LSM 2
LSM 3</td><td>Rail

Rail 1
Rail 2
Rail 3
Rail 4</td><td colspan="2">The SL8500 library has four rails that the HandBots travel, which are numbered from top to bottom 1–4 (one's-based).

ACSLS and HSC considers each rail to be a separate LSM, numbered from top to bottom 0–3 (zero-based).</td></tr>
<tr><td rowspan="2">Panel
Panel 0
Panel 1
Panel 2–n</td><td>Column
CAP
Drives
Storage slots</td><td colspan="2">Columns indicate the horizontal location in the library. As viewed from the front of the library column and panel numbers start at the center of the drive panel (1) and sweep forward with increasing numbers.

See FIGURE 2-3 on page 26 for an example of a storage panel.
The SL8500 does not use panels as an address.

An Host Library Interface (HLI) panel spans across the width of the library to include both sides (left and right) and both walls (inner and outer) for each LSM.</td></tr>
<tr><td>Side</td><td>Wall location
Outer wall
Inner wall</td><td>HandBot number
Left (–)
Right (+)</td></tr>
<tr><td>Row</td><td rowspan="2">Row</td><td colspan="2">Rows indicate the vertical location of a tape cartridge and are numbered from the top—down.</td></tr>
<tr><td>Column</td><td>Rows for the HLI address are:

Storage panels start at 2 with
Column 0 = left
and Column 1 = right

Rows 0–12 outer walls
Rows 13–26 inner walls

Each column in a normal storage panel has 27 rows.

For a total capacity of 54 cartridges per panel.</td><td>Rows for the SL8500 address are:

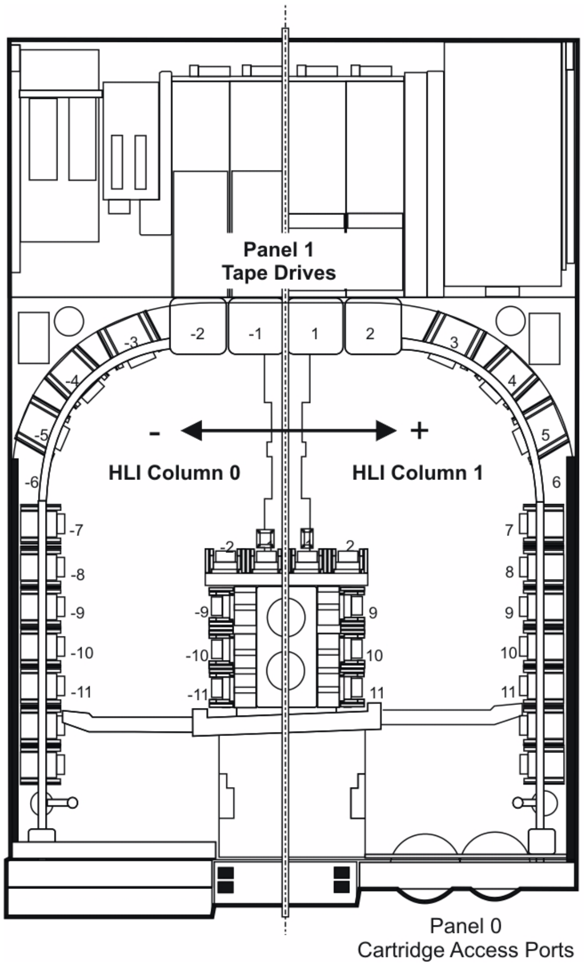
Storage slots start at
Column -3 = left
Column +3 = right

Rows 1–13 outer wall

Rows 1–14 inner wall</td></tr>
</table>

FIGURE 2-3 shows how HLI panels are mapped to columns in the SL8500 library.

FIGURE 2-3 Panel Numbering



HLI Panels Mapped to Library Columns

Panel 1 – Tape Drives
(library outside columns -/+1 & -/+2)

Panel 2 – 54 Cells
(library outside columns -/+3 & inside columns -/+1)

Panel 3 – 54 Cells
(library outside columns -/+4 & inside columns -/+2)

Panel 4 – 26 Cells (no inner wall)
(library outside columns -/+5)

Panel 5 – 14 Cells (contains PTP)
(library outside columns -/+6)

Panel 6 – 26 Cells (no inner wall)
(library outside columns -/+7)

Panel 7 – 26 Cells (no inner wall)
(library outside columns -/+8)

Panel 8 – 54 Cells (standard panel)
(library outside & inside columns -/+9)

Panel 9 – 54 Cells
(library outside & inside columns -/+10)

Panel 10 – 54 Cells
(library outside & inside columns -/+11)

Panel xx – 54 Cells
(library outside & inside columns -/+xx+1)

HLI Row Numbers

Outer walls = 0 – 13

Inner walls = 14 – 26

L205_166

The following information shows the panel number ranges for a base library and expanded library configuration.

Configuration	**Panel Number Ranges**				
Base Library	RIM	CIM			
	2 – 7	8 – 10			
One expansion module	RIM	CEM	CIM		
	2 – 7	8 – 15	16 – 18		
Two expansion modules	RIM	CEM	CEM	CIM	
	2 – 7	8 – 15	16 – 23	24 – 26	
Three expansion modules	RIM	CEM	CEM	CEM	CIM
	2 – 7	8 – 15	16 – 23	24 — 31	32 – 34

Four expansion modules	RIM	CEM	CEM	CEM	CEM	CIM	
	2 – 7	8 – 15	16 – 23	24 — 31	32 – 39	40 – 42	
Five expansion modules	RIM	CEM	CEM	CEM	CEM	CEM	CIM
	2 – 7	8 – 15	16 – 23	24 — 31	32 – 39	40 – 47	48 – 50

Touch Screen Operator Control Panel

The touch screen operator control panel—which mounts on the front of the library—is an *optional* feature. This panel consists of a flat screen display, with a touchable interface, and a panel-mounted personal computer.

Through this panel, all of the library instructions, diagnostics, library status, library and drive monitoring, and functional information can be accessed.

FIGURE 2-4 Touch Screen Operator Control Panel

The operator panel consists of:

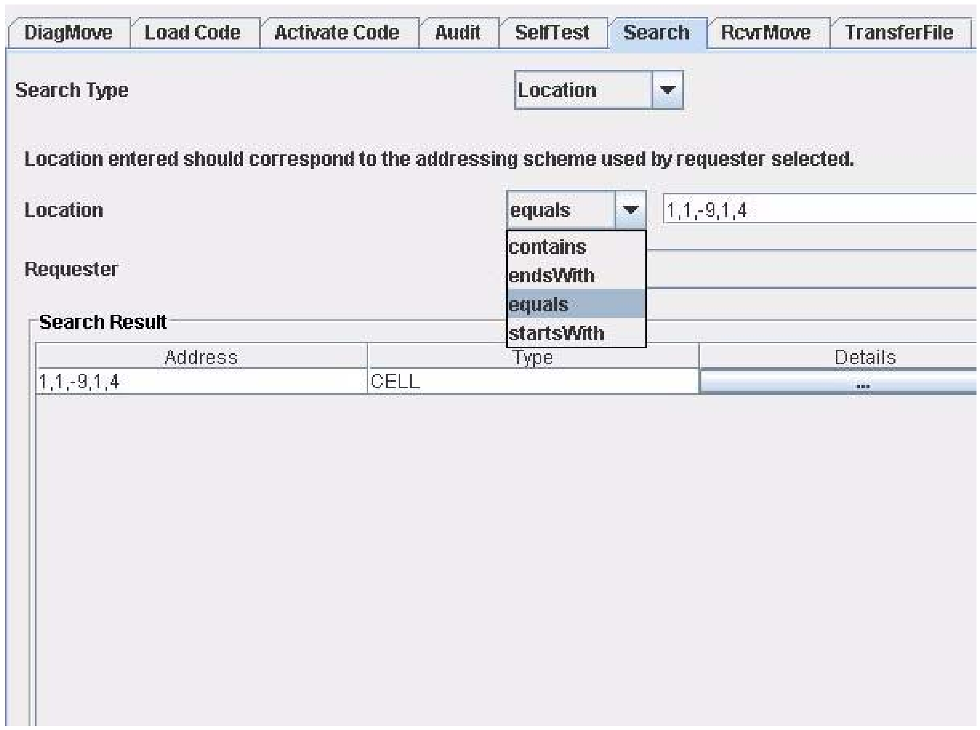
- Library Console software
- 12-inch flat screen display (*diagonal* measurement)
- Touch screen interface (no mouse or keypad necessary)
- 140 + GB hard drive
- 1 GB memory
- Java applet as the graphical user interface (GUI).

Translating Addresses Using the Library Console

You can use the StorageTek Library Console (SL Console) Search utility to translate between the SL8500 internal address and the ACSLS or HSC panel, row, and column. To locate a cartridge:

1. Log in to the SL Console, select Tools, select, Diagnostics, and select the Search tab.

FIGURE 2-5 Translating Addresses



2. From the Search Type pull down menu, select Location.
3. Select one of the following operators for the location:
   - contains

     Example: 1,1,-9 lists the contents in Library 1, Rail 1, Column -9 for all rows on both sides
   - endsWith

     Example: 1,5 lists the slot contents for all rails and columns for Side 1, Row 5
   - equals

     Example: 1,1,-9,1,1 lists the contents in that specific location (L,R,C,S,W)
   - startsWith

     Example: 1, 3 lists the slot contents for all columns, sides, and rows in Library 1, Rail 3
4. Select a Requester from the pull-down menu.
   - default

     Shown above is the physical location inside the library (cell, drive, CAP).

If you know the physical location (the internal address), and need to find the HLI-PRC address, enter that address in the *location* and pick *default* as the requester.

- hli1

  This is the HLI-PRC address of the cartridge from the library management software.

  If you know the HLI-PRC address and want to find the physical location (internal address), enter that address in the *location* and pick *hli1* as the requester. Do not specify the ACS number in the HLI address. Only specify: lsm,panel,row,column

5. Click on the Search button in the top right corner of the SL Console.
   The search result lists the location by slot-type (cell, drive, or CAP).
6. Click on the *Details* button for more information such as VOLID, media and cartridge type (LTO, and T-Series; data, cleaning, or diagnostic) and HLI address for cartridges when you specify a *default Requester*.

Refer to the SL Console Help—*Locating a Cartridge by Address*—for more information.

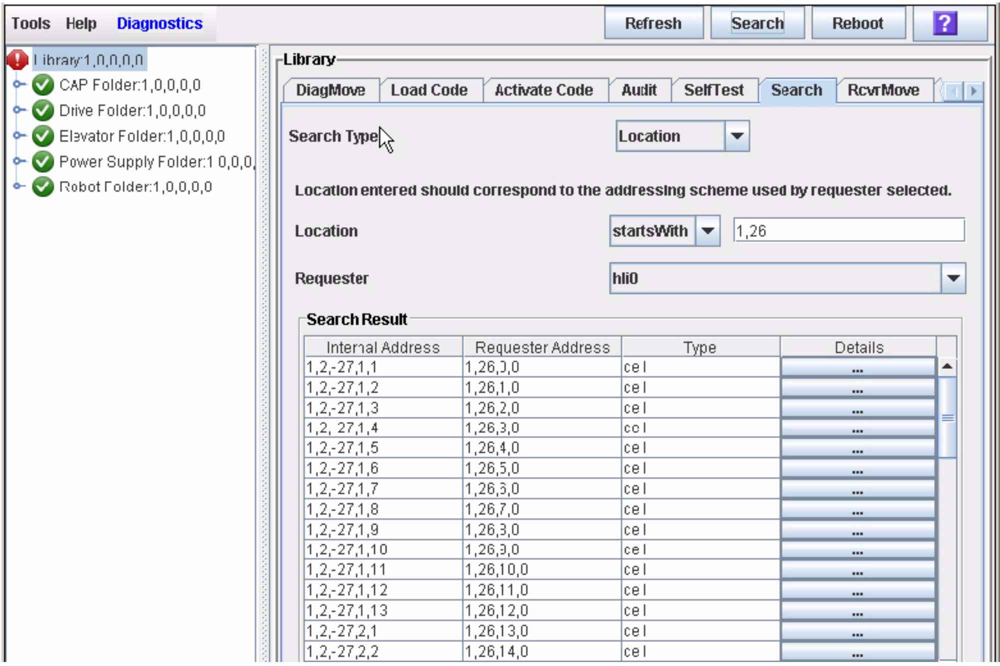
FIGURE 2-6 Translating Addresses

Choosing *default* as the Requestor *and* clicking on the Details field (...) opens a Location Details screen that contains the following information.

The location details includes additional information including the HLI-PRC address.

Choosing *hli1* and providing an HLI address as the Requestor displays *both* the internal address and the hli1 Requester address.

FIGURE 2-6 Translating Addresses



To specify a VOLID, specify the volser with the media domain and type appended. For example: VOL009T2 for a T10000C data cartridge.

Robotic Architecture

FIGURE 2-7 on page 31 shows an example of the robotics in an SL8500—called the HandBot and rail assembly.

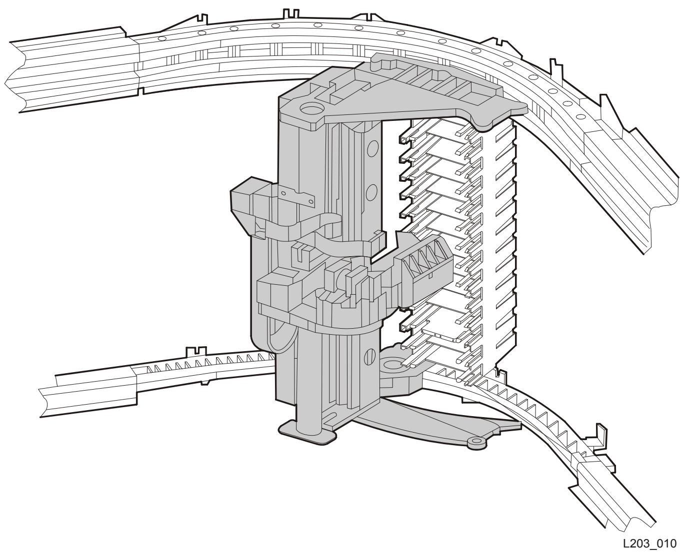
The *robotic system* in an SL8500 library consists of 4 or 8 HandBots that work in *parallel* to achieve an increase in throughput—or cartridge exchange rates—by allowing *each* robot to operate independently. Servicing of multiple mount requests can occur at the same time to improve performance.

Major components of the robotic system include:

- Each SL8500 has four separate robotic rail assemblies. These rail assemblies provide both power and communications to their own individual robotic system(s).
- Rail assemblies—also known as library storage modules—are numbered from top to bottom.
  - Rail numbers are 1 to 4.
  - Corresponding LSM numbers are 0 to 3.
- Each HandBot on a rail assembly can service up to tape drives and all of the tape cartridges for that rail. The SL8500 library can have either one or two HandBots *per rail*.

- Spanning vertically adjacent to the four rail assemblies are two elevators. These elevators perform an *internal* pass-thru operation that allows cartridges to move between rails.

FIGURE 2-7 HandBot and Rail Assembly



Note: The HandBots are a *shared* resource of the library and under control of the Library Control Card (the controller).

Note – An important concept to understand about the SL8500 is that each rail is a separate library storage module (LSM). A robot can access any location on a rail, but an elevator must be used to pass a cartridge to another rail.

Elevators

FIGURE 2-8 Elevators

The SL8500 library features two Elevators that provide *vertical* pass-thru operations between library storage modules within the *same* library.

> **Note:** Pass-thru Ports provide *horizontal* pass-thru operations between *adjacent* library storage modules.

Each of the four LSMs *share* the resources of the two elevators. There is one elevator on the left and one elevator on the right that are located in the front of the library between the front access doors and the service safety door.

Important:
Because the SL8500 has four 4 LSMs, HSC administrators must specify the elevators as pass-thru ports to each of the adjacent LSMs in the same library.

Example: Below is an example of an HSC LIBGEN showing just the four elevator pass-thru (**PASTHRU**) definitions:

HSC Elevator Configuration Example:

```
LSM0000   SLILSM PASTHRU=((0,M),(0,M),(0,M)),        X,
                ADJACNT=(LSM0001,LSM0002,LSM0003),   X
                ...

LSM0001    SLILSM PASTHRU=((0,S),(0,M),(0,M)),       X
                ADJACNT=(LSM0000,LSM0002,LSM0003),   X
                ...

LSM0002    SLILSM PASTHRU=((0,S),(0,S),(0,M)),       X
                ADJACNT=(LSM0000,LSM0001,LSM0003),   X
                ...

LSM0003    SLILSM PASTHRU=((0,S),(0,S),(0,S)),       X
                ADJACNT=(LSM0000,LSM0001,LSM0002),   X
                ...
```

In the above example:

- PASTHRU: The Master LSM for a pass-thru port is designated by "M" and "S" designates the slave LSM for a PMP.
- ADJACNT: Shows that every LSM is adjacent to all other LSMs because of the elevator.

When defining pass-thru ports:

- 0 = Vertical pass-thru components (elevators)
- 1 = Horizontal pass-thru components (pass-thru ports)

Pass-thru Ports

Pass-thru ports (PTPs) are electro-mechanical devices that allow one library storage module to pass a cartridge to another adjacent library storage module in the same complex. Connecting libraries together with pass-thru ports is what creates an SL8500 library complex.

FIGURE 2-9 is an example of a pass-thru port (PTP) mechanism.

FIGURE 2-9 Pass-thru Port Mechanism

The SL8500 pass-thru port mechanism consists of a separate frame that is installed between the Drive and Electronics Module/Robotics Interface Module of one library with the same modules of an adjacent library.

Each PTP frame has four separate mechanisms that can pass up to two cartridges—per rail—between the libraries.

There are eight PTP locations in an SL8500 library, two per rail (or LSM). These locations are on the curved portions of the Robotics Interface Module near the tape drives.

Important*:*
The need to plan ahead for the addition of pass-thru ports is extremely important. The library complex can "grow" in either direction—left *or* right.

The *preferred* method of installing PTPs to an existing library is to add the new library to the *left* when viewed from the front.

The reason for the preference is that the library can grow in the other direction—to the right—but this requires a disruption to the system to renumber the LSMs and locations of all existing cartridges and drives.

Highlights of the PTP feature are:

- All SL8500 libraries come equipped and ready for the addition of the PTP frame and feature—no additional walls are needed.
- Power for the PTPs comes from the same +48 VDC power bus as the robotic rails. Both the N+1 and 2N power configurations currently support the PTP hardware—no additional power supplies are needed.
- The PTP locations are on the curved portions of the RIM at columns +6 and –6 near the tape drives for quick access. Each PTP frame has four separate mechanisms and can pass up to two cartridges per LSM. These mechanisms are located in the rear of the library at columns +6 and –6 for quick access to an available tape drive.
- If service is required, the pass-thru port mechanism slides out of the frame from the rear of the library—not affecting library operations.
- Both ACSLS and HSC support pass-thru port operations—no additional software is needed.
    - For an *ACSLS* configuration, the library reports the configuration to ACSLS, no LIBGEN macro's are necessary.
    - For an *HSC* configuration, administrators must specify *both* the elevators and the pass-thru port mechanisms to each of the adjacent LSMs in the complex.

Managing Library Configurations

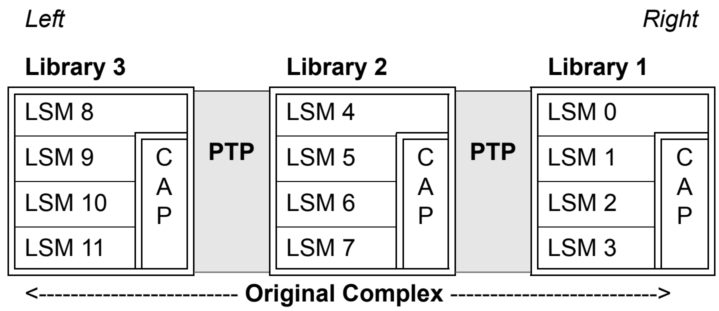
The following terms and definitions apply to SL8500 PTP operations:

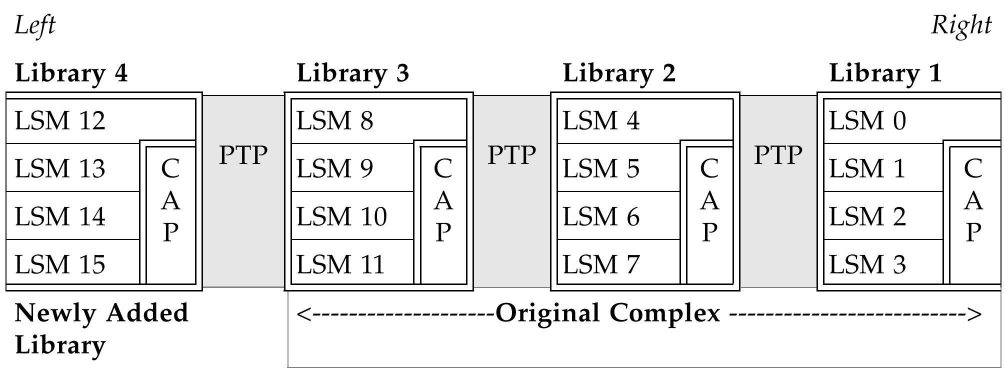
Home library	The library that provides power, signal, and control lines to the PTP mechanisms. This is the library on the right as viewed from the front.
Away library	The library that is always located on the left side of a Home library, as viewed from the front.

LSMs in an SL8500 library complex are numbered from top down and addressed from right to left as viewed from the front of the libraries.

Adding SL8500 Libraries to the *Left*

When you add libraries to the left of an existing library complex, you can dynamically upgrade the configuration of the software (ACSLS or HSC). This upgrade must be done to configure the LSMs, panels, cells, and tape drives in the new libraries. The following examples show a library complex before and after an upgrade. you





When you dynamically upgrade the configuration:

- No rebooting of ACSLS or HSC is required.
- Mount requests can continue as normal in the first or existing libraries during this upgrade.
- When cartridges are placed into the new SL8500 library, an ACSLS or HSC audit must be run to add these cartridges to the database. Existing LSMs can remain online during the audit.

Dynamically Upgrading ACSLS and HSC Configurations

For ACSLS, upgrade the configuration using either:

- Dynamic configuration (ACSLS stays online and running)
- acsss_config (ACSLS must be offline and stopped)

For HSC, upgrade the configuration using either:

- Use dynamic configuration (HSC 6.2 or ELS 7.x) by entering MODify CONFIG command
- LIBGEN, SLICREAT, and MERGEcds (HSC must be stopped)

Adding SL8500 Libraries to the *Right*

When a new SL8500 library is added to the right of the complex, the LSMs *must be renumbered*; consequently all volume and drive locations change.

Upgrading ACSLS and HSC Configurations

Existing LSMs must be offline (or in ACSLS diagnostic mode) before upgrading the SL8500 library complex and during the ACSLS or HSC audit. Otherwise, problems occur, such as:

- Mounts fail because cartridges cannot be found in their new locations.
- Entry of new cartridges collide with existing cartridges.
- Movements of cartridges to existing, renumbered, LSMs collide with cartridges already in the cells.

An outline of the steps to upgrade the library complex to the right consists of:

1. Adding the new physical SL8500 library to the complex.
2. Updating the ACSLS or HSC configurations dynamically or statically.
   - For ACSLS, vary the LSMs offline or place in diagnostic and use:
     - Dynamic configuration (config acs)
     - acsss_config (ACSLS must be offline and stopped)
   - For HSC, modify the LSMs offline and use:
     - Dynamic configuration (HSC 6.2 or ELS 7.x) by entering MODify CONFIG command
     - LIBGEN, SLICREAT, and MERGEcds (HSC must be stopped)
3. For renumbered LSMs, the you must audit the library to update volume locations.

   Audit the existing and new libraries in a specific sequence. This avoids deleting or marking absent the volumes in renumbered LSMs. The sequence of the audit is:

First:	Audit the existing LSMs that were renumbered. Start with the highest LSM numbers. Once that audit completes, go to the next lower group of LSMs. Continue with this sequence until you have audited all the older, higher numbered LSMs.
Second:	Audit the newly added LSMs *(Last to Audit)*.
Third:	Bring the LSMs back online (from their offline or diagnostic state). For ACSLS, vary the LSMs in the complex online. For HSC, modify the LSMs in the complex online.

ACSLS or HSC has now been updated with the new configuration and the new volume locations.

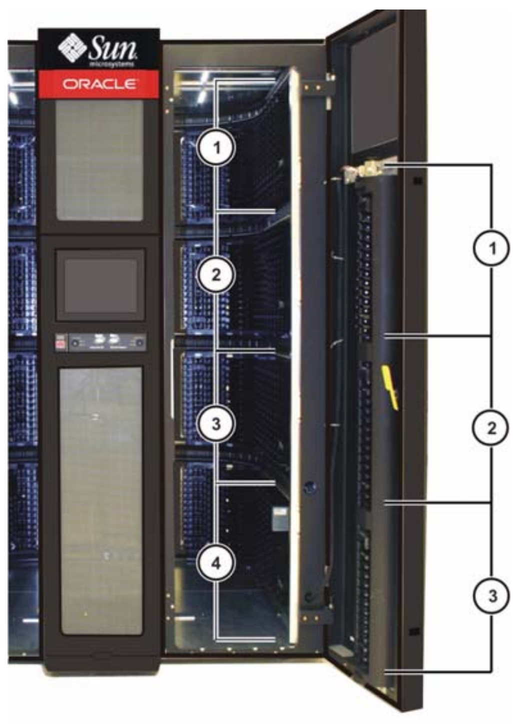
Audit Sequence:

Left						*Right*
First to Audit		**Second to Audit**		**Third to Audit**		**Last to Audit**
Library 4		Library 3		Library 2		New Library 1
LSM 12	PTP	LSM 8	PTP	LSM 4	PTP	LSM 0
LSM 13 (CAP)		LSM 9 (CAP)		LSM 5 (CAP)		LSM 1 (CAP)
LSM 14 (CAP)		LSM 10 (CAP)		LSM 6 (CAP)		LSM 2 (CAP)
LSM 15 (CAP)		LSM 11 (CAP)		LSM 7 (CAP)		LSM 3 (CAP)

<------------------------- **Original Complex** -------------------------> | **Newly Added Library**

Cartridge Access Ports

FIGURE 2-10 Cartridge Access Ports



The SL8500 library storage modules can share the resources of *two* cartridge access ports (CAPs).

- **Each CAP:**
  - Consists of 39 slots total (3 magazines with 13-slots each).
  - Spans across three rails—2, 3, and 4 (LSMs 1, 2, and 3) only.

    Note: Numbers 1 thru 4 (in the library) are rails. Numbers 1 thru 3 on the right front access door are LSMs.
  - There is no adjacent CAP section for the top rail (LSM 0). This requires an elevator (*vertical*) pass-thru operation to enter and eject cartridges.
- **CAP A** is:
  - Standard CAP (comes with the library)
  - Located on the *left* of the right front access door
- **CAP B** is:
  - Optional CAP (optional feature)
  - Located on the *right* of the right front access door

CAP Considerations

Usage considerations for the CAP include:

- When a CAP is in use for an enter or eject operation, all 39 slots are reserved for that operation.
- For addressing purposes, the CAP needs a location (ACS,LSM,CAP#). The LSM address is associated with the second rail in each library because there is no adjacent CAP magazine for the top rail. For example:

  ACS#,1,0 for **CAP A** and **ACS#,1,1** for **CAP B**
- When loading cartridges in the CAP, slots can be skipped.
- Both CAPs should be varied (ACSLS) or modified (HSC) offline *before* the Service Safety Door is activated on the *right-hand* side of the library. While the safety door is activated, there is no access to the CAPs.
- Operators should be aware that if only one CAP is required to do the job and there is no need to open both CAPs. Opening both CAPs increase the audit time since all slots are audited once a CAP is opened then closed.
- If rail with a single HandBot is inoperative, the portion of the CAP adjacent to that rail is inaccessible. In a dual HandBot rail, if the HandBot adjacent to the CAP is inoperative, that portion of the CAP is inaccessible.

Second CAP

The SL8500 library offers a second, *optional*, CAP feature. The second CAP is located on the *right-hand* side of the right front access door. The advantage of this second CAP is that it doubles the entry/ejection capabilities from 39 to 78 cartridges.

HSC requires a LIBGEN update to indicate that there are 2 CAPs. If the LIBGEN was compiled before HSC 6.2 L1H146X (VM) or L1H146Y (MVS) PTF was installed, then the 1 CAP is the default and the addition of a second CAP requires another LIBGEN. If the LIBGEN was compiled after 7.0 or 7.1, then the default is 2 CAPs and no LIBGEN is necessary.

CAP Addressing

The second CAP's operation is similar to a single CAP operation, but the library's addressing scheme changes. See TABLE 2-3 on page 39 and TABLE 2-4 on page 39.

Hardware

Using the SL8500 firmware notation of Library, Rail, Column, Side, and Row, the dual CAPs, in a single base library, with no expansion modules, now appear as:

TABLE 2-3 CAP Library Addressing—Hardware

CAP Magazine	Library	Rail	Column	Side		Row
				CAP A	CAP B	
Top	1	2	15	2	1	0
Middle	1	3	15	2	1	0
Bottom	1	4	15	2	1	0

This addressing example uses a single base library configuration with *no* storage expansion modules. When adding expansion modules, the column number increases by 8 for each module added (23, 31, 39, 47, and 55).

Previously with single CAP operations, CAP A was addressed as 1. With dual CAP operation, CAP B is 1 and CAP A is 2. This uses the inside (2) outside (1) numbering scheme for side.

The row is always 0, which is the magazine handle.

Software

For addressing purposes, software needs a fixed location for the CAP, and uses: ACS,LSM,CAP#. See FIGURE 2-10 on page 37.

The LSM address is associated with the *second* rail in each library because there is no adjacent CAP magazine for the top rail in an SL8500 library.

In the following example, a three library complex is used for CAP addressing.

TABLE 2-4 CAP Library Addressing—Software

Libraries in a Complex	CAP A			CAP B		
	ACS#	LSM	CAP	ACS#	LSM	CAP
First library	–	1	0	–	1	1
Second library	–	5	0	–	5	1
Third library	–	9	0	–	9	1

Operational Considerations

If you are familiar with other automated tape libraries, the following are a few operational differences you should consider for the SL8500.

Avoiding Pass-Thru

ACSLS and HSC attempts to avoid any unnecessary pass-thru activity during cartridge movement.

- Query mount—Orders drives by LSM proximity to a cartridge.

- Mount scratch tapes—Selects cartridges based on their proximity to a tape drive.
- Query mount scratch—Orders drives by LSM proximity to the largest pool of scratch tapes.
- Enter—Enters cartridges from the CAP magazine to the closest LSM with free cells.
- Eject—Ejects cartridges from an LSM to an adjacent CAP magazine.

Library Physical Limits

Currently:

- The maximum number of libraries supported in a complex is 10.
- The maximum number of panels in a library is 51 (with five storage expansion modules).

Mount and Dismount Commands

During a mount:

- Client requests specify cartridges by volume serial number (VOLSER) or volume ID (**`vol_id`**) and tape drives by drive location or *unit address* (only for MVS and HSC systems).

During a dismount:

- If the cartridge was selected and mounted from *the same LSM* ACSLS or HSC returns that cartridge to its original home cell.
- If a cartridge was selected from *a different LSM* and a pass-thru operation occurred to mount the cartridge on a tape drive, ACSLS or HSC tries to find a new home cell in the closest LSM with free cells to the drive as possible, *if float* is enabled.

Enter and Eject Commands

During an Enter/Import:

- Library management software normally tries to enter or import a cartridge to an LSM adjacent to the CAP magazine.

During an Eject/Export:

- For an eject or an export command, the software tries to eject the cartridge to the CAP magazine adjacent to the LSM. It this is not possible, it uses an elevator or PTP to move the cartridge to a CAP that has available capacity.
- For an eject or an export command from LSM 0, the library performs a pass-thru operation to an open slot in the top magazine with empty slots of the CAP.
- For HSC, when using an **Ordered Eject**, the software (and library operation) ejects cartridges to CAP cells in VOLSER order.
- LCM uses Ordered Eject to eject cartridges in volser order to save human operator intervention.

Optimization Guidelines

Here are a few basic guidelines that can help optimize library performance.

See "Configuring the Library for Performance" on page 49 for more guidelines.

Optimize Robotic Mount Handling

Once a HandBot successfully inserts a tape cartridge into a drive, it is immediately available for the next request and does not wait until the drive reports that the cartridge has been loaded. The SL8500 library control electronics waits to return the response to the mount request until it detects that the tape drive has successfully loaded the cartridge tape.

> **Note –** You had to specifically configure and enable this option in other, older libraries such as the SCSI-attached L-Series.

See "Configuring the Library for Performance" on page 49 for more guidelines.

Cartridge Float

Both ACSLS and HSC have cartridge float enabled by default.

- Cartridge float is a feature that allows ACSLS or HSC to place a dismounted tape cartridge in an empty slot in the same LSM as or a closer LSM to the tape drive if the tape originally came from a different LSM using a pass-thru operation.
- This feature minimizes elevator and pass-thru port activity by not requiring the cartridge to be returned to its original slot in another rail or library.

> **Warning – Turning the default Float option OFF can have serious consequences for overall library performance. In both ACSLS and HSC, turning Float OFF can greatly increase the total robotics activity to unacceptable levels.**

Tape Drive Placement

Ways tape drives can enhance performance of the library are by:

- Placing tape drives in the outer tape drive columns to minimize dual robotic contention.
- Grouping tape drives by type on the same LSM.
- Keeping compatible media and drives on the same LSM.
- Allocating LSMs to support specific application workloads.
- Maintaining free cells on each LSM to support dismounts using the *float* option.

  The lack of sufficient free cells and properly placed free cells can decrease library performance, as well as disable the ability to float on a dismount. When a mount requires one or more pass-thru operations and there is no free cell, the cartridge must be returned to it's original home cell. This increases robotics activity and can impact multiple LSMs, and in some cases, LSMs that are neither the source or destination LSM.

Do not try to distribute tape drives across all four rails is usually as this can increase pass-thru activity by the elevator and decrease overall performance of the library. Instead:

- Identify the requirements of each major application workload.
- Configure the library according to those requirements.
- Install the tape drives where they provide the most benefit.

The result from the requirements assessment may indicate that:

- Tape cartridges can be archived to a rail without tape drives.

  A suggestion would be to use the top rail for these scenarios.
  Example: inactive volumes, least recently used (LRUs) volumes, or volumes that require few enter and eject operations.

- All 16 tape drives are needed for heavy-usage tape drive applications.

  Example: high use, high activity production jobs, and back up applications.

  > **Note –** Sixteen (16) drives on an LSM can be a significant issue for short mount residency times, leading to increased wait times for the robot to be available. If the application generally has long mount residency times, such as backups, then the robotics activity is spread over a longer time frame and is not an issue. With no pass-thrus involved, the maximum mount/dismount rate is around 250 cycles an hour. High mount rate applications may require more than one LSM, and may require additional tape drives to reduce pass thrus because all drives in the cartridge's home LSM are in-use.

- Smaller groups of drives should be arranged for special applications.

  An example would be virtual mounts for VSM. A virtual tape storage subsystem (VTSS) only uses 8 tape drives concurrently.

- Application-specific requirements may separate drive-types.

  Example: placing T9840 access-centric tape drives on one rail, and T10000 capacity-centric tape drives on another.

Access Door Operations

Whenever possible, *do not open the front access doors*. Opening a front access door on the SL8500 library can be a *disruptive* operation.

Every SL8500 library has two front doors that contain safety interlock circuits. Unless the service safety door has been activated to block access to the library behind the access door, these interlock circuits *remove all DC power* to the HandBots, elevators, and pass-thru ports to protect operators from moving mechanisms.

> **Note –** Power to and operations of the tape drives remains unaffected.

Activating the service safety door allows continued library operation. However, activating the service safety door blocks can block access to some components.

- If the service safety door is activated to the right side, it blocks access to the CAP(s).
- The service safety door blocks access to the elevator on the same side as the service safety door. (There are two elevators in an SL8500, but blocking access to one of them reduces a library's pass-thru capability.)

If an access door has been opened without the service safety door being activated, when the access door is closed, the HandBots and other mechanisms automatically go through an initialization process that takes about *five minutes*. During this time, the SL8500 is offline to ACSLS or HSC and library operations are stopped.

After this, the SL8500 comes back online and starts a physical audit of all storage cells as a background operation. All automated tape operations, including mounts and dismounts, continue while the physical audit occurs in the background.

Audits and Initialization

The term *audit* refers to the process of reading and cataloging all cartridges within a library or verifying cartridge locations—the physical inventory.

An SL8500 library is capable of storing all cartridge locations within the library on the library controller card.

The physical inventory contains:

- Volume serial numbers (VOLSERs) or identification (VOLIDs)
- Internal address locations (library, rail, column, side, and row)
- Verified status (true or false)

Audit Conditions

The library audits all cartridge locations in all areas of the library, including the slots in the storage and reserved areas when:

- The library initializes at power-on.
- After either one or both access doors are opened and closed without activating the service safety door.
- A physical audit request is made through SL Console.

Audit Types

There are three types of audits that the library performs:

Physical audit Physical audits are when the HandBots:

- Scan the cartridge locations in the library
- Verify the volumes
- Update the library control card inventory
- Set the status of the cartridge location to true

Verified audit Verified audits are invoked from the SL Console and *validate* the status of a specific cartridge slot or range of slots.

Virtual audit Virtual audits are invoked from the SL Console and *display* the cartridge inventory in the console screen (either local or remote).

Audit Processes

Refer to the *SL8500 User's Guide* for detailed information on the audit processes.

Labels

The SL8500 library supports four types of barcode labels:

TABLE 2-5 Barcode Label Types

9x40	Uses a *six-plus-one* label supplied by Engineered Data Products/ Colorflex) and American Eagle/Writeline. The plus-one is the required media ID character with an implied domain type of 0.
T10000	Uses labels with *eight* characters, the last two of which are the required Media ID Domain and the Media ID Type characters.
LTO	Uses labels with *eight* characters, the last two of which are the required Media ID Domain and the Media ID Type characters.
SDLT	Uses labels with *seven* characters, the last of which is the required media ID character with an implied domain type of 1.

Media ID Labels

The use and placement of barcode labels is important for proper operations.

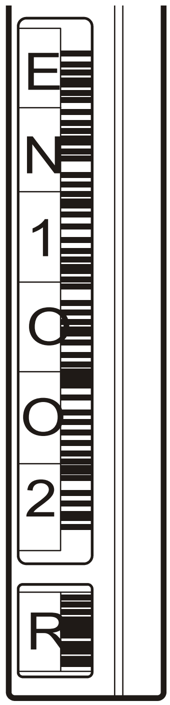
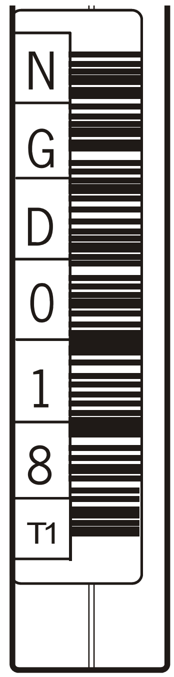
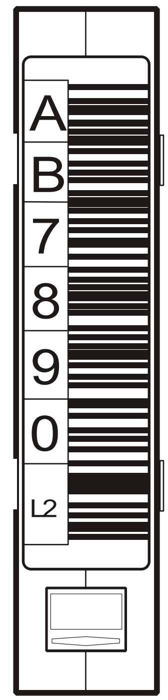
The use of *media ID* labels allows you to mix tape drive types and media types in a single library or library complex. This provides customers with a true mixed media solution, which is called:

Any Cartridge, Any Slot™

In addition, the *domain type* allows libraries to more accurately represent how the information is reported to the host. The domain type represents the tape technology (for example L for LTO) and the media ID represents the version of that technology (for example generation 1, 2, or 3).

FIGURE 2-11 on page 46 shows some examples of labels, media domains and IDs for the T9x40, T1000, and LTO. Refer to the StorageTek SL8500 Systems Assurance Guide for information on the SDLT tape cartridge.

FIGURE 2-11 Label Examples

T9x40 Six-plus-one	T10000 Eight-characters	LTO Eight-characters
 T104 057	 T104 053	 T104 051
T9940 cartridge: P = T9940 Data W = Cleaning T9840 cartridge: R = T9840 Data U = Cleaning for T9840A - T9840C Y = T9840D cleaner Implied domain = 0	T10000 cartridge: T1 = Data for T10000A/B TS = Data "Sport for T1000A/B CT = Cleaning for T10000A and T10000B T2 = T10000C Data CL = Backwards compatible cleaner (T10000A, T10000B, and T10000C)	**LTO data cartridge:** LT = WORM (400GB) L3 = Gen 3 (400 GB) L2 = Gen 2 (200 GB) L1 = Gen 1 (100 GB) LA = 50 GB LB = 30 GB LC = 10 GB L4 = Gen4 (800GB) L5 = Gen5 (1.5 TB) LU = WORM (800 GB) LV = WORM (1.5 TB) **Cleaning cartridge:** CU = Universal

Barcode Standards

The SL8500 library uses labels based on the following specifications:

- AIM Uniform Symbology Specification USS-39
- ANSI MH10.8M-1993 Code 39 Barcode Specification
- ANSI NCITS 314-199X SCSI 3 Medium Changer Commands (SMC)

These standards use discrete barcodes, which means that a fixed pattern of bars represents a single character.

All labels must conform to these standards when used in the SL8500 library.

Non-labeled Cartridges

Non-labeled cartridges are not supported in the SL8500 library. If non-labeled cartridges are left inside the library and a software audit is initiated, the cartridges are exported through the CAP.

Upside Down Cartridges

Installing cartridges correctly in the slots is very important and must be emphasized to operators.

For upside down LTO and SDLT cartridges: The label can be recognized if the cartridge is placed into a slot. However:

- The library reports the cartridge as unreadable to ACSLS or HSC. ACSLS and HSC will not enter cartridges that are reported as unreadable. (The library reports the cartridge’s volser to SL Console, but it will be marked as unreadable.)
- The library does not mount an upside down cartridge.

  You should verify if there is an upside down condition by exporting the cartridge through the CAP.   ACSLS and HSC can eject cartridges that are reported as unreadable.

Upside down 9x40 and T10000 cartridges do not slide all the way back into a slot and could cause damage to both the HandBot and the cartridge.

- The library’s vision system cannot see the barcode and will report “no cartridge present”.

Unreadable Labels

The SL8500 barcode reader tries to read a label at *five* different positions in front of a cartridge slot.

If all these attempts fail, the HandBot moves the reader in and does an up scan across the slot, then a down scan across the slot, and repeats this sequence three more times before the HandBot posts an error that the label is unreadable.

3

Configuring the Library for Performance

The SL8500 is not just another library. Each SL8500 has four separate rails or Library Storage Modules (LSMs) that work together in parallel. There can also be two robots operating concurrently on each rail. This architecture offers extremely flexible and scalable configurations that can *simplify* automated tape applications.

> *Instead of distributing cartridges and tape drives evenly across all the rails, look at it from a business perspective and logically configure each individual rail to meet your specific needs and business requirements. Allocate separate tape application workloads to specific LSMs (rails).*

This chapter explores the ways that you can manage library configurations to maximize library performance.

Redundant Robotics

A single SL8500 rail section can accommodate two robots, for a total of eight robots per library. These robots can operate in parallel, significantly increasing the overall performance of the library.

For more information on redundant robots, refer to the *SL8500 User's Guide*.

Configuring Libraries to Support Your Workloads

To maximize the performance of the SL8500:

- Minimize pass-thrus between rails and libraries when mounting and dismounting cartridges.

  For example, avoid mounting cartridges to drives in a different LSM.

- Minimize contention for library resources between different application requests.

To maximize library performance, you need to understand your tape application workloads, and configure the library so each workload uses a separate pool of library resources. To do this:

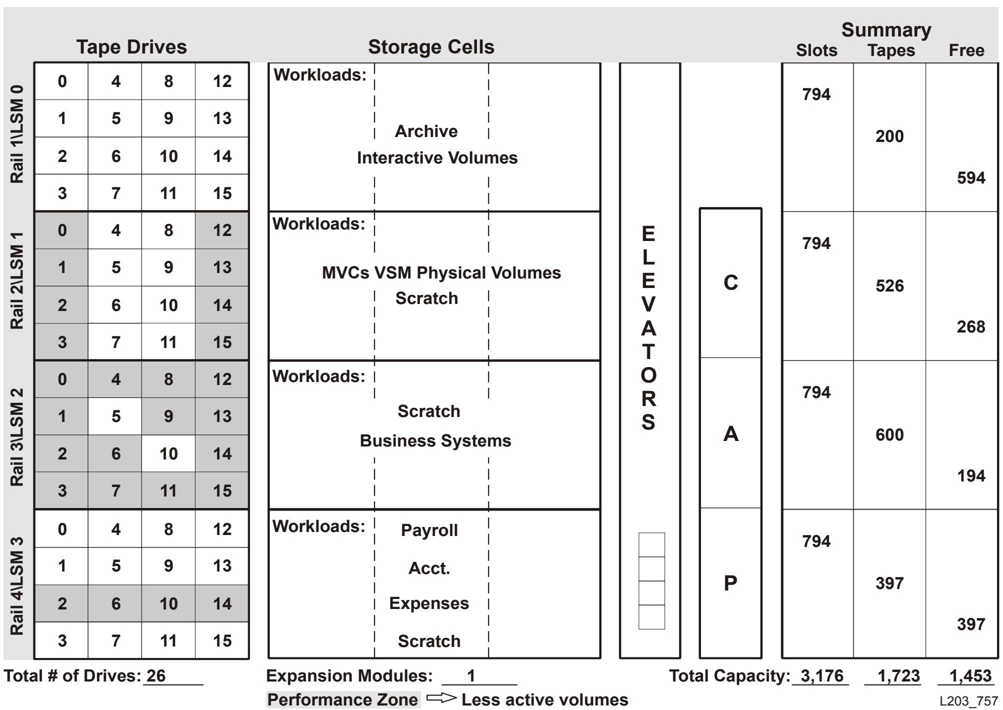
- Configure the library resources used by a workload so they are on a single LSM, or on as few LSMs as possible.
- Assign different workloads to different LSMs to minimize contention between workloads.

- Assign each workload its own tape drives, data tapes, scratch tapes, and free cells.

  Dedicating separate resources to each workload and configuring these resources on as few LSMs as possible decreases pass thru activity, minimizes the time to mount tapes, and maximizes library throughput.

FIGURE 3-1 shows an example of how a content management philosophy might look using the recommendations in this chapter.

FIGURE 3-1 Content Management Example



Slot Capacity Per LSM

Base: 362 slots

One CEM: 794

Two CEMs: 1,226

Three CEMs: 1,658

Four CEMs: 2,090

Five CEMs: 2,522

Total Capacity

Base: 1,448

One CEM: 3,178

Two CEMs: 4,904

Three CEMs: 6,632

Four CEMs: 8,360

Five CEMs: 10,088

In FIGURE 3-1 on page 50:

- Inactive tapes are archived to the top rail. These tapes are not entered or ejected frequently, and the top rail is not directly adjacent to a CAP magazine.
- The second rail supports VSM, with the RTDs (real tape drives) and MVC (multi-volume cartridges) used by VSM. It also has the scratch tapes that VSM will need.
- The third rail supports a Business Systems application with its tape drives, data cartridges, and scratch tapes.

- The bottom rail supports Payroll, Accounting, and Expenses applications with their tape drives, data cartridges, and scratch tapes.

Configuring SL8500(s) to support tape application workloads includes:

- Dedicating rails—separating workloads to specific rails
- Grouping tape drives—locating them by function and drive type, with enough drives to support the workload
- Managing cartridges—moving inactive cartridges to archival LSMs or ejecting them. Maintaining free cells on each rail so cartridges can “float” there on a dismount.
- Minimizing elevator and pass-thru port activity—enabling float and using CAPs intelligently.

Using these strategies optimizes the SL8500 library and enhances its performance.

Identifying Workloads

There are many ways to separate automated tape workloads, by:

- Application

  The easiest way to separate workloads is by the client application. For example:

  - The tape drives connected to and media controlled by a NetBackup application should be separated from the drives and media used by a TSM application. Two separate NetBackup storage domains (that do not share cartridges) are two separate workloads.
  - The drives and media used by a VSM system should be separated from the native drives and media used by z/OS applications.
  - Each VSM TapePlex is a separate workload. (see the chapter, “VSM Best Practices” on page 73)

- Drive and Media Type

  For example:

  - If one application uses both T9840 and T10000 tape drives, the T9840 tape drives and media and the T10000 tape drives and media are separate workloads. Configure the T9840 and T10000 tape drives on separate LSMs (rails). T9840 media cannot be mounted on T10000 tape drives, and vice-versa.
  - You can also reduce pass-thru activity by putting different generations of tape drives on different rails.

    LTO-4 media tends to be mounted on LTO-4 tape drives, and LTO-5 media tends to be mounted on LTO-5 drives. Also T10000T1 media tends to be mounted on T10000A and T10000B tape drives, while T10000T2 media must be mounted on T10000C drives.

- z/OS Storage Class (for IBM mainframe customers)
- VSM Management Class and Storage Class (see “VSM Best Practices” on page 73)

Size of Regions Supporting Workloads

The group of library resources supporting a workload need to be large enough to support the workload. This includes:

- Having enough tape drives so that all the cartridges that are needed at one time can be mounted. Additional, spare tape drives may be needed for larger workloads to provide empty drives that are close to cartridges.
- Having enough storage cells to store the data cartridges used by the workload, the scratch cartridge, as well as some free cells that cartridges can "float" to when they are dismounted

Configuration of Regions Supporting Workloads

The library resources supporting a workload should be concentrated on as few LSMs (rails) as possible. This is the key to minimizing pass-thru between LSMs and maximizing library performance.

The best solution is when a workload can be supported by a single LSM (rail), with no pass-thru on mounts and dismounts. The exception would be new cartridges that were entered into a different LSM.

- Workloads that require multiple LSMs incur some pass_thru activity during mounts.

  This is minimized if the application that requests the mount first selects a drive that is as close as possible to the cartridge being mounted. ELS SMC and HPSS are examples of applications that select drives close to cartridges for mounts.
- When a workload concurrently uses enough tape drives and includes enough cartridges that multiple LSMs are needed, keeping them in the same library is generally the best policy. This is because the two elevators each have four slots, while horizontal pass-thru-ports dedicate one slot to each pass-thru direction.

  If there is low pass-thru activity, horizontal pass-thru may improve performance because the pass-thru port is located close to the tape drives.
- Workloads that require multiple libraries incur more pass-thru activity.

  When a workload seems to require more than two libraries, consider options to divide it into separate workloads.

  For example, ask yourself if different types or generations of tape drives are used.

  When three or more libraries support a workload, cartridges passed between libraries on the ends must be moved between pass-thru ports in front of the drives of the library(s) in the middle. Unless there is low pass-thru activity, mount and dismount times in the intermediate library(s) suffer.

Dedicating Rails

For the SL8500, the content management philosophy needs to be based on the physical structure and capacities of the SL8500.

- The SL8500 has four rails (LSMs) per library that work in parallel.

- Each of these four LSMs has a capacity from 362 to 2522 cartridges. The basic configuration of an SL8500 library is 1,448 cartridges, expandable to 10,088 cartridges.
- Each LSM, or rail, can have a maximum of 16 tape drives.

Recommendations include:

- Placing applications that require significant enters and ejects on rails adjacent to CAP magazines.
- Assigning workloads to separate rails
- Combining rails for a workload

  If you are *not* able to assign workloads to a single rail, consider:

  - Using rails that are adjacent to each other. This provides a shorter distance for the pass-thru operation.
  - Combining rails vertically rather than horizontally.
- Populating the rails

  When populating the rails:

  - Media types: make sure the rails have compatible cartridges for the tape drives
  - Scratch cartridge pools: make sure the rails have enough *scratch cartridges*
  - Adequate free cells: make sure there are adequate free cells so cartridges can *float* to the same rail upon dismount
- Using the top rail
  - Avoid using the top rail to support an application that requires a significant number of ejects and enters. To enter and eject cartridges from LSM 0 requires elevator pass-thru activity.
  - Consider using the top rail as an archival LSM—one that uses l*ess active* tapes; or as an LSM with *very active* tapes that requires fast access, uses T9840 tape drives, with few enters and ejects.
  - For HSC-controlled systems, use the "`TLSM`" parameter on enter commands to direct inactive cartridges to the top rail.

Managing Cartridges

Managing cartridges—how cartridges are entered, ejected, handled, and treated—in the library has a major impact on performance. Some considerations include:

- Leave “float” on

  ACSLS and HSC have float on by default. Please do not turn float off.

  When float is on and cartridges are dismounted from a drive, ACSLS or HSC selects a new home cell for cartridges that came from another LSM. In other words, when mounting a cartridge required pass-thru because the cartridge was not in the same LSM as the drive, HSC and ACSLS tries to select a new home cell closer to the drive when the cartridge is dismounted. If there are no free cells in the same LSM as the drive, ACSLS and HSC tries to select a new home cell in the next closest LSM.

Floating cartridges to a new home cell near the tape drive has two effects:

- As long as there are free cells in each rail, float cuts pass-thru activity in half. This works whether the client application intelligently tries to mount cartridges on drives that are close to them or not.
- Float automatically clusters cartridges by the drives for the workload. If all of the drives for a workload are on the same rail, the cartridges used for the workload automatically float to that rail. Future mounts of these cartridges do not require any pass-thru.

Thus, turning float off doubles your pass-thru activity and impacts library performance. It also removes the automatic optimization where cartridges cluster around the drives where they are read and written.

- Free cell management

  Make sure each LSM contains enough free cells so when cartridges are dismounted that came from other LSMs, ACSLS or HSC can select a new home cell in the LSM by the drive.

  If there are not enough free cells on a rail, inactive cartridges can be ejected from the library, or moved to an archival LSM.

  Within a group of LSMs supporting one workload, you can move cartridges from full LSMs to LSMs with abundant free cells, so there are free cells in all LSMs. For example, if an SL8500 with 10,088 cells attached to an SL8500 with 3,178 cells, and both libraries have the same number of drives, the smaller SL8500 tends to fill up over time. Periodically move cartridges from the full LSMs to the LSMs with more free cells. This can be done automatically by LCM (see below), or manually for ACSLS customers (see “ACSLS Best Practices” on page 85).

- Use management applications (LCM) for z/OS

  LCM automatically manages free cells for z/OS customers.

  Use LCM to keep active volumes in the “performance zone” on the same LSMs as compatible drives, and to migrate less active volumes to locations farther away from tape drives.

  LCM can eject inactive cartridges or move them to archival LSMs

  See “LCM Best Practices” on page 79 for more details.

- Clustering cartridges

  Cluster cartridges by workload on separate rails with enough tape drives to support the maximum activity—peak usage—for that workload.

- Entering cartridges

  When manually placing cartridges in the library with the front access door open, library operations cease and the library management software—such as ACSLS or HSC—must perform a *full audit* to update the library database to match the actual contents of the library.

To maximize performance, enter cartridges through the cartridge access port (CAP). During an enter, the library stays online, mounts can continue, and the library management software tries to move the cartridge to an LSM adjacent to the CAP magazine, thus minimizing pass-thru activity.

If this is not possible, the library controller moves the cartridge through the elevator to another LSM—which requires additional movement between two HandBots and the elevator.

- Archiving cartridges

  When using HSC with LCM, move the l*east recently used* (LRU) cartridges farther out on the rail, away from the tape drives and slots in the Performance Zone.

- Managing space

  - Move *inactive* cartridges out of the library or off of an LSM to ensure there is adequate space for *active* cartridges and free cells.
  - Plan for times of *peak activity*.

- Migrating cartridges

  Migrate the *least recently used* (LRU) cartridges away from tape drives and the performance zone or to archival LSMs. This ensures there is space for the active cartridges closer to the drives.

- Supplying scratch cartridges

  Make sure each rail has the correct amount and type of data cartridges *plus* enough scratch cartridges to support the workload.

Grouping Tape Drives

During the installation, having an understanding about how to logically group and install the tape drives in an SL8500 can minimize both elevator and PTP activity. Strategies to use when determining where to install the tape drives include:

- Clustering drives

  Install tape drives that use the same media types on the same rails (LSMs). For example: place T9840 drives on one rail and T10000 drives on a different rail with the media to match.

  Potential issues: Clustering tape drives and media on the same rail works well until:

  - The number of mounts exceeds the capacity of the HandBots.
  - There are too many “active” cartridges to fit on that rail.
  - The number of concurrently mounted tapes exceeds the maximum number of tape drives.

    An indication would be too many active cartridges on that rail for the HandBots to mount (keep up with) or not enough tape drives.

  Recommendation: When resources for a specific workload exceeds the capacity of a rail, spread the cartridges and drives over two or more rails. Some suggestions might be to:

  - Add more tape drives (if possible).
  - Add expansion modules to increase cartridges for that rail.
  - Use the TLC/FSM tool to model and re-evaluate the content.
  - Upgrade to an eight HandBot configuration.
- Install drives in the outer two columns (± 2) first—this allows both HandBots to access drives at the same time.
- Exceeding limits

  Configure heavy tape applications so they do not exceed the performance limits of that LSM and/or library configuration. For example: limit peak HSM workloads by the number of concurrent recalls in that configuration.
- Using the TLC/FSM tool

  See "TLC/FSM" on page 103.
- Installing redundant HandBots (8)

  Configuring the SL8500 with eight HandBots (two HandBots per rail) provides redundancy.

Minimizing Elevator and PTP Activity

As pass-thru activity (elevator and pass-thru ports) increases, performance (exchanges per hour) decreases. There are several things you can do to minimize or improve pass-thru activity.

- Mount cartridges

  Mount cartridges in tape drives that are on the same rail (LSM).
- Make sure float is *on*
  - Take advantage of the `float` option to limit pass-thru activity.
    - For ACSLS and HS, float is the default.
    - For HSC, verify that `MNTD Float ON`
  - After a pass-thru for a mount, make sure volumes can *float* to locations in the drives' LSM on the dismount by maintaining some free cells within each LSM.
- Maintain scratch cartridges

  Make sure that scratch cartridges are available in sufficient quantity for each tape workload.

  For an SL8500, this means having scratch cartridges available on each rail (LSM) of the library.
- Plan pass-thru activity

  When planning workloads for a *library complex* where the workload requires more than one LSM, consider the following:
  - Elevators

Use *adjacent* LSMs in the same library to limit the distance the cartridges must travel. Remember, there is a 50% chance that the cartridge and drive are on the same rail between two LSMs.

- Each elevator has the capability of passing up to *four* tapes.
- Elevators are less of a bottleneck than the pass-thru ports.

Cartridge Access Port (CAP) Guidelines

Although operation of the cartridge access port does not directly affect the performance of the library, here are some guidelines that can help with its overall operation.

- Online/Offline CAP state

  The online/offline state of the CAP is independent of the online/offline state of any LSM in an SL8500.

- Entering cartridges
  - Whenever possible, enter cartridges through the CAP.
  - When planning the workloads, place applications that require significant enters and ejects on rails adjacent to CAP magazines.
  - Use the `"TLSM"` parameter on the HSC enter command to direct cartridges to specific LSMs. This causes pass-thru activity.

    An alternative to using the `"TLSM"` parameter is to load only the magazines adjacent to the desired or specific LSM.
  - Use the *watch_vols* utility for ACSLS.
  - Tip: Place labels outside the CAP indicating which magazine and LSM gets what type of cartridge. *For example:*
    - LSM 1 uses T9840 tape drives, so load that magazine with only 9840 tape cartridges
    - LSM 2 uses LTO tape drives, so load that magazine with only LTO tape cartridges
    - LSM 3 uses cartridges for a specific application or job, so load that magazine with the necessary cartridge types

    This helps operators identify what cartridges go to which LSM.
  - Enter cartridges using a CAP magazine adjacent to the desired rail (LSM) where compatible tape drives are located.

- Inserting cartridges into the CAP

  Insert cartridges with the correct orientation:
  - Flat in the slots (seated)
  - Parallel to the floor
  - Hub-side down
  - Barcode label pointing out and below the readable characters.

Hub-side

Note – You can skip CAP magazine slots when entering cartridges.

- Ejecting cartridges (HSC only considerations)

  Ordered or Unordered Ejects?

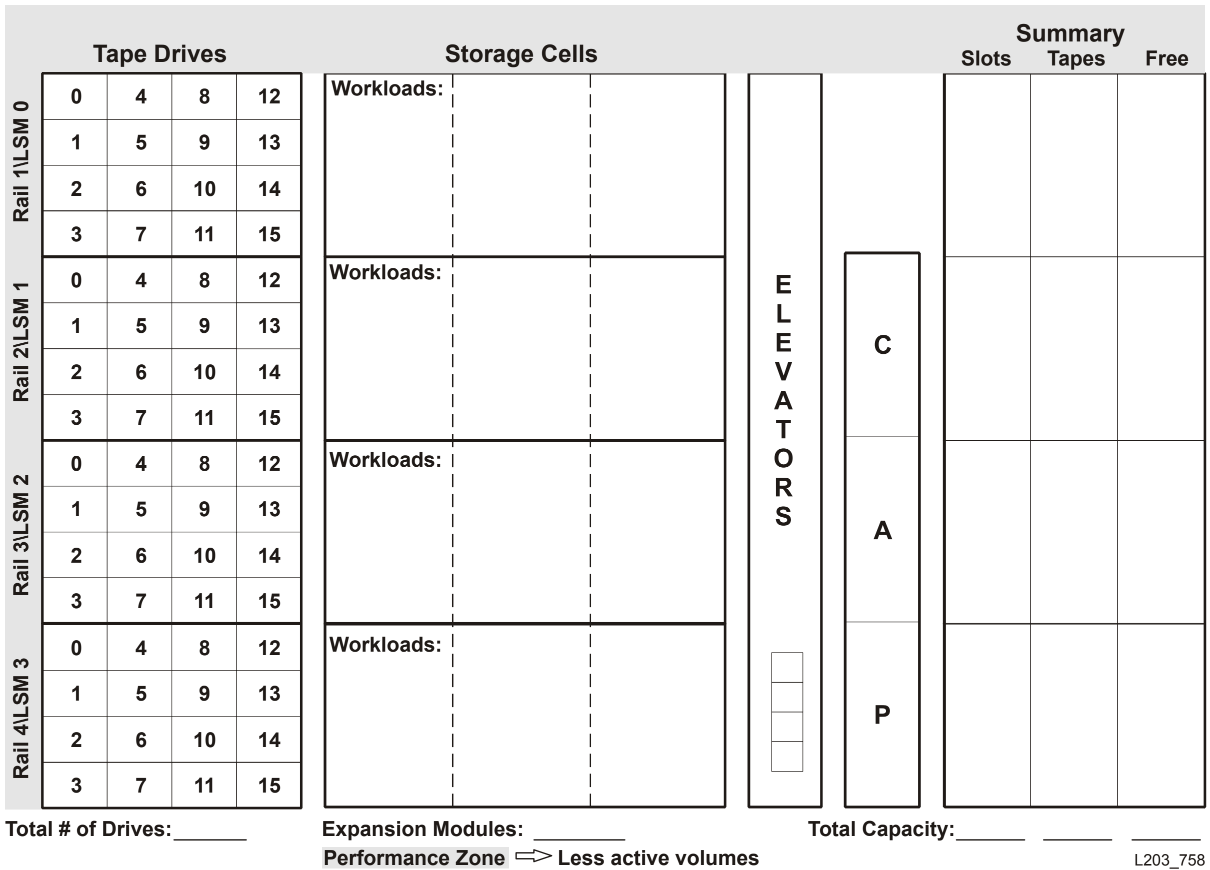
  Specifying ordered ejects places the volume serial numbers (VOLSERs) in a specific sequence. This operation is significantly slower than unordered ejects which allows HSC to eject cartridges to a CAP magazine adjacent to that LSM—minimizing pass-thru activity.

  Note – Ordered ejects are used by HSC for vaulting. This simplifies operations.

Planning for Content

Use FIGURE 3-1 on page 50 for an example. FIGURE 3-2 on page 59 provides space that you can use to help plan the content of an SL8500 library.

FIGURE 3-2 Content Management Plan



4

HSC Best Practices

HSC is the library server component of ELS (Enterprise Library Software).

The minimum release and maintenance level is NCS/HSC 6.2 with L1H146X (VM) or L1H146Y (MVS) PTFs installed. Enterprise Library Software (ELS) 7.0. 7.1 and 7.2 are more current releases.

Refer to "HSC Support for the SL8500" in the *HSC 6.2 Operator's Guide* for more information and procedures.

ELS Client Server Model

The introduction of the SMC client server architecture in the early 2000s allowed you to optimize your overall library performance by running HSC on a limited number of hosts. The best way to optimize both library performance and the performance of ELS is to implement ELS in client/server mode.

To ensure best results, use only two HSC servers and designate one of the two HSC (or HSC with VTCS) hosts as the "primary server" and direct the entire mount and dismount workload to the HSC/VTCS system represented by this server. This minimizes communication with the library and contention for the Control Data Set (CDS). This configuration provides the following benefits:

- Reduces contention for Library Communication

  With an ELS client/server configuration, as opposed to HSC/VTCS-on-every-LPAR: Only one HSC communicates with the library at any one time. This avoids multiple HSCs systems sending multiple, duplicate status requests to the library whenever: the library is re-booted, the access door is opened and closed, a Redundant Electronics switch occurs, or the HSCs are all started. The contention from these multiple requests can dramatically slow down library performance.

- Reduces CDS Contention

  An HSC client/server with a primary server avoids contention for the HSC CDS. Especially with VTCS configurations, contention for the CDS is a major factor. You can significantly reduce CDS contention by directing all VTCS mounts and dismounts to a single primary server. Defining a primary server, as described above, also causes the VTCS on the primary server to perform all migrate and recall requests associated with its mounts and dismounts. This directs nearly all of the VTCS front and back end work to the same system, both reducing CDS contention and optimizing management of RTD resources.

- Reduces host-to-host communication

  Each HSC/VTCS server must communicate with all the other HSC/VTCS servers. Without a client/server implementation with a primary server, host-to-host communication is not a factor.

For example, to illustrate the difference when you need to automate tape operations on 12 z/OS LPARs:

- If you have not upgraded your systems and are still using the old configuration, running SMC with an HSC, and possibly VTCS, server on all 12 LPARs resulted in:
  - HSC/VTCS on all 12 LPARs sending the library the same configuration and status requests in parallel whenever HSC/VTCS starts, or the library switches or becomes ready.
  - All 12 HSC/VTCS servers contending for the CDS.
  - All 12 HSC/VTCS servers communicating via host-to-host communication.

  As you can see, having each LPAR run its' own HSC/VTCS server has a huge impact on performance.

- Upgrading to a client server configuration using 12 SMC clients communicating with a primary HSC/VTCS server brings these benefits:
  - Only two servers statuses the library.
  - Normally, only one server updating the CDS
  - Host-to-Host communication is reduced with two servers.

To create a primary server configuration in your SMC parameters, do not define a local host (LOCSUB) on the SMC that is running on the secondary server host, but define a local host only on the primary server. On all of the SMC-client-only LPARs, always define the SERVER statements so that the first one points to the primary.

Redundant Robotics

A single SL8500 rail section can accommodate two robots, for a total of eight robots per library. These robots can operate in parallel, significantly increasing the overall performance of the library.

For more information on redundant robots, refer to the *SL8500 User's Guide*.

Minimizing Elevator and PTP Activity

As pass-thru activity increases, performance (exchanges per hour) decreases. There are several things you can do to minimize elevator and PTP activity, such as:

- Whenever possible, when mounting a tape, use cartridges and tape drives that are in the same LSM.
- Ensure the HSC "float" option in *on* to minimize pass-thru operations. Make sure volumes can "float" to new LSMs by maintaining some free cells within each LSM.

  Note – The `MNTD` command enables or disables the float option.
  The default setting for float is *on*.

When cartridges are dismounted, and float is on, HSC tries to avoid elevator (pass-thru) activity among LSMs by assigning a new home cell whenever the cartridge's old home cell is in a different LSM.

HSC attempts to put the cartridge away in the same LSM as the tape drive from which it was dismounted, or to the closest LSM (with free storage cells) to the drive

- Enter cartridges into an LSM that has compatible tape drives for the media being entered.

  For example: You have only T9840 drives on LSMs 2 and 3, and you want the 9840 cartridges to be located in these LSMs. When entering these cartridges, you should place them in the CAP magazines adjacent to LSMs 2 and 3. HSC then makes every effort to put the cartridges in the LSM that is adjacent to that CAP magazine.

- If site operations make frequent use of scratch cartridges, it is helpful to minimize the pass-thru operations in this area as well. Make sure that enough scratch cartridges are available in each LSM where they are needed. For an SL8500, this means having scratch cartridges available on each rail (LSM) of the library.

  Use LCM to manage your scratch cartridges.

Configuring Tape Drives

How tape drives are configured in the SL8500 can minimize both elevator and PTP activity while supporting your tape workloads. Strategies to use in determining where tape drives are located in the SL8500 include:

- Cluster drives by type with compatible media. Place tape drives that use different media types on separate rails (LSMs).

  For example: Place T9840 drives on one rail and T10000 drives on a different rail.

- Manage the tape cartridges so compatible media is on the same rail with tape drives. When entering media, enter it using a CAP magazine adjacent to the desired rail.

  Move incompatible media to a different rail that has tape drives that are compatible with that media.

- Allocate separate rails to each major application workload. For example, HSM, SAR, and VSM all need media and drives.
  - Cluster cartridges by workload, with enough drives to support the maximum drives needed for the workload.
  - Separate the cartridges used by each workload on separate rails, and ensure the rails dedicated to a workload has enough drives to meet the maximum concurrent mounts for the peak usage of the workload.
  - Ensure that the rail has not only the data cartridges for the workload, but also the scratch cartridges that are needed.
  - Do **not** use the top rail to support an application that requires significant numbers of ejects and enters.

- Configure your heavy tape applications so they do not exceed the performance limits of your library configuration.

  For example: Limit your peak HSM workload by the number of concurrent recalls in your HSM configuration.

- Actively manage your cartridges, and migrate the *least recently used* (LRU) cartridges to archival LSMs. This helps ensure that there is space for the active cartridges close to the drives.
  - Consider using the top rail as an archival LSM, as it does not have direct access to the CAP.
  - When float is on, HSC selects a new home location for a cartridge that is as close to the drive as possible on a dismount. This automatically clusters cartridges by the drives used by a workload.
  - Ensure each LSM contains sufficient quantities of free cells to allow selection of a new home cell in the LSM where the volume was mounted. (LCM manages free cells.)
  - Use a Library Management application (such as LCM) to keep active volumes on the same LSMs as compatible drives. LCM can also migrate less frequently used volumes to archival LSMs as directed by LCM control statements. See "LCM Best Practices" on page 79 for more information.
- Clustering drives and media on a single rail works until the mounts per hour threshold is reached, all drives are in use, or there are too many active cartridges to fit on a rail. When the resources needed for a workload exceeds the capacity of a rail, spread the cartridges and drives over two or more rails.
- Use the SE tool TLC/FSM to determine the optimal drive configurations. See

  When you supply a configuration and a workload (trace file of the mounts), TLC/FSM outputs the response time, drive utilization, robotic utilization, and PTP utilization.

- Configuring the SL8500 with eight HandBots (two HandBots per rail) provides redundancy so you can always access the cartridges and drives that support a workload.

See "Configuring the Library for Performance" on page 49 for more details about how to configure tape drives and manage cartridges in an SL8500 to support your tape application workloads.

Managing Cartridge Locations

How cartridges are originally entered in the library or their status in the library can have an affect on HSC performance. Considerations are:

- How to enter cartridges:

  Recommendation: Enter cartridges through the CAP.

  While the access door is open, the entire SL8500 is offline and all automated mounts stop.

If cartridges have been manually placed in SL8500 cells with the access door open, HSC must perform a full audit to update the control data set (CDS) to match the actual inventory of the library.

To maximize performance: Entered through the CAP.

During an enter, HSC always tries to move the cartridge to an LSM adjacent to the CAP magazine. If this is not possible, the library controller takes care of moving the cartridge through the elevator to another LSM. This, however, requires movements between two HandBots and the elevator.

To enter and automatically move cartridges to a specific LSM, specify the **`TLSM`** parameter. *This should be done only during off-peak times.*

- Whether or not to use ordered or unordered ejects.

  Ordered ejects—with cartridges ejected in VOLSER sequence—are significantly slower and are often used for vaulting.

- Where to locate archive cartridges.

  Recommendation: Move archival cartridges to LSMs away from drives and CAPs. The top rail in the SL8500 (such as LSM 00) is a good archival location, since it is not adjacent to the CAP.

Finding Missing Cartridges

If a cartridge is out of place or unaccounted for by HSC, locate a missing cartridge by:

1. Performing a physical audit of the SL8500 using the SL Console.

   The physical audit of the SL8500 is performed as a background task in between handling mount and other library operation requests.

   > **Caution –** If the SL8500 contents are out of sync with HSC due to manual operations such as loading cartridges directly, it is not advisable to attempt continued operations.
   >
   > If you want to manually add tapes, adding them to a particular LSM within the SL8500 is a better approach. Adding tapes to a particular LSM and auditing only the affected LSM is a quicker and more reliable solution.
   >
   > **Caution –** With a partitioned library, if a cartridge is accidently entered into the wrong partition, it is lost to the correct partition. No amount of auditing corrects the situation. To correct this, locate the volume in the other partition, eject it using the HSC or ACSLS controlling the partition, and enter it into the correct partition.

2. Running an audit to update HSC CDS to match the actual inventory of library volumes.

Understanding SL8500 Internal Addresses

For details, see "Understanding SL8500 Internal Addresses and HLI Addresses" on page 23.

Translating Addresses

Use the SL Console "Search" utility to translate between SL8500 internal (default) addresses and HSC panel, row, and column addresses. The procedure for doing this is described in the SL Console Help under *Locating a Cartridge by Address*.

Varying the SL8500 Offline

Vary or modify SL8500 components offline to the HSC before they are powered off, if they are inoperative, and before you open an SL8500 access door. This notifies HSC that they are unavailable. Once they are available, vary them back online.

Use HSC to Vary SL8500 Components Offline

You should vary or modify SL8500 components (ACSs, LSMs, and CAPs) offline through the HSC, not the SL Console, because:

- HSC allows outstanding requests to complete before taking components offline, unless it is a vary offline force. Varying components offline via the SL Console may cause outstanding requests from the HSC to fail.
- When the SL Console varies drives offline, HSC has no knowledge of this. As a result, HSC continues to send requests to the SL8500, and these requests fail.

When to Vary SL8500 Components Offline to HSC

- Before opening the access door

  Before opening the SL8500 access door, vary the ACS or modify all four LSMs offline. This allows all outstanding requests to complete and prevents new requests from starting.

  - For a standalone SL8500, vary the ACS offline:

    ```
    Vary ACS acs-id OFFline
    ```

  - For an SL8500 library complex connected through PTPs, modify all four LSMs (in the SL8500 whose access door will be opened) offline using:

    ```
    MODify LSM lsm-range OFFline
    ```

    An *lsm-range* consists of two LSM ids separated by a dash (such as `00:00-00:03`).

- If all robots on a rail (LSM) are inoperative

  If all robots on a rail are inoperative, the library sends HSC an LSM Not Ready message. The library sends HSC an LSM Ready message when at least one of the robots is operative again.

- If a CAP is inoperative

  If the CAP is inoperative, modify the CAP offline:

  ```
  MODify CAP cap-id OFFline
  ```

Using the Service Safety Door

There are some HSC commands and utilities that should not be in progress or initiated when the Service Safety Door is being used.

When the Service Safety Door is closed on either side:

`MODify CONFIG`

When the Service Safety Door is closed on the right (CAP) side:

`ENter`

`EJect`

When using the audit utility:

The **`AUDIt`** utility can be used. However, if there is a need to eject cartridges as a result of the audit—*for example:* because the audit encounters duplicates or unreadable labels—the audit will terminate and the cartridges will **not** be ejected.

When Closing the Service Safety Door

Whenever replacing hardware requires using the Service Safety Door, it is advisable to keep that Service Safety Door closed for the minimum amount of time possible.

This is because the Service Safety Door blocks other hardware components (elevators, CAPs, and cells) to which access may be required for completing specific requests. Minimizing the time these components are unavailable minimizes this risk.

- When the Service Safety Door is closed on the right side, it will block access to the CAP.
  - Before closing the Service Safety Door on the right side of the SL8500, modify the CAP offline through the HSC.
  - After the Service Safety Door is opened, modify the CAP online through the HSC.

    Note – When the SL8500 Service Safety Door is closed to separate a service bay from the rest of the library, the CSE can open the access door on that side without taking the LSM or ACS offline.

Host-to-Host Communications (COMMPATH)

The host-to-host communications method used is critical for optimal HSC performance. For more information, see COMMPATH under "Considering HSC and VTCS Parameters " on page 74.

Working Around an Inoperative HandBot

Currently, in an SL8500 when the HandBot adjacent to the middle CAP magazine is inoperative, you cannot use the CAP. This causes all enter and eject requests from HSC to fail.

The middle CAP magazine is adjacent to the third SL8500 rail. On a single SL8500, this is LSM 2.

The middle CAP magazine can be inaccessible on:

- a four HandBot SL8500, when the only robot on LSM 2 is inoperative
- an eight HandBot SL8500, when the robot closest to the middle CAP magazine is inoperative. This is the right HandBot in a dual HandBot configuration.

The following work-around allows you use the SL8500 CAP when the HandBot adjacent to the middle magazine is inoperative:

1. Start an enter through HSC.
2. Open the CAP and remove the bottom magazine.

   This leaves the top two magazines in the CAP, but the second magazine cannot be accessed. Only the top magazine can be used for enters and ejects.

   - To enter cartridges:
     - Place them in the top magazine and close the CAP.
     - Continue entering cartridges using only the top magazine.
   - To eject cartridges:
     - Leave the top magazine empty, close the CAP, and terminate the enter.
     - Eject cartridges - HSC will place cartridges only in the top magazine.

       Note – *Do not* place the bottom magazine back into the CAP until the robot adjacent to the middle CAP magazine is operational.

HSC Recording Interval

Review and, if necessary, change the System Management Facility (SMF) parameters in SYS1.PARMLIB member SMFPRM*xx* to modify HSC recording interval for ACS statistics. Take these steps:

- Find HSC subsystem name.
- Change HSC recording interval.

  The smaller the number, the more often data is recorded. Smaller intervals create more work for the library, which must report the statistics to each host at every interval. Each time the statistics are reported, they are also cleared.

  We recommend you set a recording interval for both virtual and non-virtual environments of 15 minutes (default).

  The recording interval should *not* be smaller than 15 minutes (default).

  ```
  INTERVAL(001500)
  ```

  Note – If your using VSM, you should keep this interval to 15 minutes.

Assuming your HSC subsystem name is SLS0, the following example shows the line for the HSC recording interval for ACS statistics.

```
SUBSYS(SLS0,INTERVAL(010000),TYPE(255))
```

Using Dynamic Hardware Reconfiguration

With HSC 6.2, dynamic hardware reconfiguration allows you to implement configuration changes to libraries (and components) while HSC remains online and running.

Invoke dynamic hardware reconfiguration by entering the **`MODify CONFIG`** command, which lets you add, change, or remove drives, panels, and LSMs while HSC is up and running.

`MODify CONFIG` provides the following benefits:

- lets HSC continue running, allowing you to perform mount requests to unaffected library components.
- allows you to reconfigure specified library components while all other configuration information remains unchanged.

  For example: Mounts and dismounts to all existing drives will not be affected when you add, change, or remove drives.

Before Reconfiguring HSC for the SL8500

Before you use dynamic hardware reconfiguration for the SL8500, verify that all the components of the SL8500 are operational. HSC builds its library configuration from the information reported by the library. If SL8500 components are not operational, the library information may not be reported to HSC, and HSC configuration of the SL8500 will be incomplete.

To verify that all the components of the SL8500 are operational:

1. Logon to the Library Console. You can use either the console on the SL8500 or a remote library console.
2. Select Tools -> System Detail.
   - All SL8500 components should be green.

     Note – Drives that are yellow can be configured now, or later, using dynamic hardware reconfiguration.
   - Missing components can be added later using the **`MODify CONFIG`** command.

   Important:
   Before configuring the SL8500, the elevators *must* be green.

   If the elevators are not green, *do not* configure the SL8500 to HSC. The elevators are the logical pass-thru-ports (PTPs).

   Without PTPs, HSC will not know that the SL8500 rails are connected.
3. Once the SL8500 components are operational, configure SL8500 to HSC.

Refer to the HSC 6.2 System Programmer's Guide or ELS 7.x Commands, Control Statement, and Utility Reference "MODify" command and Configuring HSC and VTCS 7.x.

Changing the Configuration

When you change the configuration of an SL8500 library—expand, add, merge, or split—you must also upgrade HSC's map of the library configuration that is recorded in the HSC control data set (CDS).

Important:
For non-disruptive growth, StorageTek recommends adding libraries from *right* to *left* when facing the front doors (this is the preferred method).

However, the library complex can grow in the other direction, from *left* to *right*, but this requires an outage to update the HSC configuration and to update volume addresses in the renumbered LSMs.

Refer to the Configuring HSC and VTCS 7.x Tech Tip on the Oracle Technology Network.

LSMs in an SL8500 complex are numbered from right to left and top to bottom as viewed from the front of the libraries.

TABLE 4-1 shows an example of this numbering scheme.

TABLE 4-1 Adding and Expanding on Configurations

Left / Right

ACS 0							
LSM 12	PTP	LSM 08	PTP	LSM 04	PTP	LSM 00	Top
LSM 13		LSM 09		LSM 05		LSM 01	
LSM 14		LSM 10		LSM 06		LSM 02	
LSM 15		LSM 11		LSM 07		LSM 03	Bottom

TABLE 4-2 shows and example of splitting the configuration above into two separate automated cartridge systems (ACSs).

TABLE 4-2 Splitting Configurations

ACS 1		
LSM 04	PTP	LSM 00
LSM 05		LSM 01
LSM 06		LSM 02
LSM 07		LSM 03

ACS 0		
LSM 04	PTP	LSM 00
LSM 05		LSM 01
LSM 06		LSM 02
LSM 07		LSM 03

TABLE 4-2 now provides an example of *merging* two ACSs in the configuration above into one.

Note – The LSMs in ACS 1 will become part of ACS 0, and will be renumbered to become LSM 08 thru 0F.

Adding New SL8500 Libraries

When additional SL8500s are added to an existing SL8500 library complex, the new HSC configuration must be updated. If the addition of new SL8500s causes the LSMs in the existing SL8500s to be renumbered, the cartridge addresses in those LSMs must be updated.

For more information and procedures, refer to HSC 6.2 *Operator.s Guide*, Appendix B, "HSC Support for Near Continuous Operation (NCO)," "Adding and Configuring SL8500s", or "Configuring HSC and VTCS 7.x".

Adding Libraries to the Left

Adding libraries to the left is the preferred method.

When you add libraries to the left of an existing library complex, you can dynamically upgrade the configuration of the software. This upgrade must be done to configure both the libraries and the additional tape drives.

When you dynamically upgrade the configuration:

- No rebooting of HSC is required.
- Mount requests can continue as normal in the first or existing libraries during this upgrade.
- When cartridges are placed into the new SL8500 library, an HSC audit must be run to add these cartridges to the database. Existing LSMs can remain online during the audit.

Dynamically Upgrading HSC Configurations

For HSC, upgrade the configuration using either:

- Dynamic configuration (HSC 6.1) enter MODify CONFIG command
- LIBGEN, SLICREAT, and MERGEcds (HSC must be stopped)

Adding Libraries to the Right

When a new SL8500 library is added to the *right* of the complex, the LSMs must be re-numbered; consequently the volume locations will change.

Important:

- Vary the LSMs offline *before* the reconfiguration.
- Audit the existing and new SL8500 libraries *in* a specific sequence to avoid deleting then re-adding the volumes in the re-numbered LSMs.

Existing LSMs must be offline while upgrading the SL8500 library complex and during the HSC audit. Otherwise, problems will occur, such as:

- Mounts will fail because cartridges cannot be found in their new locations.
- Entry of new cartridges will collide with existing cartridges.
- Movements of cartridges to existing, re-numbered, LSMs will collide with cartridges already in the cells.

Expanding an SL8500 Library

Expansion occurs when SEMs are added to the SL8500 to increase its capacity. When this happens the CIM, which includes the CAP, must move out. As a result, newer and higher panel numbers are assigned to the three cell panels on the CIM.

When the cell panels on the CIM are assigned higher panel numbers, the addresses of all the cartridges on the CIM change. You must audit these panels so HSC can update the CDS with the new addresses of these cartridges.

For more information and procedures, refer to HSC *6.2 Operator's Guide*, "HSC Support for the SL8500 Library."

Merging or Splitting SL8500 Libraries

When merging multiple, separate SL8500s or splitting SL8500s in an existing SL8500 library complex, the new HSC configuration must be updated.

For more information and procedures, refer to Configuring HSC and VTCS 7.0.

5

VSM Best Practices

This chapter provides the current best practices for using Virtual Storage Manager (VSM) with the SL8500 Library.

ELS Client Server Model

For sites where VSM supports multiple z/OS LPARs, implementing an ELS Client Server configuration, where two HSC/VTCS servers support multiple SMC clients is very important. Because VTCS causes very heavy I/O activity to the CDS, reducing the CDS contention from multiple HSC/VTCS hosts is essential. Designating one HSC/VTCS host as the “primary server” eliminates I/O contention between HCS/VTCS hosts.

For more information, see “ELS Client Server Model” on page 61.

Configuring VSM for SL8500 Library

The number of Real Tape Drives (RTDs) attached to a single Virtual Tape Storage Subsystem (VTSS) is typically 8 to 16, although there can be a maximum of 32.

During normal production processing, most RTDs are typically busy. This has an impact on the opportunities for selecting the ideally placed RTD (in the same LSM as the selected Multi-Volume Cartridge (MVC)) if there is more than LSM per VTSS. You can experience higher pass-thru activity when more than one LSM is used for any VTSS. The higher the number of LSMs attached to a single VTSS, the greater the amount of pass-thru activity. For this reason, the best performance is obtained when all RTDs in any VTSS are configured in a single LSM. The ideal situation exists when an RTD is available in the LSM where the MVC resides.

There is a common misconception that having more than one LSM attached to any VTSS improves reliability by increasing redundancy. In fact, it does exactly the opposite.

By increasing the number of LSMs that house RTDs attached to a single VTSS, the chance of Virtual Tape Volume (VTV) access failure increases. This is because, in the event of a failure in a two-LSM, single ACS, single VTSS configuration with simplexed VTVs, VTCS is usually able to continue migration (since migration MVCs should be available in each LSM). About half of the VTVs will have become unavailable for recall back into the VTSS buffer. The chances of this failure happening are doubled in a two-LSM, single ACS configuration when compared to a single LSM, single ACS configuration.

Even duplexing VTVs in a two-LSM, single ACS configuration does not address this issue. This is because VTCS only guarantees that the two VTV copies will be on separate MVCs, regardless of location in the libraries. Named MVCPools in each LSM do not address this issue either because they do not guarantee LSM location.

In a multi-ACS environment with duplexed, triplexed or quadplexed VTVs, you would eliminate the exposure of a VTV being unavailable due to an LSM or ACS failure by migrating one VTV copy to each ACS using MIGpol or ACS-list (for duplexed only). Migrations and recalls would continue to occur in the event of an ACS failure or media failure, and will result in business continuity in the event the local site is destroyed (only if the ACSs are located in different sites).

Considering VTCS Maintenance

You should ensure that you have all of the latest PTFs applied to ELS.

Considering HSC and VTCS Parameters

COMMPATH

This is an HSC command which designates the host-to-host communications method in a HSC/VTCS environment. The choices are:

- VTAM (by far the best and the recommended method)
- LMU
- CDS (this is the default)

In a VSM environment, the CDS should never be the communications method. The LMU is the minimum level (VTAM being the highest) that should be used in a VSM environment. In a VSM **and** SL8500 configuration, it is highly recommended that you use VTAM, although you could use LMU -- but, **definitely not CDS**.

When you define the COMMPATH, it is **highly** recommended that the order of ACSs, used in the LMUPATH sub-parameter method, specify 9310 Powderhorn ACSs as the first ACSs in the definition, if they exist in the environment, followed by the SL8500 ACSs. Please refer to the *ELS Command, Control Statement and Utility Reference* for information on this HSC command.

VTCS Coupling Facility

The VTCS Coupling Facility is implemented via the Coupling Facility Lock Structure parameter, LOCKSTR on the VTCS CONFIg Global statement. If this is used, then the VTCS host-to-host traffic would no longer be handled by the HSC host-to-host communications. VTCS communications would then be handled through the Coupling Facility, which is yet a higher method of host-to-host communications than VTAM.

> **Note –** HSC host-to-host communication would still be via the CDS, LMU or VTAM, and the above mentioned recommendations under HSC COMMPATH would still apply for HSC.

VTCS Migration Policies

In planning RTD and MVC placement within the SL8500 libraries, you must review your VTCS Migration Policies to ensure that they are appropriately set to accomplish their goal in optimizing performance of VSM in an SL8500 library complex.

Statement and parameter definitions to be reviewed are:

POLICY and TAPEREQ Statements

To ensure that VTVs are being assigned the proper Management Class.

Management Class Statements

MIGpol parameter to ensure the correct number of 1 to 4 VTV copies is being directed to the appropriate ACS(s).

ACSlist parameter, if used, to designate ACSs instead of MIGpol. MIGpol provides more control by directing VTV copies using Storage Class.

Storage Class Statements

ACS parameter to specify which ACS is to be used for each Storage Class.

MVCPool - if Named MVCPools are being used.

> **Note –** Oracle recommends using POOLPARM/VOLPARM to define VTV and MVC ranges in the VTCS CONFIG.

VTSSSEL/VTSSLST and STORSEL/STORLST

These parameters allow you to specify lists of VTSSs and Storage Classes and your corresponding preferencing for certain functions within VSM to minimize MVC pass-thru.

Named MVCPools

The most efficient use of MVCs is not to use Named MVCPools. However, if you are separating and maintaining your VSM workloads in separate LSMs within an SL8500, you should consider using Named MVCPools to complete MVC separation by having a Named MVCPool for each logical group. You should then use Library Content Manager (LCM), previously called ExLM, to manage the location of the MVCs within the ACS to ensure that they continue to reside in the desired rail.

Note:

1. Oracle recommends using POOLPARM/VOLPARM to define VTV and MVC ranges in the VTCS CONFIG.
2. If Named MVCPools are defined, please make sure that a default MVCPool is also defined.

Please refer to the *ELS Command, Control Statement and Utility Reference* for information on the use of the above VTCS parameter definitions.

Considering VSM Workload Separation

Your VSM workload should ideally be confined to a single LSM per VTSS to avoid pass-thru operations.

If this is not possible because the workload is too large for a single LSM, then you may want to consider breaking the workload into smaller segments to fit into a single LSM.

If the workload is broken into more than one segment, then the VTCS VTSSSEL, VTSSLST, STORSEL, STORLST statements can be used to preference VTSSs and ACSs for minimized pass-thru, while still maintaining their ability to switch to alternative VTSSs and ACSs in the event of hardware failure.

For example, if HSM is currently being directed to VSM, it may be a suitable candidate for consideration to break into a separate VSM workload and direct to specific VTSSs and ACSs with its own named MVCPool.

Please refer to *ELS Command, Control Statement and Utility Reference* for instructions on the use of these VTCS parameters.

VSM Configuration Planning

The following factors can be used in a logical sequence to assist in the planning of a VSM Configuration to determine RTD and MVC placement within a SL8500 Library to achieve optimum performance.

- Determine the total number of MVCs
- Consider multiplexing (do the MVCs need to be split into 2, 3, 4 VTV copies?)
- Determine the location of multiplexed copies (are they in a different/same ACS or different/same LSM?)
- Determine the number of LSMs in the SL8500(s) required to fit MVCs
    - If multiplexing to different ACS(s), then focus on one copy first
    - If same ACS, then focus on all copies
- Determine the number of RTDs that can fit in one SL8500
    - Determine if the total RTDs for each VTSS can be installed in a single LSM
- Consider workloads
    - Analyze “active” versus “inactive” MVCs
- Determine RTD & MVC placement based on the above criteria

Placing RTDs and MVCs within the Library

The following recommendations include an example where LSM1 contains all active MVCs and all RTDs. LSMs 0, 2 and 3 are used as an extended store.

- For optimum performance, RTDs should be located in the outside two columns in preference to the two inner columns
- The ideal MVC placement is within one LSM per VTSS
- Analyze MVC characteristics and logically separate MVCs into active and inactive MVC groupings
- Place these active MVCs in the LSM where the RTDs reside
- Place the remaining or less active MVCs in the remaining LSM(s)
- Consider loading LSM0 with the inactive groups of MVCs first by using all three CAP magazines and the TLSM parameter to MOVE the MVCs to LSM0
- The CAPs can then be loaded adjacent to their appropriate LSMs with the remaining MVCs, active to LSM1 and inactive to LSMs 2 and 3
- Set-up LCM to manage the continual rotation of scratch MVCs and to move MVCs from the extended store to the active LSM where the RTDs reside
- Consider over-configuring RTDs if requirements for active MVCs are greater than one LSM

  This allows for a greater chance of an RTD being available in the LSM where the MVC resides, thus reducing pass thru.
- Set FLOAT(ON) to ensure that an MVC remains on the rail where the RTD is located.

Improving SL8500 Performance using LCM

A good way for planning workload separation for VSM in a SL8500 is to logically separate active groups of MVCs and extended store groups of MVCs.

By separating in this fashion, RTDs can usually be concentrated in one, or possibly two LSMs, with the active MVCs located on those rails and the inactive or less active MVCs placed on the remaining rails.

Managed by LCM, this:

- Allows VTCS to take advantage of RTD preferencing by having the more active MVCs and RTDs housed together on the same rail(s).
- Eliminates or minimizes vertical and/or horizontal pass-thrus.

Use LCM to identify active MVCs and move these into the LSM(s) that contain RTDs. All other MVCs can be moved to LSMs with no RTDs. The size of the active MVC pool can be adjusted to suit the size of the LSM(s) that have RTDs by varying the MVC Last Use Date. For example:

> If you were using MDAYS=45 and you had insufficient slots in the active LSM, you could reduce MDAYS to, say, 32 and likely reduce the size of the active MVC pool.
>
> It's *likely* because 32 days would typically provide for month end processing to still be included in the active pool. However, 45 days may not have many more active MVCs, depending on the site's processing characteristics. Going below 32 days, to 25 days, for example, would typically make a large difference in the active MVC pool, but would also impact month end processing performance.

If migrating to an SL8500 for the first time, run an LCM Volume Report to obtain a history of cartridge aging and use statistics before moving the cartridges to the SL8500. This report should be produced by LSM, sorting by the parameter MDAYS, which means days since the cartridge was last mounted. The MVCs should then be ejected in groups of MDAYS for transfer to the SL8500.

Please refer "LCM Best Practices" on page 79. Also refer to the *LCM User's Guide* for information on the LCM Volume Report and the "Using the SL8500 Performance Zone" Chapter of the same Guide for recommendations on optimizing performance of the SL8500 using LCM.

RTD Preferencing

VTCS first selects the target MVC and then attempts to preference an RTD residing in the same LSM where the MVC is located. If no RTD is available in that LSM, either because they are all busy or offline, the remaining RTDs that can perform the mount request will be ordered by robotic service times based on their proximity to the MVC. The service times are updated dynamically as mounts take place.

6

LCM Best Practices

Library Content Manager (LCM) is the new name for the product formerly known as the Expert Library Manager (ExLM). LCM is a software product that provides content management for mainframe automated tape environments. LCM works in conjunction with: Host Software Component (HSC), Virtual Storage Manager (VSM), and your tape management system (TMS).

A minimum of ExLM 6.2 is required. Library Content Manager (LCM) 7.0 and 7.1 are more current releases.

This chapter provides the current best practices for using LCM with the SL8500 library.

Selection Criteria

Planning for an LCM solution should focus on how you uses your automated tape libraries, such as:

- How many scratch volumes do you use in an average day?
- When do operators enter volumes?
  - At the beginning of the day
  - Throughout the day as necessary
  - During each shift
- Do you move volumes to off-site vaults and when?
- What times are best for operators to enter and eject volumes?
- Which are the most active data volumes?
- Do volumes reside outside the library?
- Which and how many CAPs do you want to use for volume ejects?
- Physical tape functions
  - Scratch synchronization and management
  - Physical tape placement
  - Free cell management

- Volume ejection

Adjusting Content Management Philosophies

The *most important* change for LCM is the need to *re-evaluate* the content management philosophy with respect to the physical structure and capacities of the SL8500.

- The SL8500 has four LSMs per library that work in *parallel*.
- Each of these four LSMs starts with a capacity of *362* cartridges that is expandable to 2522 cartridges.

  The basic configuration of an SL8500 library is 1,448 cartridges; spread across four LSMs is equal to 362.
- There is a maximum of *16* tape drives per LSM.

The major considerations for content management is to position scratch tapes, non-scratch tapes, and free cells in such a manner to reduce or eliminate pass-thru operations during production cycles.

- In some cases, this may require a greater number of scratch tapes and free cells per LSM.
- In other cases, it may require the placement of more active volumes with more available tape drives.
- In all cases, matching tape volumes to tape drives and where they are mounted is why LCM is an important tool that can help optimize the performance of the SL8500.

In addition, to support the SL8500, LCM required some minimal changes. The most visible are:

- Increased the LSMid format to support more than 16 library storage modules (LSMs) within an automated cartridge system (ACS).
- Added an additional attribute—called the Performance Zone (`PZ`)—to the `METHOD` statement.
- Provides an option (`NOEJSEQ`) to allow the standard LCM ordering of ejects to be bypassed and allow HSC to select the order of ejects to potentially reduce pass-thrus. Note that this option may result in increased manual handling of cartridges after the eject process.
- Added a slot location field, SL8500Cell, for the `Report Volume` to provide the necessary translation when locating a cartridge.

Here are some other considerations to plan for because of the physical structure of the SL8500:

- Using Pass-thru Mechanisms
- Ejecting Cartridges
- Entering Cartridges
- Using the Performance Zone
- Locating Physical Tape Cartridges

Using Pass-thru Mechanisms

The SL8500 has two pass-thru mechanisms—elevators and pass-thru ports—that have slightly different characteristics that require consideration when developing the content management philosophy for a specific customer.

Elevators**:** Provide *vertical* pass-thru operations between LSMs. Each of the four LSMs *share* the resources of two elevators—one on the left and one on the right—located in the front of the library.

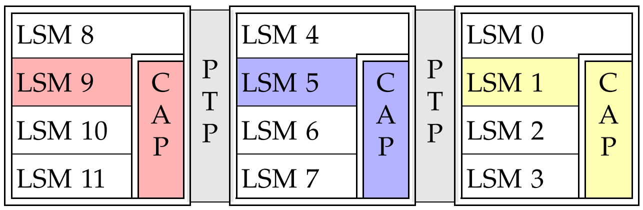
Pass-thru ports: Provide *horizontal* pass-thru operations between libraries. These mechanisms are located in the rear of the library for quick access to an available tape drive.

Consideration:	Why is a pass-thru operation needed?
Recommendation:	Any pass-thru operation, regardless of type or type of library, during production has an impact on overall performance as it involves additional robotics activity. Reducing such pass-thru operations is one of the simplest methodologies for improving performance. This is one of the main intents of using LCM for content management. In some cases, a pass-thru may be inevitable but it does not have to occur at job execution time. LCM content management can pre-position volumes such that most volumes do not require a pass-thru at mount time and/or reduce the impact of pass-thrus for volumes that cannot be pre-positioned.
Consideration:	If pass-thru operations are required, which type of pass-thru is best?
Recommendation:	That depends. The design of LCM is to place workloads so that the volumes and the tape drives are on the same LSM. If the workload requires two LSMs, LCM attempts to place the workload in the same SL8500 on two vertically adjacent LSMs or in two horizontally adjacent LSMs in an SL8500 library complex. The first scenario would use the elevator for the pass-thru; the second would use the pass-thru port mechanisms. While the two vertically adjacent LSMs provides the best performance, any combination of two adjacent LSMs will work. Every multiple SL8500 configuration has a fixed number of vertical and horizontal combinations where the elevator is a shared resource. In most cases, each environment may have a mix of these combinations. TLC/FSM can assist in determining placement of workloads.
Consideration:	What if the workload takes more than two LSMs?
Recommendation:	When three or four LSMs are required for the workload, placing that task in a single SL8500 would be a good choice because each pass-thru operation would only use a single mechanism—the elevator. Pass-thrus between non-adjacent LSM results in multiple pass-thru operations and can impact intermediate LSMs that the cartridge moves through. Try to separate workloads to avoid pass-thru between non-adjacent LSMs.

Ejecting Cartridges

Currently there are one or two 39-slot cartridge access port that span three rails in the SL8500 library. Each of the four LSMs must *share* the resources of these CAP—which is identified by the LSM on rail 2 (LSM 01).

The second rail in all libraries of a library complex own the CAPs (LSMs 01, 05, 09, 11, and so on).



LCM directs all cartridge ejects to those specific CAPs on the appropriate LSMs. There is no CAP associated with the other LSMs, meaning:

- Ejects directed to the nearest CAP use the CAPs tied to LSM01.

  The result of this physical configuration is that many ejects require a vertical pass-thru operation.

As LCM ejects volumes in the specified sequence—the default is by ascending volume serial number—the result can be a significant number of additional pass-thrus.

However, ejecting cartridges in the LCM specified order often reduces manual handling outside the library.

Important:
LCM provides an option specific to the SL8500 that allows HSC to ignore the LCM specified order and to eject the volumes using a minimum number of vertical pass-thru operations.

The option is `EJSEQ` or `NOEJSEQ` in the control statement of the LCM run.

- `EJSEQ` requires HSC to honor the LCM specified sequence (the default)
- `NOEJSEQ` gives HSC control of the eject order which may reduce total eject time

> **Note –** The result of using the `NOEJSEQ` option is that ejected volumes are out of order (the LCM specified sequence) and may require manual sorting to restore the volumes in the proper sequence.

Because the top rail (LSMs 00, 04, 08, 12, and so on) have no direct access to any magazine in the CAP, all ejects from this rail require a pass-thru. For this reason, the upper LSMs are ideal for workloads that use active volumes and that do not require as many ejects, such as VSM, HSM, and ABARS.

> **Note –** Aggregate backup and recovery support (ABARS) is a function that backs up a user-defined related group of data sets, called an aggregate, and recovers those data sets on the same system or on a recovery system

Entering Cartridges

To enter cartridges, LCM directs operators to place specific volumes into specific LSMs using the Operator and Enter Reports. Operators should place these volumes in the order specified.

HSC then enters and places these volumes into the LSMs adjacent to the magazines in the CAP door. The potential result is that the placement of the volumes may not be in the specified LSM.

Important:
To avoid this situation, operators should enter the volumes one LSM at a time using the **`Enter`** command and the **`TLSM`** parameter.

- Do not use the **`SCRATCH`** parameter with the **`Enter`** command.
- Execute an **`LCM Sync`** run after all enters are complete to ensure proper scratch status.

Using the Performance Zone

LCM support for the SL8500 implements the concept of the Performance Zone (PZ), a software construct that is not known to either HSC or the library hardware. The PZ is an area of the LSM that has better than average overall mount/dismount times. For a fully expanded (10088 cell) SL8500, this is around half of that average mount/dismount time.

- The size of the PZ is set within the LCM code and can be modified based upon the latest information on library mount/dismount performance.

  The PZ is currently sized at 524 slots and consists of HSC panel numbers 04 to 15. Note that HSC panels 02 and 03 are not included in the PZ, even though they are the closest panels to the drives. This is a deliberate action to prevent placement of highly accessed cartridges, the desired cartridges to place in the PZ, in those panels and causing higher than average robotics activity on the inner arrays opposite the tape drives.

- PZ is an attribute in the `METHOD` statement that defines the management technique for *non-scratch—active*—volumes. For example:

  ```
  Method Name(PerfZone) Eject(No)
   Cond(Ref LE 2Eject(No) PerformanceZone;
  ```

  Applications that fit well into the *performance zone* are similar to those that require very few ejects—`Eject(NO)`. A common factor are those volumes that tend to be recalled regularly or need the fast access time. Again, VSM, HSM, and ABARS are good candidates.

Selection of the volumes to reside in the PZ is critical to obtain the best performance. Limit these volumes to those that benefit most from a reduced average mount time or have a high likelihood for recall. Examples include, the most recently created volumes or volumes that are mounted repeatedly.

If more PZ cartridges exist on the LSM after the PZ area is totally filled with such PZ cartridges, LCM moves those PZ cartridges into available free cells nearest the PZ, beginning with empty cell in HSC panel 16. Non-PZ cartridges are not moved, but the relocated cartridges see improved mount/dismount times, though not to the same degree as those located in the PZ area itself.

Locating Physical Tape Cartridges

Many LCM users generate an **`Index`** report using the Report Volume function as a reference file on a workstation. This report, usually sorted by Dataset Name (DSN), includes the volume serial number, generation number, the HSC cell location and slot information.

For example:

```
Report Volume

Title('Report INDEXRPT')
DDname(INDEXRPT)
Style(Data)
Control(DataSetName Ascending)
Column (Serial,
        Scratch,
        InitialLSMCell,
        SL8500Cell,
        LocationCode,
        Slot,
        Copy,
        Generation,
        DataSetName);
```

LCM has added an SL8500Cell field that provides the necessary translation to locate cartridges.

Changing Configurations

The overall LCM configuration for a SL8500 basically consists of two components, the placement of tape drives and the placement of tape volumes.

If after a period of running and gathering data with a specific configuration it is determined that another configuration may provide better performance, moving to that new configuration is fairly simple with LCM.

- Placement of volumes with LCM is a function of the control statements and options selected for the LCM management run.
- Change the control statements and options for the new configurations.
- During the next run, LCM moves the volumes into the new configuration.
- Because this could be a robotic intensive activity, execute this change during a slow production period.
- If necessary, relocate the physical location of the tape drives to match the tape volumes and configuration.

7

ACSLS Best Practices

This chapter provides guidelines for optimizing the Automated Cartridge System Library Software (ACSLS) for the SL8500 library.

The minimum release is ACSLS 7.1 with PUT0701. ACSLS 7.3.1 and 8.0.2 maintenance levels are more current and are required for some features.

Refer to the *ACSLS Administrator's Guide* for more information and procedures.

Minimizing Elevator and PTP Activity

There are several things you can do to minimize elevator and PTP activity, such as:

TABLE 7-1 Minimizing Elevator and PTP Activity

Mounting cartridges	Whenever possible, when mounting a tape, use cartridges and tape drives that are in the same LSM. The ACSLS "query mount" command returns a list of media-compatible drives ordered primarily by least pass-thru distance, and secondarily by least-recently used. LSM refers to a **single rail** within the SL8500 library. Each SL8500 contains four LSMs.
Using float	Take advantage of the ACSLS "float" option (enabled by default by ACSLS) by maintaining some free cells within each LSM. Cartridge float is a feature that allows ACSLS to place a dismounted tape cartridge in an empty slot in the same LSM or a closer LSM as the tape drive if the tape originally came from a different LSM using a pass-thru operation. When cartridges are dismounted, ACSLS tries to avoid elevator (pass-thru) activity among LSMs by assigning a new home cell whenever the cartridge's old home cell is in a different LSM. ACSLS attempts to put the cartridge away: • in the same LSM as the tape drive from which it was dismounted • or to the closest LSM (with free storage cells) to the drive

TABLE 7-1 Minimizing Elevator and PTP Activity

Entering cartridges	Enter cartridges into an LSM that has compatible tape drives for the media being entered. Example: You have only LTO drives on LSMs 2 and 3, and you want the LTO cartridges to be located in these LSMs. When entering these cartridges, you should place them in the CAP magazines adjacent to LSMs 2 and 3. ACSLS then makes every effort to put the cartridges in the LSM that is adjacent to that CAP magazine.
Scratch cartridges	Make sure that scratch cartridges are available in sufficient quantity in each LSM where they will be used. For an SL8500, this means having scratch cartridges available on each rail (LSM) of the library.
Free cells	Make sure there are adequate free cells in each LSM.

Configuring Tape Drives

How tape drives are configured in the SL8500 can minimize both elevator and PTP activity while supporting your tape workloads. Strategies to use in determining where tape drives are located in the SL8500 include:

- Cluster drives by type, placing drives that use different media types on separate rails (LSMs). For example, place T9840 drives on one rail and T10000 drives on a different rail.
- Manage your tape cartridges so compatible media is on the same rail with tape drives. When entering media, enter it through a CAP magazine adjacent to the desired rail. Move incompatible media to a different rail (that has drives that are compatible with the media).
- Allocate separate rail(s) to each major application workload. For example: Separate the drives and media for Veritas NetBackup and Tivoli applications all need media and drives.
- Cluster cartridges by workload, with enough drives to support the maximum drives needed for the workload. Separate the cartridges used by each workload on separate rails, and ensure the rail(s) dedicated to a workload has enough drives to meet the maximum concurrent mounts for the peak usage of the workload. Ensure that the rail has not only the data cartridges for the workload, but also the scratch cartridges that will be needed.
- Configure your heavy tape applications so they will not exceed the performance limits of your library configuration.
- Actively manage your cartridges, and migrate the least recently used (LRU) cartridges to archival LSMs. This helps ensure that there will be space for the active cartridges close to the drives. Consider using the top rail as an archival LSM, as it does not have direct access to the CAP.

When Float is on, ACSLS will select a new home location for a cartridge that is as close to the drive as possible on a dismount. This automatically clusters cartridges by the drives used by a workload.

Use a library cartridge management application to keep active volumes on the same LSMs (rails) as compatible drives. Migrate less frequently used volumes to archival LSMs.

- Clustering drives and media on a single rail works until the mounts per hour threshold is reached, all drives are in use, or there are too many active cartridges to fit on a rail. When the resources needed for a workload exceeds the capacity of a rail, spread the cartridges and drives over two or more rails.
- Configuring the SL8500 with 8 HandBots (two HandBots per rail) provides redundancy so you can always access the cartridges and drives that support a workload.

Managing Cartridge Locations

How cartridges are originally entered in the library or their status in the library can have an affect on ACSLS performance. Considerations are:

Entering cartridges	Recommendation: Enter cartridges through the CAP. When manually placing cartridges in the library with the front access door open, library operations cease and ACSLS must perform a full audit to update the library database to match the actual contents of the library. To maximize performance: Enter cartridges through the cartridge access port (CAP). During an enter, the library stays online, mounts can continue, and the library management software always tries to move the cartridge to an LSM adjacent to the CAP magazine—minimizing pass-thru activity. If this is not possible, the library controller moves the cartridge through the elevator to another LSM—which requires additional movement between two HandBots and the elevator.
Clustering cartridges	Cluster cartridges by workload on separate rails with enough tape drives to support the maximum activity—peak usage—for that workload.
Using float	Recommendation: When float is on (default), ACSLS selects a new home cell for a cartridge that is in an LSM as close to the drive as possible on a dismount. This option automatically clusters cartridges by the drives for the workload. Make sure each LSM contains enough free cells to allow selection of a new home cell in that LSM. Note: Float can be overridden on an LSM-by-LSM basis with the Extended Store LSM feature.
Supplying scratch cartridges	Make sure each rail has the correct amount and type of data cartridges plus enough scratch cartridges to support the workload.

Moving Little-Used Cartridges from Active LSMs

ACSLS provides a solution for moving little-used cartridges from active LSMs in order to free-up cells. For details, refer to the *StorageTek ACSLS 8.1 Administrator's Guide.*

ACSLS to SL8500 Connection Options

There are multiple options for connecting ACSLS to SL8500 libraries. These options can be used independently or together for communication between ACSLS and the SL8500. For details, refer to "Ethernet Connectivity" on page 107.

ACSLS Queues and Retries Mounts and Dismounts during Library Outages

Mounts and dismounts do not have to fail when:

- You need to physically enter the library,
- A Redundant Electronics switch occurs, or
- The library controller reboots, or
- ACSLS temporarily loses communication with the library.

ACSLS 7.3.1 or 8.0.2+ automatically queues mounts and dismounts during temporary library or tape drive outages and retries the requests when the library and drives are available again. Because mounts and dismounts do not fail, backup jobs do not have to be restarted.

The length of time that ACSLS will wait for the components to become available is governed by the MOUNT_RETRY_TIME_LIMIT Dynamic Variable, and the interval between checks to see if all required components are available is specified by MOUNT_RETRY_DELAY.

Set your MOUNT_RETRY_TIME_LIMIT based on your client applications mount and dismount timeouts. Find out the current settings of the mount and dismount timeouts in your backup application, or other ACSLS client and lengthen them, if necessary, to take advantage of queuing and retry. To find and set the timeouts in selected client applications:

- NetBackup
- Oracle Secure Backup
- SAM-FS
- Tivoli Storage Manager

After you have set the timeout in your client application(s), set the ACSLS MOUNT_RETRY_TIME_LIMIT a little shorter so ACSLS will report a failure before the client application times out.

Note – Currently, ACSLS does not queue and retry moves, enters, or ejects during temporary library outages.

Understanding SL8500 Internal Addresses

Use the SL Console "Search" utility to translate between SL8500 internal (default) addresses and ACSLS panel, row, column addresses. See Chapter 2, "SL8500 Architecture" for information.

Translating Addresses

Use the SL Console "Search" utility to translate between SL8500 internal (default) addresses and ACSLS panel, row, and column addresses.

See Chapter 2, "SL8500 Architecture" for information.

Finding Missing Cartridges

If the SL8500 contents are out of sync with ACSLS due to manual operations such as loading cartridges directly, it is not advisable to attempt continued operations.

If you want to manually add tapes, adding them to a particular LSM within the SL8500 is a better approach. Adding tapes to a particular LSM and auditing only the affected LSM is a quicker and more reliable solution.

To do this, modify the affected LSM to an offline diagnostic state to ACSLS while the audit is in process. After the SL8500 library audit is performed, modify the LSM online to ACSLS.

If a cartridge is out of place or unaccounted for by ACSLS:

1. Perform a physical audit of the SL8500 using the SL Console.
   The physical audit of the SL8500 is performed as a background task in between handling mount and other library operation requests.
2. Run an ACSLS audit to update the ACSLS database to match the actual inventory of library volumes.

   Note – The **`audit`** command updates the ACSLS database to match the actual inventory of the library and resolve discrepancies between the library and the ACSLS database.

Varying the SL8500 Offline

You should vary SL8500 components offline to ACSLS before they are powered-off, if they are inoperative, and before you open an SL8500 access door. This notifies ACSLS that they are unavailable. Once they are available, vary them back online.

Using ACSLS to Vary Components Offline

Note – *Do not* use the Library Console to vary components offline to ACSLS (such as ACSs, LSMs, and CAPs).

- Varying components offline using SL Console would be equal to using a "force" command and may cause requests in progress to fail.
- The SL Console has no knowledge of outstanding requests to ACSLS.
- ACSLS allows outstanding requests to complete before taking components offline, unless it is a **`vary offline force`**.

Using the Service Safety Door

Whenever replacing hardware requires *closing* the Service Safety Door, it is advisable to keep the door closed for the minimum amount of time possible.

This is because the Service Safety Door blocks other hardware components (such as the elevators, CAPs, and storage cells) that may require access for completing specific requests.

Minimizing the time these components are unavailable minimizes this risk.

Using ACSLS:

When closing the Service Safety Door on the right side, it will block access to the CAP; therefore, before closing the door on the right side you can:

- Vary the *cartridge access ports* offline
- After the door is opened, vary the cartridge access ports back online

> **Note –** When the SL8500 Service Safety Door is closed to separate a service bay from the rest of the library, the service representative can open the access door on that side without taking the LSM or ACS offline.

Caution: Do not use these ACSLS commands or utilities when using the Service Safety Door:

When closed on either side, do not use these utilities:

- **`acsss_config`**
- **`config`**

When closed on the right—CAP—side, do not use these commands:

- **`enter`**
- **`eject`**
- **`set cap mode auto <cap_id>`**

When closed on the right—CAP—side, the following commands *can be used*, **but special considerations apply:**

- **`audit`**

  The audit command can be used; however, if there is a need to eject cartridges as a result of the audit—such as the audit encounters duplicates or unreadable labels—the audit will complete and update the ACSLS database, but the cartridges will *not* be ejected.

- **`vary acs`** and **`vary lsm`**

  These vary commands will succeed, but display messages on **`cmd_proc`** and the event log reporting CAP failures and inoperative CAPs.

Configuring ACSLS for the SL8500

Before you configure ACSLS for an SL8500 library:

- Verify that all the components of the SL8500 are operational.

ACSLS builds its configuration from the operational information reported by the library.

Important:
If all of the library components are not operational—with the exception of the tape drives—the information may not be correctly reported to ACSLS and the configuration will be incomplete.

To verify that all the components of the SL8500 are operational:

---

1. Logon to the Library Console.
   You can use either the touch screen operator panel on the front of the SL8500 or use a remote Library Console connection.
2. Select Tools, then System Detail.
   - All components should be green (such as CAP, elevator, and robots).
   - Exception: Drives that are yellow can be configured later.
   - Missing drives can be added using the Dynamic Configuration utility (**config drives**).
3. After you verify that all the components are operational, you can configure the SL8500 library to ACSLS.

Refer to the *ACSLS Administrator's Guide* chapters "Configuring Your Library Hardware" and "Verifying and Changing Dynamic and Static Variables".

Using the Dynamic Configuration Utility

The dynamic configuration (config) utility allows you to implement configuration changes to ACSLS libraries (and components) while ACSLS remains online and running. These configuration changes are recorded in the **acsss_config.log** file.

The following dynamic configuration utilities are supported:

- **config acs**
- **config drives**
- **config lsm**
- **config ports**

Using the **config** utility provides the following benefits:

- ACSLS can continue running, allowing you to perform mount requests to unaffected library components.
- Allows you to reconfigure specified library components while all other configuration information remains unchanged.

  For example: When specifying:

  - An ACS, the configurations of other ACSs are not affected.
  - An LSM, the configurations of other LSMs are not affected.

- A drive panel, the drives on a panel, mounts and dismounts to all existing drives are not affected.

To add these libraries, you must:

1. Stop ACSLS
2. Run **`acsss_config`** to update the ACSLS configuration.
3. Start ACSLS.

Changing the Configuration

When you change the configuration of an SL8500 library—expand, add, merge, or split—you must also update the ACSLS map of the library configuration that is recorded in the ACSLS database.

Important:

For non-disruptive growth, StorageTek recommends adding libraries from *right* to *left* when facing the front doors (this is the preferred method).

However, the library complex can grow in the other direction, from *left* to *right*, but this requires an outage to update the ACSLS configuration and update volume addresses in the renumbered LSMs.

LSMs in an SL8500 complex are numbered from right to left and top to bottom as viewed from the front of the libraries.

TABLE 7-2 on page 92 shows an example of this numbering scheme.

TABLE 7-2 Adding and Expanding on Configurations

Left Right

ACS 0							
LSM 12	PTP	LSM 8	PTP	LSM 4	PTP	LSM 0	Top
LSM 13		LSM 9		LSM 5		LSM 1	
LSM 14		LSM 10		LSM 6		LSM 2	
LSM 15		LSM 11		LSM 7		LSM 3	Bottom

TABLE 7-3 shows and example of splitting the configuration above into two separate automated cartridge systems (ACSs).

TABLE 7-3 Splitting Configurations

ACS 1		
LSM 4	PTP	LSM 0
LSM 5		LSM 1
LSM 6		LSM 2
LSM 7		LSM 3

ACS 0		
LSM 4	PTP	LSM 0
LSM 5		LSM 1
LSM 6		LSM 2
LSM 7		LSM 3

TABLE 7-2 now provides an example of merging two ACSs in the configuration above into one.

Note – The LSMs in ACS 1 will become part of ACS 0, and they will be renumbered to become LSM 8 thru 15

Adding New SL8500 Libraries

When additional SL8500s are added to an existing SL8500 library complex, the new ACSLS configuration must be updated. If the addition of new SL8500s causes the LSMs in the existing SL8500s to be renumbered, the cartridge addresses in those LSMs must be updated.

For more information and procedures, refer to the *ACSLS Administrator's Guide* appendix "ACSLS Support of the SL8500" - section "Connecting SL8500s with Pass-Thru-Ports ".

Adding Libraries to the Left

Adding libraries to the left is the preferred method.

When you add libraries to the *left* of an existing library complex, you can *dynamically* upgrade the configuration of the software. This upgrade must be done to configure both the libraries and the additional tape drives.
When you *dynamically* upgrade the configuration:

- No rebooting of ACSLS is required.
- Mount requests can continue as normal in the first or existing libraries during this upgrade.
- When cartridges are placed into the new SL8500 library, an ACSLS audit must be run to add these cartridges to the database. Existing LSMs can remain online during the audit.

Dynamically Upgrading ACSLS Configurations

For ACSLS, upgrade the configuration using either:

- Dynamic configuration (ACSLS online and running)
- **`acsss_config`** (ACSLS must be offline and stopped)

Adding Libraries to the Right

When a new SL8500 library is added to the *right* of the complex, the LSMs must be re-numbered; consequently the volume locations will change.

Important:

- Vary the LSMs offline or place ACSLS in diagnostic *before* reconfiguration
- Audit the existing and new SL8500 libraries *in a specific sequence* to avoid deleting then re-adding the volumes in the re-numbered LSMs.

Existing LSMs must be offline while upgrading the SL8500 library complex and during the ACSLS audit. Otherwise, problems will occur, such as:

- Mounts will fail because cartridges cannot be found in their new locations.

- Entry of new cartridges will collide with existing cartridges.
- Movements of cartridges to existing, re-numbered, LSMs will collide with cartridges already in the cells.

Expanding an SL8500 Library

Expansion occurs when Storage Expansion Modules are added to the SL8500 to increase its capacity. When this happens the Customer Interface Module (CIM), which includes the CAP, must move out. As a result, newer and higher panel numbers are assigned to the three cell panels on the CIM.

When the cell panels on the CIM are assigned higher panel numbers, the addresses of all the cartridges on the CIM change. You must audit these panels so ACSLS can update its database with the new addresses of these cartridges.

For more information and procedures, refer to the *ACSLS Administrator's Guide* appendix "ACSLS Support of the SL8500".

Merging or Splitting SL8500 Libraries

When merging multiple, separate SL8500s or splitting SL8500s in an existing SL8500 library complex, the new ACSLS configuration must be updated.

For more information and procedures, refer to the *ACSLS Administrator's Guide* appendix "ACSLS Support of the SL8500" - sections Procedures for "Merging ACSs" and "Removing PTPs and Splitting ACSs".

Using ACSLS HA

ACSLS HA (High Availability) is a software/solution which can be installed by Professional Services. This solution is available for the Solaris 10 platform.

In environments where there is only one ACS, it is sometimes desirable to fail over highly available servers in the event that communication is lost to the library.

FAIL_OVER variable for ACSLS HA 2.0 and 3.0

ACSLS 7.2 (HA 2.0)

The ACSLS HA agent contains a variable that causes different behaviors based on these environmental considerations called "FAIL_OVER".

This variable exists within the script located in:

```
/opt/VRTSvcs/bin/STKLMU/monitor
```

ACSLS 7.3 (HA 3.0)

In ACSLS HA 3.0, failover is controlled by the acsls_env file in the /opt/SUNWacsls/lib directory.

Note: The explanation in the header of the acsls_env file is confusing. Please use the explanation of how failover operates below.

FAIL_OVER variable

The FAIL_OVER variable contains one of two values, “0” or “1”.

- Setting the variable to 0

  By setting “FAIL_OVER” to a value of “0”, you can have the primary ACSLS server automatically fail over to the standby server in an attempt to resolve library communication failures.

  Setting this variable to “0” is NOT recommended in environments with multiple libraries or Redundant Electronics. If this is set in environments with multiple libraries, failing over will impact all libraries. Setting the variable to “0” for a library with RE will cause an HA Failover whenever an RE switch occurs.

- Setting the variable to 1.

  Setting the “FAIL_OVER” variable to a value of “1” causes the monitoring script to log a message to the:

  /var/VRTSvcs/log/engine_A.log

  that communication to a library has failed but no action will be taken.

Failover controlled by file in ACSLS HA 8.0

In ACSLS HA 8.0, failover is controlled by the ha_acs_list.txt file in the $ACS_HOME/acslsha/ directory. The file identifies the ACSs ACSLS HA should monitor and whether it should failover if all communication to the ACS is lost. The header of ha_acs_list.txt has a complete explanation of the use of the file.

8

Independent Software Vendors

The manner in which independent software vendors (ISVs) design and implement their applications to support the SL8500 library is "open" to that specific vendor—where as some vendor's applications work better with the SL8500 than others.

This chapter discusses characteristics to be aware of for various applications.

> **Note –** Each ISV may handle optimization of the SL8500 differently in the way the software applications attempt to: minimize pass-thru activity (elevator and pass-thru port); select media (specific volumes and scratch tapes); optimize tape drives (selection and usage characteristics)

Interoperability

Not sure if your customer's software of choice supports StorageTek hardware?

Will the different components of your solution work together?

Check out the Interoperability Tool on the Oracle Technology Network. This tool can only be accessed by an Oracle employee or ISV.

The Interop Tool is designed for connectivity information on all supported products regardless of the branding. The configurations listed are reflective of the most up-to-date information reported from various sources, including Oracle testing labs and our technology partners.

The Interop Tool lists configurations with valid connectivity, *it does not validate.*

Characteristics

Table 8-1 discusses some of the characteristics for software applications.

TABLE 8-1 Application Characteristics

Workload separation	The same concepts for managing library content that applies to ACSLS and in the other chapters of this guide also apply to vendor applications: • Dedicating rails, separating workloads to specific rails • Grouping tape drives by type, function, and application • Managing cartridges • Minimizing elevator and pass-thru port activity • Enabling or disabling float
Tape drive location and usage	Each LSM supports a maximum of 16 drives. In order to minimize elevator movement or possible drive busy conditions with the ISV software, the drives available in that LSM should always be greater than the number of concurrent jobs being run on that LSM.
Tape drive selection methods	Selection methods such as least recently used (LRU) or sequential, without regard to pass-thru distance, can induce more pass-thru activity.
Media selection methods	The way a software application selects the media and finds and mounts to a tape drive can minimize pass-thru movement.

Minimize pass-thru activity	If you are not able to easily separate the workload, consider:
	• Using rails that are adjacent to each other. This provides a shorter distance for the pass-thru operation.
	• Pass-thru's are either:
	  • Vertical: using the elevator in the same library, or
	  • Horizontal: using pass-thru ports to a different library

Application knowledge	Knowledge or 'functionality' of a software application pertains to how well it understand the components of an: • Automated cartridge systems (ACS) • Library storage modules (LSMs) • Pass-thru ports (PTPs) • Addressing and number schemes • ACSLS capabilities and how to work with them
Fence or Pool of resources	Associating drives and media in the same LSM to a drive/media pool.
Usage of '`query mount`' commands	The **`query mount`** commands return a list of media-compatible drives for a volume ordered primarily by least pass-thru distance and secondarily by least-recently-used status within the same pass-thru distance.

TABLE 8-1 Application Characteristics

Usage of the '`float`' option	Determining when setting **`float`** on benefits an application and if it does not.
Timeouts	In large library complexes, you may need to adjust the timeouts in both the client application and in the host software.

Workload Separation

Being able to separate workloads is a major contributing factor to optimizing performance of the SL8500.

- Placing back up applications on a specific rail.
- Grouping tape drive types.

Tape Drive Location and Usage

When configuring rails and applications, selection and location of tape drives can help minimize pass-thru activity.

Example:	Mount requests are failing because the tape drives are always busy, or an increase pass-thru activity is happening. • There are too many "active" cartridges for the number of tape drives on that rail • The number of concurrently mounted tapes exceeds the number of tape drives.
Recommendation:	Over-configure tapes drives on rails to ensure applications do not exceed peak workloads that might cause a pass-thru for an available tape drive. Configure heavy tape applications so they do not exceed the performance limits of that LSM and/or library configuration.

Each LSM supports a maximum of 16 drives. In order to minimize elevator movement or possible drive busy conditions with the ISV software, the drives available in that LSM should always be greater than the number of concurrent jobs being run to that LSM.

Tape Drive Selection Methods

Vendors that use a *least recently used* (LRU) or sequential selection for tape drives can cause additional pass-thru activity.

For example:	If the cartridge selected is in LSM 1, and the least recently used tape drive is in LSM 3, a pass-thru is required to satisfy the mount.
Recommendation:	Fence or create a pool on the LSM—media selection and drive selection would occur only on that LSM—so no pass-thru activity is necessary.

Note: Using "query mount" returns a list of media-compatible drives sorted primarily by least pass-thru distance and secondarily by least recently used drive within the same pass-thru distance.

Media Selection Methods

Applications vendors implement a media selection in one-of-two ways:

1. Select the media first—then find an available tape drive.
   Chances are better that an available drive is on the LSM if a logical workload separation was used.

2. Select a tape drive first—then search for a specific volume or scratch tape.

   Some vendors (such as Symantec NetBackup) minimize pass-thru movement using an algorithm behind ACSLS that:

   - First selects a particular cartridge for the operation and
   - Then looks for a drive available in that LSM.

   If no drives are available the applications looks *down* (in LSM numbering) to the next closest LSM for a drive. If a drive is not available it looks up to the next closest LSM above.

   For example: A cartridge gets selected in LSM 1.

   - If no drive is available, it next looks at LSM 2.
   - If there are still no drives available, it then checks LSM 0.
   - If again, no drives are available, it checks LSM 3.

     This is an example of the ISV software trying to minimize elevator movement. However, using "query mount" is better because it uses the knowledge of library configurations in Oracle software to minimize pass-thru.

Application Knowledge

Knowledge or *functionality* of a software application pertains to how well it understand the components of the SL8500 library, including:

- Library storage modules (LSMs)
- Pass-thru ports (PTPs)

  Not all software applications understand pass-thru ports and depend on library management software to get the media from the source to its destination—for example: from LSM 1 to LSM 5.

LSM 8	PTP	LSM 4	PTP	LSM 0
LSM 9		LSM 5		LSM 1
LSM 10		LSM 6		LSM 2
LSM 11		LSM 7		LSM 3

Left ← – – Right

> **Note –** To get a tape from LSM 1 to LSM 5, not vertical but horizontal movement is involved using the pass-thru ports between the libraries.

- Addressing and number schemes
- ACSLS capabilities and how to work with them

mount scratch and mount*

For a specified drive, select a scratch cartridge and mount it. Optionally, select the cartridge from a specified scratch pool and/or with a specified media type. ACSLS selects a compatible scratch cartridge in the closest LSM to the drive. In order to rotate use among all cartridges, the compatible cartridge with the least recent access date is selected within the selected LSM.

query mount

The query mount command displays the status of media-compatible tape drives for a specified data volume. These drives are not displayed if a volumes is absent or rejected.

Format	`query mount vol_id`
Options	`vol_id` specifies the volume to query.
Usage	Use the **`query mount`** command to report the tape drives attached to the same ACS as the volume and compatible with the media type. The compatible tape drives are ordered primarily by proximity to the specified volume and secondarily by least recent used. Selecting a tape drive near the top of the list will reduce pass-thrus and optimize library performance.
Example	To display the proximity an lru status of tape drives for volume STK012; Enter: **`query mount STK012`**

HPSS is an ISV that uses the **`query mount`** command to optimize library performance.

query mount * (query mount scratch)

The query mount * command displays the status of media-compatible tape drives for a specified scratch pool (and, optionally, for a specific volume media type within the pool).

Format	`query mount * pool_id... [media media_type	media *]`
Options	`pool_id` specifies the scratch pool to query. media **`media_type	media *`** specifies the media type.

Usage	Use the **`query mount *`** command to display the status of all library tape drives compatible with all volume media types in a specified scratch pool in the same ACS as the volumes. Pool 0 is a common scratch pool. The tape drives are in order by proximity to the densest scratch pool.
Example	To display status of compatible tape drives listed by proximity to the largest concentration of scratch tapes in pool 5. Enter: **`query mount * 5`** To display status of compatible tape drives in proximity to the largest concentration of 9940 scratch tapes in common pool 0. Enter: **`query mount * 0 media 9940`**

Timeouts

In large and/or busy SL8500 library complexes, you may need to adjust the software application timeout values. For example, the Symantec NetBackup timeout of 5 minutes may need to be increased to 15 minutes or more in a busy string of multiple connected SL8500s.

If your library is managed by ACSLS, after adjusting your applications timeout values, set the ACSLS MOUNT_RETRY_TIME_LIMIT to be a couple minutes shorter.

Selecting Cartridge and Drive in the same LSM

Some ISV software is capable of associating a drive and media in the same LSM to a drive/media pool which enables the user to use only drives and media within that LSM. This also prevents moves requiring pass-thru. It requires the number of drives within that LSM to be greater than the number of concurrent jobs being run that require media from the pool. If the jobs exceed the number of drives in this configuration, the drives will be busy and unable to satisfy the additional requests. The result can be a backup job that either waits or does not run.

9

TLC/FSM

This chapter provides an introduction to the Tape Library Configurator/Field Simulation Model (TLC/FSM).

TLC/FSM for Tape and Library Configurations that meet Expectations

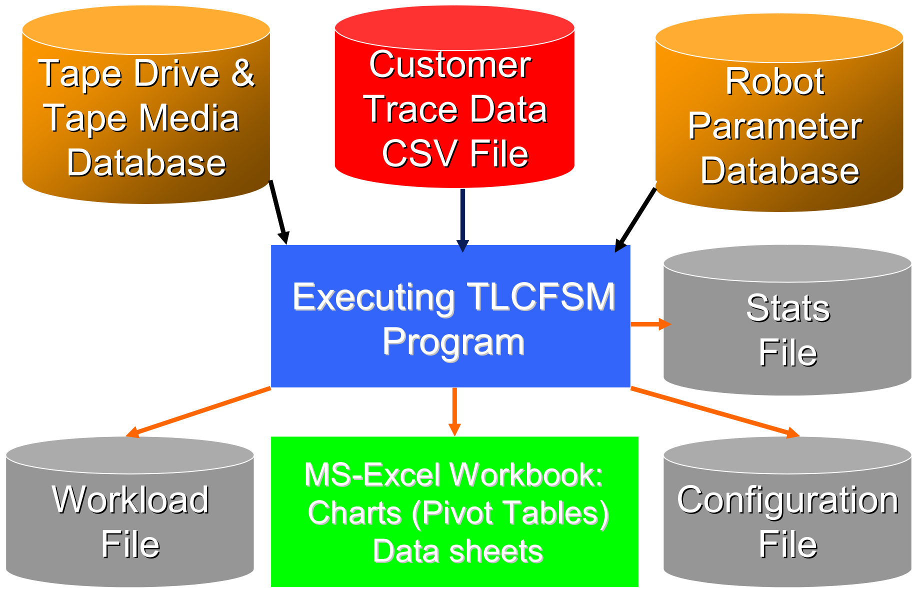
The TLC/FSM uses statistics on tape usage from you to ensure that your new library configurations meet your performance requirements. The tape statistics input can be either HSC SMF records or volume statistics from ACSLS. Oracle analyzes these statistics against model tape library configurations in a Tape Study. The output of the Tape Study is reported to you, and it produces recommendations for tape library and drive configurations that support a your tape workloads and performance expectations.

TLC/FSM Details

The TLC/FSM, a discrete event simulator, is a tool available for sizing, configuring, and modeling tape library systems using historical tape activity statistics from you. The model analyzes the data on historical tape activity from and simulates the mount and dismount activity required to replicate the workload. This analysis addresses time requirements, and simulates the robotics in multiple SL8500 or 9310 subsystems, SL3000s. It includes the simulation of robotics, pass-through-ports, and elevators to arrive at an accurate forecast of tape automation

Note – *The TLC/FSM tool is proprietary, confidential and can only be executed by an Oracle employee.*

FIGURE 9-1 Tape Library Configurator Field Simulation Model



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Input for the TLC/FSM from HSC and ACSLS

Gather trace data from current library activity to model and configure the SL8500 to support a customer's application workloads. You can use the trace data from either 9310 or SL8500 libraries to model the configurations of tape drives and cartridges for an SL8500. To model SL8500 configurations:

1. Modify the default settings of both HSC and ACSLS.
2. Collect the data from HSC or ACSLS.
3. Use the TLC/FSM utilities to convert this data into comma separated value (CSV) files.

HSC: Record Cartridge Movement Statistics

TLC/FSM uses cartridge move statistics from HSC. The library reports these statistics on the completion of every successful cartridge movement that the host (HSC) requests.

> **Note –** Both the 9310 and SL8500 report these cartridge movement statistics. Cartridge movements include mounts, dismounts, swaps (to another drive), moves between storage cells, and moves to and from a CAP.

HSC reports cartridge movement statistics in SMF subtype 7 records.
By default, HSC only records SMF subtypes 0-6.

To record SMF subtype 7 records:

1. Add subtype 7 to the list of SMF subtypes in **`SYS1.PARMLIB(SMFPRMxx)`**.
2. Modify the line:

   `SUBPARM(SLS0(SUBTYPE(1,2,3,4,5,6,7)))`

   Where **`"SLS0"`** is the name of your HSC subsystem.

   Modifying the HSC SMF parameters in **`SYS1.PARMLIB(SMFPRMxx) i`**s described in the: *NCS Installation Guide, Performing HSC Post-Installation Tasks and Adding SMF Parameters for the HSC* section.

ACSLS: Record Library Volume Statistics

ACSLS does not record cartridge movement statistics. TLC/FSM uses library volume statistics from ACSLS. To do this:

1. Enable library volume statistics with the **`LIB_VOL_STATS`**, **`VOL_STATS_FILE_NUM`**, and **`VOL_STATS_FILE_SIZE`** variables.

   This can be a large amount of data.
2. Make sure that you have enough space in the partition where ACSLS is installed (usually /export/home) first.

10

Ethernet Connectivity

This chapter provides network examples for the Dual TCP/IP feature, which provides two separate TCP/IP connections to an SL8500 library; Multi TCP/IP, which provides connections to multiple connected SL8500s; and Redundant Electronics (RE), which provides failover protection for enterprise libraries.

> **Note –** Dual TCP/IP connections are not redundant, they are two separate, active/active interfaces that should *not* connect to the same subnet.

Refer to the *ACSLS Administrator's Guide* for examples of the preferred configurations for ACSLS with the Dual TCP/IP and Multi TCP/IP support, the RE feature, and an ACSLS High Availability (HA) environment. Each example provides a drawing with routing tables and the CLI commands used to configure each example.

Refer to the HSC Programmer's Guide for the preferred configurations for HSC with the Dual TCP/IP and Multi TCP/IP support.

Network Recommendations

A private network connection to an Ethernet hub or switch is *recommended* for maximum throughput and minimum resource contention when establishing a host connection to an SL8500 library.

Consult with your systems and/or network administrator for information about the network, routers, and IP addresses. When doing so, keep the following considerations in mind:

The simplest topology (a private network connection to a hub or switch) is often the best. Simplification will:

- Offer maximum throughput
- Provide minimum resource contention
- Lend itself to higher security for library communication
- Supply the least expensive alternative
- Provide quick identification of any problems within the network

This is only a suggestion; however, your network and desired topology are ultimately the determining factors. When a more complicated setup is required, consultation between your network and system administrators and Oracle's Advanced Customer Support (ACS) may be necessary.

TCP/IP Important Considerations

Shared Networks:
The following are some examples of issues that can arise when you connect the SL8500 library to a shared network.

- A TCP/IP-connected library can handle standard host traffic, but it cannot resolve floods of Address Resolution Protocol (ARP) broadcasts. For this reason, it is best to attach the library on a controlled network, such as behind a switch or router.

  Later generation networks, such as 1000Base-T and Gig-E, support earlier communication modes. However, broadcasts from external servers may transmit data at bandwidths that could overwhelm the library.

  It is best to attach the library on a controlled network, such as with a switch that can isolate the library from network broadcasts.

- When you connect the library on shared networks, and broadcasts are sent to all network nodes, they may also be directed to the library (even though it does not need them).

  During the time the library is receiving these irrelevant broadcasts, it cannot receive requests or reply to others in a timely fashion. This heavy broadcast traffic on the network can saturate the library to the point that, to the host, it may appear that the TCP/IP connection has been lost.

- Heavy network traffic can also overwhelm the library's Ethernet controller causing the processor to continuously reset and re-initialize the controller, then recover the host-to-library communications.

Network Planning

When planning the network connections to an SL8500 library or library complex:

1. Consult with the systems and/or network administrator for information about the network and to obtain IP addresses.
2. Complete the information in the following table.
   You may want to make additional copies.

TABLE 10-1 Network Entries

Description		Content
Port 2A	Host name	
	IP address	
	Gateway	
	Netmask	

TABLE 10-1 Network Entries

Port 2B	Host name	
	IP address	
	Gateway	
	Netmask	

3. Obtain or make a drawing of the network configuration. This will help with the configuration and fault isolation if necessary.
4. Important: The date and time of the SL8500 must also be checked and, if necessary, set through the CLI interface.

Supported Configurations

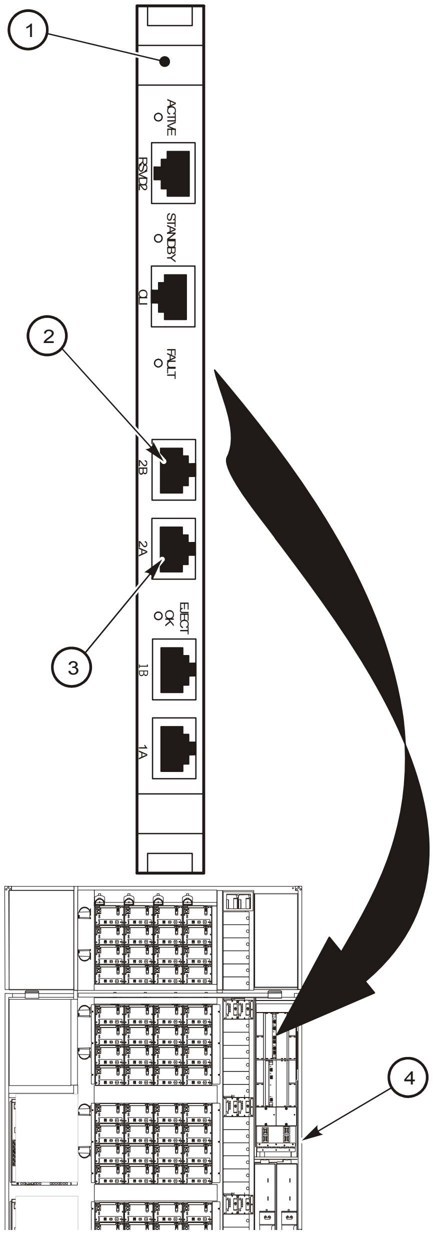
Important:

- Because of the complexity in Dual TCP/IP network configurations, initial installations should be reviewed by the Library Team before the installation.
- Oracle Service also recommends involvement during all Dual TCP/IP installation, planning, and implementation phases.
- Any services provided for Dual TCP/IP installations not approved by services will be billed on a time and materials basis.

Ethernet Interfaces

The SL8500 library uses TCP/IP protocol over an Ethernet physical interface to manage and communicate with the host and library management applications.

FIGURE 10-1 Ethernet Connections



This interface enables both:

- Open system platforms with ACSLS
- Enterprise-level mainframes with HSC

to connect to and communicate with the SL8500.

The HBC card is the library controller responsible for coordinating all component operations within the library and providing the interface connection with the host. There are two pairs of HBC/HBCR and HBT cards with the Redundant Electronics (RE) feature. (The HBT card manages the library's interface to the tape drives and is not shown here.)

Connections:
There are two separate Ethernet connections on the HBC card for host to library communications—Ports 2A and 2B.

- Port 2A provides the Dual TCP/IP connection—this is an optional feature for SL8500 libraries.
- Port 2B provides the primary connection for host communications–this is the standard connection for SL8500 libraries.

Compliance:
Both ports comply with the Institute of Electrical and Electronics Engineers standard–IEEE 802.3–for Ethernet networks.

Both ports are capable of auto-negotiating with the:

- Method of transmission
    - Half-duplex: Transmits data in just one direction at a time
    - Full-duplex: Transmits data in *two* directions simultaneously
- Speed of the transmission
    - 10Base-T: 10 megabits per second (Mbps)
    - 100Base-T: 100 megabits per second (Mbps)

Figure callouts:

1. Library Control Card
2. Port 2B—primary TCP/IP host connection
3. Port 2A—secondary, dual TCP/IP host connection
4. Electronics control module

- See "Ethernet Connectivity" on page 107 for more information.

Dual TCP/IP

Dual TCP/IP provides *two separate* host connections between the host software (ACSLS or HSC) and the library controller.

- Dual TCP/IP is an **active/active** design—when both communication paths are available, ACSLS and HSC use both of them to communicate with the SL8500.
  - HSC uses each path alternately.
  - ACSLS continuously monitors both connections using one path as primary and occasionally using the second path.

  This helps ensure that both paths are working properly so that if one fails, there is a high degree of confidence that the other path is operational.
- Both HSC and ACSLS detect when a path is unavailable and automatically re-send transmissions over the other path.

  The SL8500 also re-sends transmissions over the other path when a path becomes unavailable. After retrying for four to five minutes, ACSLS, HSC, and the SL8500 will mark a path as unavailable and just use the remaining path.
- When a path is marked as unavailable, ACSLS, HSC, and the SL8500 continues to monitor the path. When the path becomes available again, ACSLS, HSC, and the SL8500 will automatically re-connect.

  When HSC or ACSLS is connected to more than TCP/IP connection on a library, the connections should be through at least two different subnets for redundancy. If one subnet fails, communication between HSC or ACSLS and the library still continues over the other subnet(s).

  When HSC or ACSLS has two connections to one SL8500 HBC or HBCR card, you must configure the SL8500 and HSC mainframe or ACSLS server routing tables as described in the *SL8500 User's Guide, the ACSLS Administrator's Guide*, or the *HSC Systems Programmers Guide*.

  If you have only a single connection between the HSC host or the ACSLS server and each SL8500 HBC card, configuring the ACSLS and SL8500 routing tables is not necessary.

Multi TCP/IP

When SL8500 3.98b or higher firmware is installed, ACSLS or HSC can connect to more than one SL8500 in an ACS (library complex).

Configuring and managing Multi TCP/IP communication is simpler than Dual TCP/IP because routing tables do not need to be defined on the HSC host or ACSLS server and the SL8500 libraries. However, Multi TCP/IP requires a string of connected SL8500 libraries. It does not apply to single, stand-alone, SL8500 or SL3000 libraries.

Both HSC and ACSLS support multiple connections to a library complex (ACS).

- With release 6.2, 7.0, and 7.1 (with required PTFs), HSC supports the following connections from one host to the libraries in an ACS.

- PTFs for 32 connection are:
  - 6.2 - L1H15MF (VM) and L1H15ME (MVS)
  - 7.0 - L1H15MH
- PTFs for 40 connections:
  - 6.2 - L1H16HJ (VM) and L1H16HK (MVS)
  - 7.0 - L1H16HL
  - 7.1 - L1H16HM
- ACSLS supports up to 15 connections to the libraries in an ACS.

These connections can be to any library and to either the active or standby library controller, if Redundant Electronics (see below) is enabled. When HSC or ACSLS is connected to more than one library, the connections should be through at least two different subnets for redundancy. If one subnet fails, communication between HSC or ACSLS and the library still continues over the other subnet(s).

For ACSLS to optimize library performance and minimize inter-library communication among SL8500s, define your first connection (port 0) to the library with the most activity.

For more information, refer to the StorageTek SL8500 Modular Library System Technical Brief - Host to Library Communications.

Redundant Electronics

The optional SL8500 or SL3000 Redundant Electronics feature provides failover protection in enterprise libraries. If the library controller experiences errors, it automatically switches operations to an alternate library controller, with minimal disruption to library and host operations. This allows your Oracle support representative to replace the faulty card while the library continues normal operations.

The Redundant Electronics feature also provides minimal disruption of library operations during firmware upgrades.

> **Note –** The libraries offer redundancy in a variety of components, including robots and power systems. The term "Redundant Electronics" refers specifically to redundancy in the library and drive controller components.

The Redundant Electronics feature requires all of the following hardware components:

- Active library controller (HBC or HBCR) paired with the active drive controller (HBT)
- Standby HBC or HBCR paired with the standby HBT
- Other redundant components

For more information, refer to the *StorageTek SL8500* or *SL3000 User's Guide.*

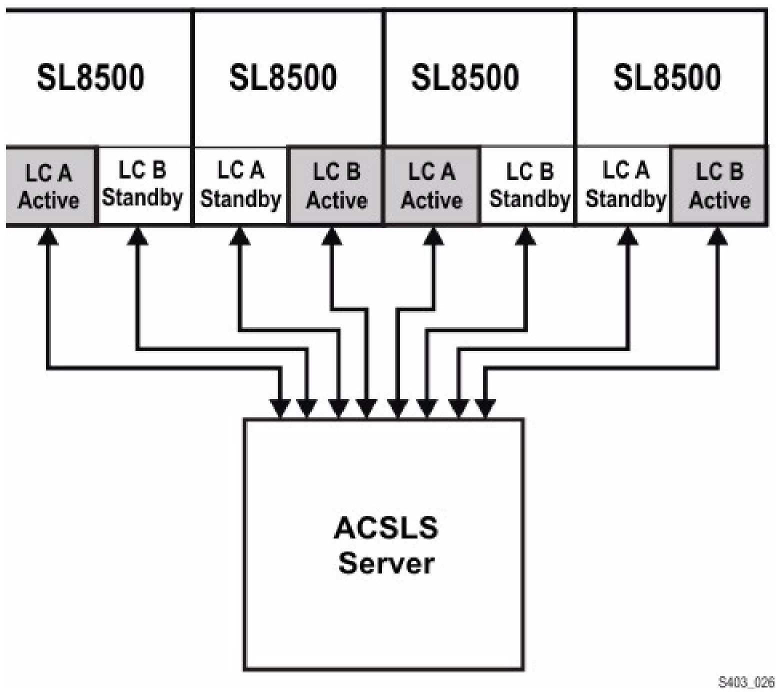
ACSLS and HSC Support for Redundant Electronics

ACSLS and HSC handle a mix of active and standby SL8500 Library Controller (LC) cards within a single library complex. This is more complex than the 9330 Dual LMU.

Note – All libraries in a complex do not need to be equipped with RE.

As shown in the following ACSLS example, either the A or B cards within each SL8500 can be the active controller card. Within some libraries the A cards are active, while in other libraries the B cards are active.

FIGURE 10-2 ACSLS with Redundant Electronics



Each library in a string of connected SL8500s can now have its own pair of A and B Library Controllers. HSC or ACSLS can communicate with all of the active LCs at the same time.

To support RE, both HSC and ACSLS queue requests during temporary library outages and retry the requests when the library is available again. These temporary library outages include RE switches between the active and standby library controllers and opening a library’s access door.

Switching between active and standby Library Controllers:

- The HSC “SWitch Acs acs-id LIBrary lib-id” command will force a switch between the active and standby library controllers. The HSC “SWitch” command can switch either a standalone library or an SL8500 in a connected string of SL8500s in a library complex.

- The ACSLS “switch lmu” command can be used to force a switch between library controllers in an SL3000 or a single SL8500 library. The “switch lmu” command cannot be used to switch one SL8500 that is connected to other SL8500s in a library complex.

Library Firmware Supporting Redundant Electronics

- SL8500 6.0x firmware is required to support Redundant Electronics.
- SL3000 3.0x firmware is required to support Redundant Electronics.

ACSLS Maintenance Required for Redundant Electronics

ACSLS 7.3.1 or 8.0.2 maintenance is required to support Redundant Electronics.

HSC Maintenance Required for Redundant Electronics

- 6.2
  - L1H15MF(VM)
  - L1H15ME(MVS)
- 7.0
  - L1H15MH (MVS)
- 7.1
  - included

Also for the HSC/ELS multi-RE PTFs, the connections will be increased to 40.

11

Partitioning

The definition of a **partition** according to the Merriam–Webster dictionary is:

1. To divide into parts or shares.
2. To separate or divide by a partition, such as a wall.

In computing, many people are familiar with hard disk drive partitioning to create several logical divisions on the same hard drive. This separation allows administrators to apply different operating system functions, files, and formatting to the same physical hard drive. In layman's terms, partitioning a hard drive makes it appear to be more than one hard drive.

The SL8500 Modular Library System now provides the ability to partition the library—within hardware boundaries—to support from one to eight physical partitions.

Purpose

Partitioning the SL8500 library means you can have:

- More than one operating system and application manage the library.
- An improvement in the protection or isolation of files.
- An increase in system and library performance.
- A higher level of data organization.
- An increase in user efficiency.

Partitions may be customized to fit different requirements, for example:

  - allowing for special partitions to protect or archive data
  - enabling multiple organizations, companies, or departments access
  - isolating clients (such as for service centers)
  - separating different encryption key groups
  - dedicating partitions as test systems for new technologies or data migration to new tape drives

Legacy and Enhanced Partitioning

SL8500 partitioning was implemented in two phases:

- Legacy SL8500 partitioning support:

  Each rail is the smallest element of a partition, but partitions may include more than one rail. If a partition includes more than one rail, those rails must be adjacent. A partition also includes all the drives on the rails assigned to it.

  Legacy SL8500 partitioning is supported by these minimum software levels: SL8500 firmware FRS_3.7x, SLC version FRS_3.25, ACSLS Release 7.1 with PUT0701, ACSLS HA 2, and NCS 6.1 with selected PTFs.

- Enhanced SL8500 partitioning:

  Enhanced partitions now support up to 8 native physical partitions. Partition boundaries can be as small as a single array of storage cells and one tape drive. Partitions now support non-contiguous resource assignments. Partitions are set up using the StorageTek Library Console. CAPs and Robotics are a shared library resource and are not assigned to specific partitions.

  Enhanced SL8500 partitioning support requires these minimum software levels: SL8500 firmware FRS_7.0x, SLC version FRS_5.5x, ACSLS 7.3.1 or 8.0.2 maintenance levels, ACSLS HA 3 or 8, and ELS with required PTFs. (See the full list of software and firmware requirements on page 118.)

This chapter focuses on enhanced SL8500 partitioning. It is more flexible than legacy partitioning support, and legacy partitioning support is a subset of enhanced partitioning support.

Guidelines

Essential elements for understanding partitions are:

- Clear communication occur between the system programmers, network administrators, both ACSLS and HSC administrators, and Oracle service representatives.
- Only a single library may be partitioned—pass-thru port (PTP) operations are not allowed. However, if libraries are currently connected using PTPs, and you want to keep that structure for future development; a service representative can disconnect the local network interface and connections within the library to disable this configuration. *You will not need to disassemble the complex.*
- You must be current on maintenance levels of their library management software (ACSLS and HSC). See the software and firmware requirements on page 118.
- Depending on the library configuration, each rail has:
  - Minimum capacity of *362* cartridges.

    The basic configuration of an SL8500 library is 1,448 cartridges; spread across four LSMs provides 362 cartridges per rail.

  - Maximum capacity of 2,522 cartridges.

    The maximum configuration of an SL8500 library is 10,088 cartridges; spread across four LSMs provides 2,522 cartridges per rail.

  - From 1 to 16 tape drives.

- Hosts with a common database—HSC hosts using a common Control Data Set (CDS)—can share a partition; these hosts are called a "host group."

  A single HSC CDS can manage more than one partition within the same SL8500 library.

- A single ACSLS server can manage multiple partitions in the same library. Each partition is configured as a separate ACS.

- When partitioned, the library controller reports cells and drives assigned to another partition within the library as not present or installed. This provides two things:

  - It displays the entire library, and

  - If partitioning is changed (cells and/or drives added to or removed from a partition), cartridge and drive locations remain constant.

Remember:

- Elevators, robots, and CAPs are *shared resources* and—each partition can fully use shared resources for cartridge movement, enter, and eject operations. All drives, storage slots and cartridges within a partition are solely owned by that host or host group.

- One partition cannot access cells, cartridges, and drives assigned to another partition.

- Elevator operation is under the control of the library controller when CAP operations are issued. The library controller uses the elevators and HandBots to access the entire capacity of the CAPs for enters and ejects without regard for the partitions.

- Partitions share the ownership of the CAPs. That is, if one host/partition has CAP A reserved, a different host/partition can have CAP B reserved, or one host/partition can have both CAPs reserved.

  See"CAPs and Partitions" on page 122 for more information.

- Automatic mode is not supported for CAPs in a partitioned library.

- Duplicate VOLSERs are supported by the library; however, ACSLS and HSC do not, unless:

  - The duplicate VOLSERs are in different partitions.

  - With HSC managed partitions, the duplicate VOLSERs are in different control data sets.

  - With ACSLS managed partitions, the duplicate VOLSERs are managed by different ACSLS servers.

    Warning – If cartridges with a duplicate VOLSER are managed by different partitions and one of these cartridges is in-transit when a Redundant Electronics switch occurs or the library is re-booted, the library may not know which partition owns the cartridge. The library may report the cartridge to all partitions, and the cartridge may be recovered by the wrong partition and added to that partition.

- Library complex considerations:
  When breaking apart an established library complex to partition libraries within it, you need to understand the numbering and addressing scheme of the library.
- All cell arrays and drives do not need to be included in a partition, they can remain unassigned to allow for future growth.

Software and Firmware Requirements

Requirements for enhanced partitioning in the SL8500 library include:

- Order number: SL8500-UPG-PART
- Upgrade number: XSL8500-UPG-PART
- SL8500 firmware FRS_**7.0x** or higher
- SL Console at Version FRS_**5.5x** or higher
- ACSLS 7.3.1 or 8.0.2 maintenance levels
- ACSLS HA 3 with update patch, 143988-01, or ACSLS HA 8
- NCS (NearLine Control Solution) Version 6.2
- HSC (MVS) Version 6.2 with required PTFs
- HSC (VM) Version 6.2 with required PTFs
- VSM (Virtual Storage Module) all supported versions
- ExPR (Expert Performance Reported) with PTF L1E025H
- LCM (Library Content Manager)
  - Version 6.0 with PTF L1L00F6,
  - Version 6.1 (none),
  - Version 6.2 with PTF L1L00F7

Hosts without the latest level of software (ACSLS or HSC) or without the latest maintenance will not be able to manage a partitioned ACS online.

> **Note –** Software and firmware levels can be downloaded and ready in advance of activation. When the time and window is available, these codes can be activated. This preparation can limit down time of the library and operating system.

Planning and Capacities

Refer to the *StorageTek SL8500 Modular Library System User's Guide* for partition planning and capacities.

Getting Started

TABLE 11-1 Steps and Tasks for Partitioning

Step	Task	Reference	Responsibility*
1. Team	Create a Team. When planning for partitions, using a process similar to that of the system assurance process, which is the exchange of information among team members. Team members should include representatives from both your team and Oracles' to ensure that all aspects of the process are planned carefully and performed efficiently.		• Customer • SE, ACS • Svc Rep
2. Codes	Review the software and firmware requirements. Update as required.	"Software and Firmware Requirements" on page 118	• Customer • SE, ACS • Svc Rep
3. Planning	• Create a planning team • Define your expectations • Complete the assessment • Identify the configurations • Complete the planning diagrams	"Planning" on page 120	• Customer • SE, ACS • Svc Rep
4. Media	• Verify the distribution of cartridges and required tape drives are available and ready.		• Customer
5. Library	• Convert a library complex (if necessary).		• Svc Rep
6. Enable	• License and enable partitioning.	"Enabling Partitions" on page 121	• Svc Rep
7. Hosts	• Momentarily stop all host activity. • Make the hosts inaccessible.	"Host Software Precautions" on page 121	• Customer
8. Use	Instruct the customer how to: • Partition and re-partition the library • Override a CAP reservation	"Assigning Partitions" on page 121	• Customer • Svc Rep

SE = Systems Engineer
ACS = Oracle's Advanced Customer Support
Service = Service Representative (Svc)
Customer = System administrators, network administrators, system programmers, operators.

Planning

Team members should include representatives from both your team and Oracle to ensure that all aspects of the process are planned carefully and performed efficiently. Tasks include:

- Identify and define your requirements and expectations
- Identify the proposed configurations
- Complete the following assessment:

Is this a new installation or an existing installation?	New: Existing: If existing, cartridge migration may be required to configure the partitions correctly. Cartridge migration required? Yes No
How many partitions are there going to be in the library?	
How many cells and drives are there going to be for a partition?	
What is the name and purpose for each partition?	
What type of operating systems for each partition?	
What type of library management software for each partition? Make sure you have the latest versions and updates. See page 118 for information.	ACSLS: HSC: ACSLS: HSC: ACSLS: HSC: ACSLS: HSC:
What type of applications are being used?	
How many cartridges are needed for each partition?	
How many free slots are needed for each partition?	

What are the tape drive types and quantities? Try to assign the cells and drives for a partition from as few rails as possible.	

- Complete a plan using the figures in this chapter as an example.
- Place this information with the library.

Enabling Partitions

Partitioning is an optional feature that you can purchase.

Once purchased, you download the Hardware Activation File that enables partitioning from Oracle E-Delivery. You can then use SL Console to install the hardware activation key on the library.

Host Software Precautions

Important:

When you partition or re-partition a library, you do not have to reboot (IPL) the library. However, when you *apply* the changes to the partitions, the library takes the LSM(s) in the partitions offline temporarily. For this reason, it is best to minimize any disruptions to the operating systems and library management software before you partition.

- The amount of time the library goes offline is minimal.
- This action affects the *whole library* whether we think it may not.
- Any changes of this type are considered disruptive.

An example of a procedure that all hosts (ACSLS or HSC) should follow when partitioning or changing partitions is:

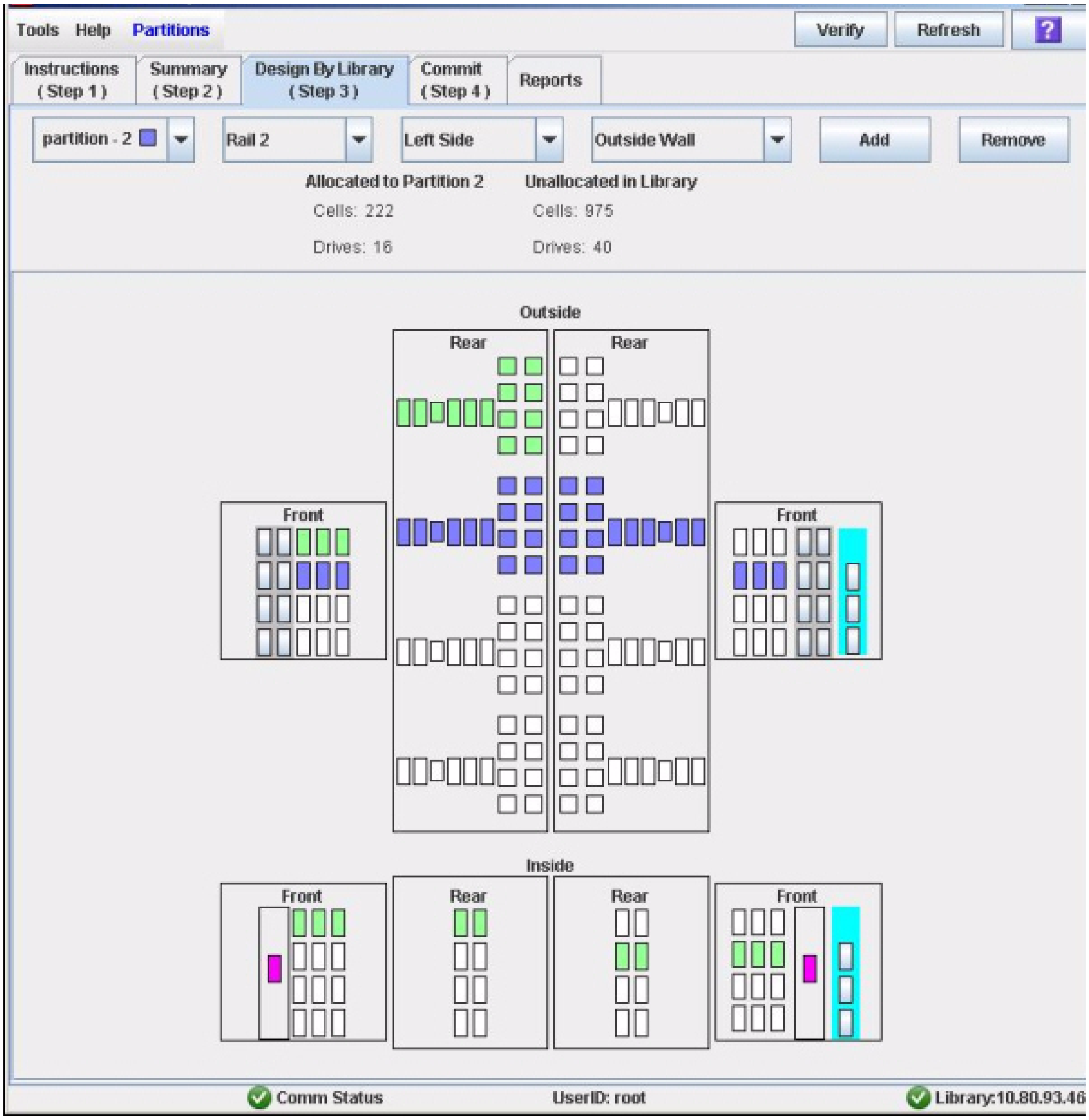
1. Plan the distribution of cartridges (such as enters, ejects, and moves).
2. If any resources will be removed from a partition, momentarily stop enters and ejects and any moves. ACSLS and HSC will queue mounts and dismounts during the outage and retry them after the outage.
3. Using the touch screen operator panel or remote SLC software, change the partitioning configuration.
4. If drives or CAPs were added to or removed from your partition, you must re-configure your host (ACSLS or HSC). If cell arrays were added to or removed from the partition, you must audit the library.
5. Restart the host activity.

Assigning Partitions

The SL Console allows you to allocate drives and cell arrays to each partition as shown in FIGURE 11-1 on page 122.

Refer to the *StorageTek SL8500 Modular Library System User's Guide* for additional information and procedures for allocating library resources to partitions.

FIGURE 11-1 Allocating Drives and Cell Arrays to Partitions



CAPs and Partitions

- A second CAP is *not* required to support partitioning.
- CAPs are a shared resource—that is, CAPs can be used by all partitions in the library; however, they can only be used by *one partition at a time*.
  - That is, if one partition has CAP A reserved, a different partition can have CAP B reserved, or one partition can have both CAPs reserved.

  - One partition can be doing an enter, while another partition is doing an eject or two partitions doing enters or two partitions doing ejects.
- While a partition is using a CAP (for enters or ejects), the CAP is reserved to that partition and is unavailable to all others.
- Automatic mode is *not* supported in a partitioned library. This change may be an operational change for some.

Reserving the CAP

In order for a partition to reserve a CAP, the following conditions must be met:

- The CAP must be available and not reserved by any other partition.
- The CAP must be empty.
- The CAP must be closed and locked.

Each host must *reserve* the CAP to use it; and then *unreserve* it to release the CAP for another host.

> **Note –** ACSLS and HSC reserve a CAP when they start an enter or eject operation; and release the CAP using either a *cancel* (ACSLS) or *drain* (HSC) command.

A

Structural Elements

This appendix describes the library walls, explains how the numbering scheme works, and tape drive locations and numbers.

Types of Library Walls and Storage Slots

The SL8500 library has two types of walls:

- *Outer* walls–consist of 13-slot arrays with space for the robotic rails
- *Inner* walls–consist of 14-slot arrays with gaps for the robotic rails

A service area is in the front of the Customer Interface Module that is reserved for the diagnostic and cleaning cartridges (198 slots).

In addition to the 13- and 14-slot arrays, there are:

- 8-slot arrays in columns 6 and -6 with the pass-thru ports
- 4-slot arrays for the elevators and pass-thru ports
- 3-slot arrays at the end of each rail—near the end stops.

Each array has *two targets* centered vertically with allowances that accommodate the different sizes and depths of the tape cartridges.

Cartridges placed in cells lie flat, hub down, and parallel to the floor. To prevent slippage, cartridges are held within their cells by internal cartridge retention feature.

Aisle space between the inner and outer walls is limited to 0.5 m (18 in.). Because of this, entry into the library beyond the maintenance area should be limited.

Internal Addressing Design

Cartridge cell locations in previous libraries were listed by: Panel, Row, and Column.

Cartridge slot designations in an SL8500 library uses five parameters:
Library, Rail, Column, Side, Row (L,R,C,S,W):

- Library: Is the number of that library or within a library complex
- Rail: Rails are numbered top down from 1 – 4 with rail 1 being on top.
    - Each rail is considered a separate library storage module (LSM).

  - LSMs are numbered 0 – 3 (top down).
- Column: Indicate the *horizontal* location of a tape cartridge are “assigned” numbers referenced from the center of the drive bay at the rear of the library forward, where:
  - +1 is just *right* of the center of the drive bays and
  - -1 is just to the *left* of the drive bays

  Column numbering is consecutive—the first columns that contain tape cartridges are +3 and -3 and continue forward to the front access doors.

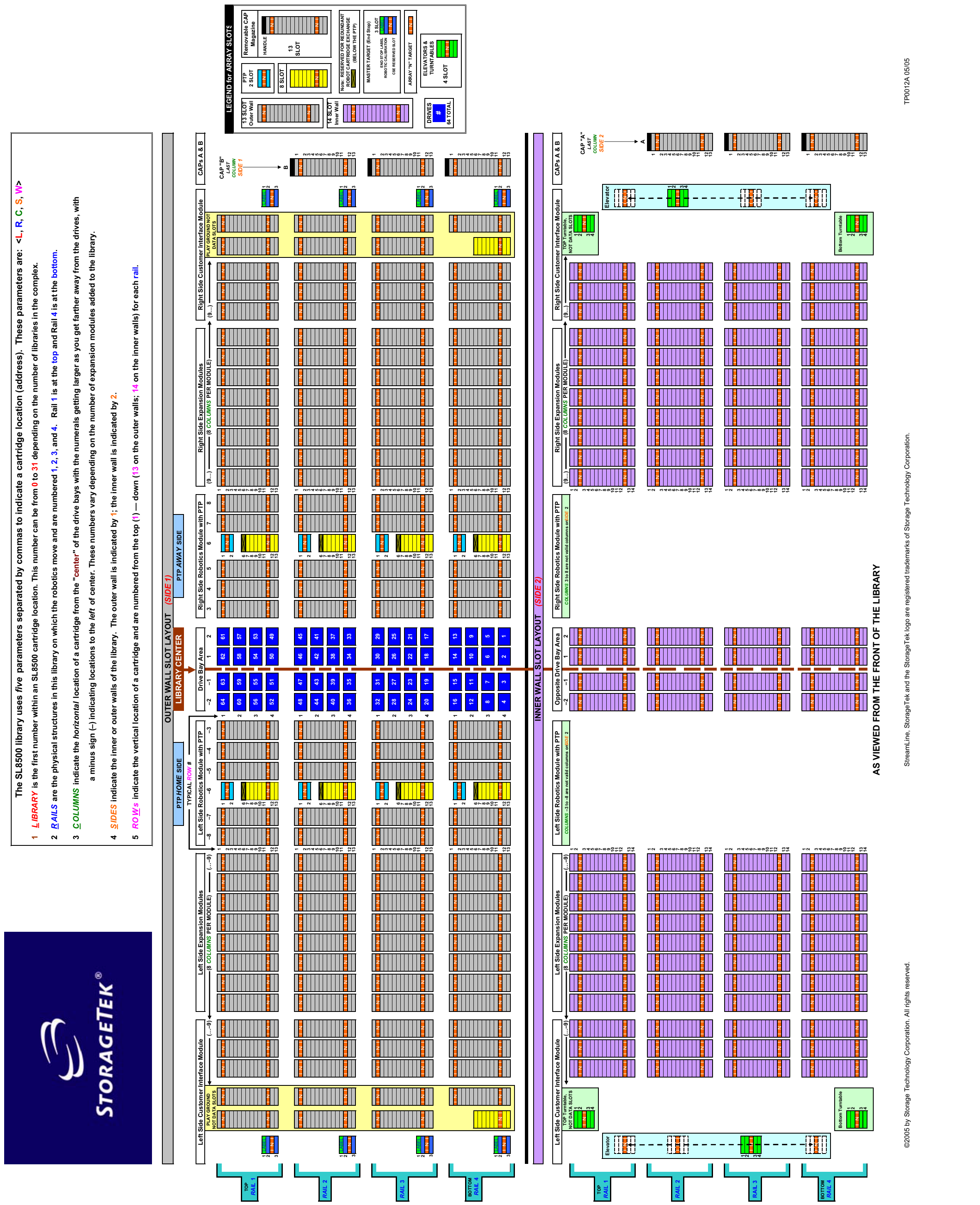
  > **Note –** Floor labels can be placed inside the library to help identify column numbers and locations—part number: 314864902.

- Side: Indicates the inner and outer walls, or left and right HandBots in a redundant configuration.
  - Outer wall = 1, Inner walls = 2
  - Left HandBot = 1, Right HandBot = 2
- Row: Is the *vertical* location of a tape cartridge and are consecutively numbered from the top (1) down (13 outer wall and 14 inner wall).

FIGURE A-1 on page 127 uses the *Internal Addressing Poster* an example of how the numbering scheme works. These posters measure 36 -by- 24 inches (91 -by- 61 centimeters).

FIGURE A-1 Internal Addressing Map

Poster—Part Number TP0012



These posters can be ordered through Sun Learning Services (SLS).

Tape Drives

All of the tape drives in the SL8500 library are physically located in the Drive and Electronics Module and are identified in the same way that the tape cartridges are—using the five parameters: Library, Rail, Column, Side, and Row. TABLE A-1 on page 129 shows the addressing scheme for the tape drives.

TABLE A-1 Tape Drive Numbering

(Looking at the rear of the library)

Library[1]	Rail[2]	Column[3]				Side[4]	Row[5]
		2	1	-1	-2		
		61	62	63	64		1
		57	58	59	60		2
		53	54	55	56		3
	1	49	50	51	52		4
		45	46	47	48		1
		41	42	43	44		2
		37	38	39	40		3
	2	33	34	35	36		4
		29	30	31	32		1
		25	26	27	28		2
		21	22	23	24		3
	3	17	18	19	20		4
		13	14	15	16		1
		9	10	11	12		2
		5	6	7	8		3
1 - 32	4	1	2	3	4	1	4
		2	1	–1	–2		
Library[1]	Rail[2]	Column[3]				Side[4]	Row[5]

1. **L**ibrary, 1 through 32
2. **R**ail, which corresponds to the LSM, 1 through 4, (top down)
3. **C**olumn, relative to the centerline (as viewed from rear outside)
4. **S**ide, always 1 (tape drives are only on the outer wall)
5. Ro**w**, 1 through 4 (top down)

For example:
1, 2, -1, 1, 3 would be drive 39
1, 1, -2, 1, 1 is drive 64

The tape drives are associated with and belong to an *LSM*. To mount a cartridge tape in a different LSM, the cartridge must go through an internal pass-thru operation (in this case, *the elevator*) to the drive.

TABLE A-2 shows both the internal—software—mapping (viewed from looking *inside* the library at the tape drives), and the **external**—physical—numbering of the drives (looking *outside* at the rear of the Drive and Electronics Module).

TABLE A-2 Software Drive Numbering and Physical Drive Numbering

LSM	Internal Software (ACSLS or HSC)—Drives Numbers				External—Physical Drive Numbers			
	Drive 0	Drive 4	Drive 8	Drive 12	Drive 61	Drive 62	Drive 63	Drive 64
	Drive 1	Drive 5	Drive 9	Drive 13	Drive 57	Drive 58	Drive5 9	Drive 60
Rail 1	Drive 2	Drive 6	Drive 10	Drive 14	Drive 53	Drive 54	Drive 55	Drive 56
LSM 0	Drive 3	Drive 7	Drive 11	Drive 15	Drive 49	Drive 50	Drive 51	Drive 52
	Drive 0	Drive 4	Drive 8	Drive 12	Drive 45	Drive 46	Drive 47	Drive 48
	Drive 1	Drive 5	Drive 9	Drive 13	Drive 41	Drive 42	Drive 43	Drive 44
Rail 2	Drive 2	Drive 6	Drive 10	Drive 14	Drive 37	Drive 38	Drive 39	Drive 40
LSM 1	Drive 3	Drive 7	Drive 11	Drive 15	Drive 33	Drive 34	Drive 35	Drive 36
	Drive 0	Drive 4	Drive 8	Drive 12	Drive 29	Drive 30	Drive 31	Drive 32
	Drive 1	Drive 5	Drive 9	Drive 13	Drive 25	Drive 26	Drive 27	Drive 28
Rail 3	Drive 2	Drive 6	Drive 10	Drive 14	Drive 21	Drive 22	Drive 23	Drive 24
LSM 2	Drive 3	Drive 7	Drive 11	Drive 15	Drive 17	Drive 18	Drive 19	Drive 20
	Drive 0	Drive 4	Drive 8	Drive 12	Drive 13	Drive 14	Drive 15	Drive 16
	Drive 1	Drive 5	Drive 9	Drive 13	Drive 9	Drive 10	Drive 11	Drive 12
Rail 4	Drive 2	Drive 6	Drive 10	Drive 14	Drive 5	Drive 6	Drive 7	Drive 8
LSM 3	Drive 3	Drive 7	Drive 11	Drive 15	Drive 1	Drive 2	Drive 3	Drive 4

These tables show a matching of drives (the highlighted drives). *For example:*

- Internal/software LSM 0 Drive 0 matches with external/physical Drive 64.
- Internal LSM 1 Drive 15 matches with external/physical Drive 33.
- Internal LSM 2 Drive 3 matches with external physical Drive 20.

A default behavior of some tape management software (such as ACSLS) is to dismount the drive and leave the cartridge in the same LSM (rail). This depends on software features such as fixed volume location, float/no float, or extended store.

B

SL8500 Terminology and Specs

This appendix provides additional SL8500 modular library system terminology and specifications.

Terminology

TABLE B-1 Terminology

Term	Explanation
Away library	For two libraries connected by PTPs, the away library is the library on the *left* side of the home library (as referenced from the front of both libraries). The away library does not supply power to, control, or recover the PTP. SL8500 libraries are joined together by four PTPs because there are four rails. **Note:** Internal racks and Ethernet switches are required for PTP operations.
CAP	Located on the right access door. CAP A is standard (39-slots); CAP B is optional.
Cartridge expansion module (CEM)	One to five expansion modules can be added to the basic configuration.
Elevators	Devices that transports cartridges vertically, across rail boundaries. This amounts to pass-thru operations. Two elevators are standard.
Export	A specified cartridge is placed into the CAP by a HandBot for removal by the operator

TABLE B-1 Terminology

HandBots	Components that moves linearly along a rail and vertically along their own Z columns. The linear path is "U-shaped" rather than circular. The track shape and the ability to handle multiple HandBots is termed StreamLine RaceTrackTM architecture. Handbots store and retrieve cartridges. Handbots read cartridge VOLIDs: • When entered through a CAP • During a physical audit • During some error recoveries to verify a single drive or slot location Since the location and VOLIDs of cataloged cartridges are resident on the HBC card, VOLIDs are not read during normal mount/dismount/move activities; mounts/dismounts are done by "dead reckoning".
Home library	For two libraries connected by PTPs, the home library is the library on the right, supplying power and signals through its *left* side (as referenced from the front of both libraries) to the PTP. Either library can initiate PTP activity. *Home* denotes the library supplying power and communication to the PTP. Two SL8500 libraries are joined together by *four* PTPs because there are four rails per library. An SL8500 library PTP can only perform a PTP operation to another adjacent library. **Note:** Internal racks and Ethernet switches are required for PTP operations. See Away library above.
Import	Enter a cartridge through the CAP.
Library complex	Two or more libraries joined together with multiple PTPs. In this configuration, all libraries operate in a peer-to-peer relationship. The concepts of "master" and "standby" do not apply to SL8500 libraries. It is referred to as an ACS by ACSLS and HSC.
Physical audit	Cartridge volume identifiers (VOLIDs) and locations are stored within the library's memory. A physical audit is performed at power-on or when access doors are closed.
Rack area	Up to four internal 48 cm (19-in.) racks are available for qualified customer hub and switch components. **Note:** Internal racks and Ethernet switches are required for PTP operations.
Rail	Each rail within an SL8500 is designated as one LSM (4 LSMs per SL8500 Library) by host software. A power rail is one of four sections in a library that provides: • Power and communications for HandBot electronics • A track for HandBots to put and get cartridges to or from a slot or tape drive, elevator, PTP, or CAP.

TABLE B-1 Terminology

Size/capacity	Determined by the number of modules installed: three are required (1448 cartridges), but an additional five storage expansion modules can be added for a total of over 10,000 cartridges. Slots are enabled to allow "capacity on demand."
SL8500 Modular Library	A single unit composed of at least three modules (drive and electronics module, robotics interface module, customer interface module); up to five cartridge expansion modules may be added.
Tape drive capacity	From 0 to 64, with 16 per drive array assembly
Verified audit	Through an SL Console command, cartridge VOLIDs and locations are validated.
Virtual audit	Cartridge database is displayed through StreamLine Library Console.
Wrist	Describes outer-to-inner wall HandBot motion.
Z motion	Describes the vertical path of a HandBot hand assembly

Library Capacities

- TABLE B-2 on page 133 shows weights, measures, and capacities
- TABLE B-3 on page 136 shows power requirements

TABLE B-2 SL8500 Library

Measurements	
Modular Library	
Height:	236.6 cm (93.15 in.)
Width:	170.8 cm (67.25 in.)
Length: Base library 1 expansion module 2 expansion modules 3 expansion modules 4 expansion modules 5 expansion modules	 276.9 cm (109 in.) 372.1 cm (146.5 in.) 467.4 cm (184 in.) 562.6 cm (221.5 in.) 657.8 cm (259 in.) 753.1 cm (296.5 in.))
Note: One of the benefits of the SL8500 is the consolidation LMU, LCU, Drive Cabinets, and LSM within the SL8500. Plus additional consolidation with internal rack space for network components.	
Total Area (64 drives)	9.6 m2 (103.4 ft2)
Weight	
Base library Empty Loaded	 1497 kg (3,300 lb) 2835 kg (6,250 lb)

TABLE B-2 SL8500 Library (Continued)

1 expansion module Loaded	1883 kg 4,150 lb) 3640 kg (8,025 lb)
2 expansion modules Loaded	2268 kg (5,000 lb) 4445 kg (9,800 lb)
3 expansion modules Loaded	2654 kg (5,850 lb) 5250 kg (11,575 lb)
4 expansion modules Loaded	3039 kg (6,700 lb) 6055 kg (13,350 lb)
5 expansion modules Loaded	3425 kg (7,550 lb) 6860 kg (15,125 lb)
Total Weight (64 drives)	5250 kg (11,575 lb)
Front	66 cm (26 in.)
Rear	85 cm (33.5 in.)
Pass-thru ports	15.25 cm (6 in.)
Door width	10.16 cm (4 in.)
Planning Requirements	
Raised Floor Loading	260 kg/m2 (120 lb/ft2)
Loading per pad	454 kg (1,000 lb)
Distribution pads	26 (with 3 expansions)
Assembly area	56 m2 (600 ft2)
Power Requirements	
Voltage	200 to 240 VAC
Frequency	47 to 63 Hz
Phases (Current)	
Single Phase	3 inputs (24 Amps) 6 redundant
Three Phase: (recommended)	Delta (40 Amps) Wye (24 Amps) SUVA (24 Amps)
Minimum system (16 drives)	3.32 kW 11,320 Btu/hr
Maximum system (64 drives, plus 8 HandBots, 4 racks)	12.27 kW 41,840 Btu/hr

TABLE B-2 SL8500 Library (Continued)

Capacities	
Tape drives (max) single library complex	 64 640
Tape cartridges (max) single library complex	 10,088 100,880
Storage Density	59 cartridges per 0.1 m2 (1 ft2)
Libraries in a Complex	31 (ACSLS) or 32 (HSC)
Cartridge Access Ports	39-slots standard 39-slots optional 78 total
Storage (Tape Cartridges) - uncompressed	
Single Library T9840 A (20 GB) T9840 B (20 GB) T9840 C (40 GB) T9840 D (75 GB) T9940 B (200 GB) T10000A (500 GB) T00000B (1 TB) T10000C (5 TB) LTO Gen 2 (200 GB) LTO Gen 3 (400 GB) LTO Gen 4 (800 GB) LTO Gen 5 (1.5 TB)	1,000 cartridges (min.) 20 TB 20 TB 40 TB 75 TB 200 TB 500 TB 1 PB 5 PB 200 TB 400 TB 800 TB 1.5 PB
Complex (10 libraries) T9840 A (20 GB) T9840 B (20 GB) T9840 C (40 GB) T9840 D (75 GB) T9940 B (200 GB) T10000A (500 GB) T00000B (1 TB) T10000C (5 TB) LTO Gen 2 (200 GB) LTO Gen 3 (400 GB) LTO Gen 4 (800 GB) LTO Gen 5 (1.5 TB)	100,000 cartridges 2 PB 2 PB 4 PB 7.5 PB 20 PB 50 PB 100 PB 500 PB 20 PB 40 PB 80 PB 150 PB

TABLE B-2 SL8500 Library (Continued)

Native Tranfer Rate	
Single Library	64 drives
T9840 A (10 MB/s)	2.3 TB/hr
T9840 B (19 MB/s)	4.4 TB/hr
T9840 C (30 MB/s)	6.9 TB/hr
T9840 D (30 MB/s)	6.9 TB/hr
T9940 B (30 MB/s)	6.9 TB/hr
T10000A (120 MB/s)	27.6 TB/hr
T00000B (120 MB/s)	27.6 TB/hr
T10000C (240 MB/s)	55.3 TB/hr
LTO Gen 2 (32-35 MB/s)	8.1 TB/hr
LTO Gen 3 (40 MB/s)	9.2 TB/hr
LTO Gen 4 (120 MB/s)	27.6 TB/hr
LTO Gen 5 (140 MB/s)	32.3 TB/hr
Complex (10 libraries)	640 drives
T9840 A (10 MB/s)	23 TB/hr
T9840 B (19 MB/s)	44 TB/hr
T9840 C (30 MB/s)	69 TB/hr
T9840 D (30 MB/s)	69 TB/hr
T9940 B (30 MB/s)	69 TB/hr
T10000A (120 MB/s)	276 TB/hr
T00000B (120 MB/s)	276 TB/hr
T10000C (240 MB/s)	553 TB/hr
LTO Gen 2 (32-35 MB/s)	81 TB/hr
LTO Gen 3 (40 MB/s)	92 TB/hr
LTO Gen 4 (120 MB/s)	276 TB/hr
LTO Gen 5 (140 MB/s)	323 TB/hr

TABLE B-3 Power Requirement Comparisons

SL8500 ~ A Quick Reference

SL8500 modular library system						
4 Robots		**Watts**		**8 Robots**	**Watts**	
Component	**Qty**	**Idle**	**Max**	**Qty**	**Idle**	**Max**
Modular Library	1	200	1500	1	400	3000
Control Module	1	100	100	1	100	100
Control Module	2	200	200	2	200	200
Rack space (base)			1440	—	—	1440
Rack space (redundant)			2880	—	—	2880
Tape Drives:						

TABLE B-3 Power Requirement Comparisons

SL8500 ~ A Quick Reference

SL8500 modular library system						
4 Robots		**Watts**		**8 Robots**	**Watts**	
Component	**Qty**	**Idle**	**Max**	**Qty**	**Idle**	**Max**
T9x40	4	344	432	4	344	432
	16	1370	1728	16	1370	1728
	20	1720	2160	20	1720	2160
	40	3440	4320	40	3440	4320
	64	5504	6192	64	5504	6192
LTO	4	180	280	4	180	280
	16	720	1120	16	720	1120
	20	900	1400	20	900	1400
	40	1800	2800	40	1800	2800
	64	2880	4480	64	2880	4480
Example (maximum case): For a SL8500 with 4 robots, 2 ECM's and 16 T9X40 drives: 1500 + 200 + 1728 = 3428 watts				Example (maximum case): SL8500 with 8 robots and 16 T9X40 drives: 3000 + 200 + 1728 = 4928 watts		

Glossary

This glossary defines terms and abbreviations in this and other product related publications.

Numerics

2N
A PDU that supplies power to the redundant AC power grid and the third and fourth accessory racks. *See also* N+1.

A

access door
A door on either side of the front facade through which service personnel can enter the library. Optional CAPs are attached to the right access door.

accessory rack
An area of the drive and electronics module that is used for Product Name library electronic and power equipment and for other standard 19-inch rack-mount electronic equipment. Up to four racks are permitted in the electronics/drive assembly. Rack-mount equipment must be on the approve d equipment list.

ACS (Automated Cartridge System)
A group of libraries connected via pass-thru. *Synonymous with* “library complex”.

ACS Library Software (ACSLS)
Manages contents of multiple libraries and controls library hardware to mount and dismount cartridges on tape drives. Generally used by Open Systems clients.

asynchronous (ASYNC)
Not synchronized; not occurring at regular, predetermined intervals. Asynchronous transmissions send one data character at a time, at irregular intervals, rather than in one steady stream; a start bit and a stop bit notify the receiver when the transmission begins and ends. *Contrast with* synchronous.

audit
See host audit and security audit.

automation bezel
A tape drive attachment with a locator target for positioning gets and puts to the tape drive.

B

backplane
The main circuit board inside electronic equipment that contains the central processing unit, the bus, memory sockets, expansion slots, and other components.

bar code line scan camera
A component of the robot that is used for cartridge identification and position calibration.

blind mate connector
A connector that allows hot plugging instead of manually placing a cable between two fixed connectors.

bulk load
Manually loading cartridges into the library, for example, during library installation.

C

CAP
See cartridge access port.

card
Synonymous with printed wire assembly.

cartridge access port (CAP)
A bi-directional port built into the door panel of an LSM, which provides for the manual entry or automatic ejection of data or cleaning cartridges.

Synonymous with import/export mail slot in SCSI and open system libraries.

cartridge bias
Left or right justification of a cartridge within a storage cell, CAP, or tape drive.

cartridge expansion module
An optional module for the Product Name library that provides up to 1728 additional cartridge storage slots. From one to five modules can be attached to each library.

cartridge mover
See robot.

cartridge proximity detector
A component that determines if a cell is empty or contains an unlabeled cartridge during a label reading error recovery procedure. *Synonymous with* empty cell detector.

CCD
(1) Charge couple device.

(2) Cell contents database.

cell
The location in the library in which a tape cartridge is stored. *Synonymous with* slot.

cell array
An array that holds multiple cartridges when not in use.

The Product Name library uses 8-cell, 13-cell, and 14-cell arrays for cartridge storage.

cleaning cartridge
A tape cartridge that contains special material to clean the tape path in a transport or drive.

CLI
Command line interface.

client server model
Where two HCS or HSC/VTCS servers support many SMC clients, with one HSC or HSC/VTCS server being the primary server.

cold swap
To remove and replace a system component (typically one such as a logic board that has no redundant backup) after system operations have been stopped and system power has been disabled. *Contrast with* hot swap.

CompactPCI (cPCI®)
Industry standard bus used for card-to-card bus expansion.

cPCI
See CompactPCI.

customer interface module
The front module of the SL500 library at which you has access to the touch screen operator panel and service personnel have access to the library and service bay.

D

data cartridge
A term used to distinguish a cartridge onto which a tape drive may write data from a cartridge used for cleaning or diagnostic purposes.

diagnostic cartridge
A data cartridge with a “DG” label that is used for diagnostic routines.

DLE
Data link escape.

drive and electronics module
The module in an Product Name library that houses the electronics control module, power distribution units (PDUs), power supplies, accessory racks and equipment, and tape drives for the library.

drive array assembly
An array that is installed in the drive and electronics module for mounting tape drive tray assemblies. The drive and electronics module holds up to four array assemblies, and each array holds up to 16 tape drive tray assemblies.

drive bay
A partitioned section of the tape drive array assembly that holds one tape drive tray assembly.

drop-off cells
Cells used to hold a cartridge in the event of a robot failure that occurs while a cartridge is in the robot hand.

Dual TCP/IP
Provides two separate host connections between the host software (ACSLS or HSC) and a library.

E

ECM
See electronics control module.

ELS
See Enterprise Library Software.

eject
ACSLS and HSC. synonym for export.

electronics control module
The assembly that:

- Processes commands from a host system
- Coordinates the activities of robots, elevators, pass-thru ports, and tape drives
- Monitors status inputs from sensors and switches

elevator
The device that transports cartridges vertically, across rail boundaries.

emergency power-off (EPO)
(1) A safety scheme that allows a "power down" of a subsystem or a system as a whole instead of powering it down component-by-component.

(2) A safety switch on a machine or in a data center that allows a user to immediately power down a machine or a data center power supply by cutting off the external source power.

enter
See import.

Enterprise Library Software (ELS)
The software products that automate tape operations for mainframe users.

Enterprise Systems Connection (ESCON)
(1) A set of fiber-optic based products and services developed by IBM that allows devices within a storage environment to be dynamically configured. A channel-to-control unit I/O interface that uses optical cables as a transmission medium.

environmental monitors
A collective term for the sensors that track temperatures, fan speeds, and the status of various other mechanism within a library.

EPO
See emergency power-off.

ESCON
See Enterprise Systems Connection.

Ethernet
A local-area, packet-switched network technology. Originally designed for coaxial cable, it is now found running over shielded, twisted-pair cable. Ethernet is a 10- or 100-megabytes-per-second LAN.

export
The action in which the library places a cartridge into the cartridge access port so that the operator can remove the cartridge from the library. *Synonymous with* eject.

F

failover

The act of moving to a secondary or redundant path when the primary path fails. Also, in ACSLS HA, failing over to the alternate ACSLS server.

FFC

Flat flexible cable.

Fibre Channel

A bidirectional, full-duplex, point-to-point, serial data channel structured for high performance capacity. The Fibre Channel is an interconnection of multiple communication ports, called N_Ports. These N_Ports are interconnected by a switching network, called a fabric, to a point-to-point link, or an arbitrated loop. Fibre Channel is a generalized transport mechanism with no protocol of its own. A Fibre Channel does not have a native input/output command set, but can transport existing Upper Level Protocols (ULP) such as SCSI and IPI. Fibre Channel operates at speeds of 100 MB per second (full speed), 50 MB per second (half speed), 25 MB (quarter speed), or 12.5 MB (eighth speed). Fibre Channel operates over distances of up to 100 m over copper media or up to 10 km over optical links.

fibre connection (FICON)

An IBM S/390-based channel architecture that provides up to 256 channels in a single connection, each having a capacity of 100 MB per second.

FICON

See fibre connection.

front controller module

The module that houses the controller for the elevators, CAPs, turntables, and safety barrier.

front facade

The external portion of the customer interface module, between the access doors, that holds the:

- Membrane keypad
- Product logos
- Optional touch screen operator control panel

G

get

An activity in which a robot obtains a cartridge from a cell or drive.

gripper

(1) The portion of the hand assembly that grasps the cartridge.

(2) The part of the hand assembly that grasps and holds a cartridge during transport.

H

hand assembly

A part of the library robot whose function is to grasp cartridges and move them between storage cells and drives. A camera on the hand assembly reads cartridge volume labels.

See also bar code line scan camera.

HBZ module
See front controller module.

HLI/PRC
Host Library Interface/Panel Row Column

host audit
The process of updating the cartridge VOLIDs and locations (collected by a security audit) in a host CDS. This audit is initiated by a host command.

Host Software Component (HSC)
Library server that manages the library for mainframe users.

hot swap
Removal and replacement of a system component while system power remains on and system operations continue. *Contrast with* cold swap. *Contrast with* hot-pluggable. *Synonymous with* online servicing.

hot-pluggable
The capability that allows a CSE to replace FRUs while power to the FRU is maintained. This feature allows hardware maintenance actions and hardware upgrades to proceed without disrupting subsystem availability. *Contrast with* hot swap.

HSC
See Host Software Component.

I

import
The process of placing a cartridge into the cartridge access port so that the library can insert it into a storage cell.

ACSLS and HSC. synonym for import.

interlock switch
A switch that disconnects power to library mechanisms, excluding tape drives, when the front door is opened.

K

keypad interface
See membrane keypad.

L

LibCam Monitoring
A feature that provides two cameras, one for each leg of the horseshoe, for viewing activity inside the library.

library camera
See LibCam Monitoring.

library complex
Two or more SL8500 libraries attached to each other with PTP. *Synonymous with* ACS for ACSLS and HSC.

library controller (LC)
The HBC card within the SL8500 library that controls operations and communicates with the operator panel.

Library Contents Manager (LCM)
Manages cartridges within a library controlled by ELS.

library operator panel
See touch screen operator control panel.

library storage module (LSM)
Library component connected to other LSMs in an ACS via pass-thru. *Synonymous with* an SL8500 rail.

logical library
A virtual representation of a Physical library. *Synonymous with* virtual library partition.

M

magazine
A removable array that holds cartridges and is placed into the cartridge access port (CAP).

master (pass-thru port)
The side of a pass-thru port (PTP) that contains the electronics that control the actions of the PTP. *See also* standby (pass-thru port).

membrane keypad
A keypad mounted on the front facade used to monitor the status of the SL500 library and to operate the CAPs.

Multi TCP/IP
Using TCP/IP connections to multiple libraries to provide redundant communication paths between the host software (ACSLS or HSC) and an SL8500 library complex.

Multi-Volume Cartridge (MVC)
A physical tape cartridge residing in an LSM that either contains migrated virtual tape volumes (VTVs) or is identified as a volume that can be selected for VTV stacking.

N

N+1
A PDU that provides power to the redundant AC power grid. *See also* 2N.

O

online replacement
Replacement or service of a module while the library remains operational. The service person may be required to power off the module before removing or replacing it. *Synonymous with* hot swap.

operator panel
See touch screen operator control panel.

P

pass-thru port (PTP)
A mechanism that enables a cartridge to pass through from one library to another in a multiple modular library system.

PCI
Peripheral component interconnect.

PDU
See power distribution unit.

Physical library
A single SL8500 library consisting of a customer interface module, robotics interface module, and an drive and electronics module, with one to three Storage Expansion Modules optional. *See also* logical library.

PLC
Power line communications.

PLI
See primary library interface.

power distribution unit (PDU)
A device for the distribution of AC line power from one inlet to multiple outlets. Multiple PDUs provide higher availability because the power continues if one PDU (or its alternating current [AC] source if the PDUs use separate AC sources) loses power.

power grid
A power circuit that minimizes power failures that cause the library to cease operations.

An SL8500 library has five power grids, two for AC power and three for DC power.

power/communication bus rail
A rail that sits on the robot track to provide 48 VDC power and communication to the robot.

primary library interface (PLI)
The communication path between the operator panel and the library controller (the HBC card.) This consists of Ethernet with TCP/IP and XML.

PTP
See pass-thru port.

put
An activity in which a robot places a cartridge into a cell or drive.

PWA
Printed wiring assembly.

R

rail
(1) That portion of the upper robot track assembly that provides power and communication to the robot. (2) All of the cartridge slots and drives accessible via a rail. *Synonymous with* LSM.

rail assembly
The mechanism on which the robot travels between cartridge arrays and tape drives.

reach mechanism
A component of the robot that moves the gripper to get or put a cartridge at a designated location.

real tape drive (RTD)
The physical transport attached to the LSM. The transport has a data path to a VTSS and may also have a data path to MVS or to another VTSS.

Redundant Electronics (RE)
The optional SL8500 RE feature provides failover protection in enterprise libraries. RE uses a two sets of Library Controller cards. At any given time, one set is active and the other set is standby. The active Library Controller can failover to the standby in response to a command from ACSLS or the SL Console. Automatic failover can be initiated by the library in the event of a library card failure.

remote operator console
The customer's operator panel that interfaces with the PLI. *See also* security software layer.

robot
A mechanism that moves horizontally along a track in the SL8500 to transport tape cartridges to and from other locations in the library. *Also called* an S-bot or t-bot.

robotics interface module
The module containing the curved rails and pass-through port (PTP) assemblies.

S

S-bot
Small robot.

security audit
The process of reading and storing in Product Name library memory the VOLIDs and locations of all cartridges in the library. *See also* host audit.

security software layer (SSL)
The communication path between the PLI and the remote operator console.

service area
An area between the access doors of the customer interface module and the safety barrier in which an inoperable robot is stored for service and other mechanisms can be repaired or replaced.

Service Safety Door (SSD)
A motor-driven barrier that separates the service areas of the front interface assembly from the rest of the library,. The SSD allows service personnel to safely repair or replace failed library mechanisms, while the front access door is opened and closed, without interference with most library operations.

SL500
See StorageTek 500 Modular Library System.

SL8500
See StorageTek 8500 Modular Library System.

SL3000
See StorageTek 3000 Modular Library System.

SMC
See Storage Management Component.

SSi
System Server infrastructure.

standby (pass-thru port)
The side of a pass-thru port (PTP) that operates in response to actions initiated by the master side of the PTP. *See also* master (pass-thru port).

Storage Management Component (SMC)
Software interface between IBM's z/OS operating system and Oracle StorageTek real and virtual tape hardware. SMC performs the allocation process, message handling, and SMS processing for the ELS solution.

StorageTek 500 Modular Library System
A smaller automated tape library comprised of: base module containing the robotics unit; drive expansion module; and cartridge expansion module

StorageTek 3000 Modular Library System
A medium-sized automated tape library.

StorageTek 8500 Modular Library System
A large-sized automated tape library.

T

tape cartridge
A container holding magnetic tape that can be processed without separating the tape from the container. The library uses data, diagnostic, and cleaning cartridges. These cartridges are not interchangeable.

tape drive
An electromechanical device that moves magnetic tape and includes mechanisms for writing and reading data to and from the tape.

tape drive tray assembly
The mechanical structure that houses a tape drive, fan assembly, power and logic cards, cables, and connectors for data and logic cables. *Synonymous with* drive tray assembly.

tape storage area
The area in the SL8500 library where cartridges are stored.

tape transport interface (TTI)
An interface to control/monitor tape movement. (GLS Glossary

t-bot
Tall robot.

touch screen operator control panel
An optional feature consisting of a flat-panel display with a touch screen interface and a panel mount computer. This feature is attached to the front facade.

track
The horizontal path upon which a robot travels.

track drive mechanism
The component that moves the robot along the track between the cell arrays, CAPs, and tape drives.

TTI
See tape transport interface.

U

U
A standard unit of measurement of vertical space inside a rack-mount cabinet equal to 44.5 mm (1.75 in.).

UART
Universal asynchronous receiver/transmitter.

V

vacancy plate
A plate that covers an unused bay, such as a drive bay or power supply bay.

Virtual Tape Control System (VTCS)
The primary host code that controls activity and information about VTSSs, VTVs, RTDs, and MVCs.

Virtual Tape Drive (VTD)
An emulation of a physical transport in the VTSS that looks like a physical tape transport to MVS. The data written to a VTD is really being written to DASD. The VTSS has 64 VTDs that do virtual mounts of VTVs.

Virtual Tape Storage Subsystem (VTSS)
The DASD buffer containing virtual volumes (VTVs) and virtual drives (VTDs). The VTSS is a STK RAID 6 hardware device with microcode that enables transport emulation. The RAID device can read and write "tape" data from/to disk, and can read and write the data from/to an RTD.

Virtual Tape Volume (VTV)
A portion of the DASD buffer that appears to the operating system as a real tape volume. Data is written to and read from the VTV, and the VTV can be migrated to and recalled from real tape.

VSM
See Virtual Storage Manager.

VTCS
See Virtual Tape Control System.

VTD
See Virtual Tape Drive.

VTSS
See Virtual Tape Storage Subsystem.

W

wrist
A mechanism in the robot assembly that allows the robot to access the outer and inner storage walls.

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