SL8500
Modular Library System

Best Practices Guide

Part Number: TM0017
Revision C

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Best Practices Guide

Sun Microsystems, Inc.
www.sun.com

Part Number: TM0017
May 2007
Revision C

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Summary of Changes

Date	Revision	Description
December 2005	A	Initial release of the *Best Practices Guide*.
March 2007	B	
May 2007	C	Changes to the revision include: Updated the HSC examples in Chapter 9, "Ethernet Connectivity".

Change bars included.

Contents

Figures

Tables

Preface

This document contains best practice guidelines for the optimization for the SL8500 library along with suggestions about how to improve the performance.

Intended Audience

This document is written for Sun Microsystems and StorageTek account executives, system engineers (SEs), professional services (PS), and marketing and sales representatives.

It is intended to be *shared* with customers that are interested in planning for, purchasing, and using the SL8500 modular library system.

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 within a complex
- Slots (hardware) and cells (software)
- Tape drives, transports, tape transports, and just “drives”

Alert Messages

Alert messages call your attention to information that is especially important or that has a unique relationship to the main text or graphic.

Note: A note provides additional information that is of special interest. A note might point out exceptions to rules or procedures. A note usually, but not always, follows the information to which it pertains.

Caution: A caution informs you of conditions that might result in damage to hardware, corruption of data, or corruption of application software. A caution always precedes the information to which it pertains.

Organization

Chapter	Use this chapter to...
Chapter 1, SL8500 Architecture	Understand the architecture of the SL8500 modular library system and differences between other libraries.
Chapter 2, Library Content Management	Discover ways to optimize the SL8500 library and improve performance.
Chapter 3, HSC Best Practices	Find out how you can improve performance of the SL8500 library with the Host Software Component (HSC).
Chapter 4, VSM Best Practices	Discover configuration recommendations for Virtual Storage Manager (VSM) that can improve performance.
Chapter 5, ExLM Best Practices	Understand reasons for adjusting and *re-evaluating* the content management philosophy with respect to the physical structure of the SL8500.
Chapter 6, ACSLS Best Practices	Learn some guidelines for optimizing the Automated Cartridge System Library Software (ACSLS) for the SL8500 library.
Chapter 7, Independent Software Vendors	Become aware of the characteristics for various applications in which independent software vendors (ISVs) design support for the SL8500 library
Chapter 8, TLC/FSM	Get an introduction to the Tape Library Configurator Field Simulation Model (TLC/FSM). This tool helps with configuring tape libraries.
Chapter 9, Ethernet Connectivity	Learn about the supported configurations and network examples for the Dual TCP/IP feature.
Chapter 10, Partitioning	Get prepared for partitioning of the SL8500 library. This chapter provides requirements, guidelines, and a list of tasks to help partition a library.
Appendix A, Structural Elements	Understand some of the structural elements of the library, including the walls, storage slots, and addressing scheme.
Appendix B, Comparisons	Compare various measurements and values between the SL8500 and the 9310 PowderHorn tape libraries.

Related Publications

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

Software Publications	
ACSLS 7.1 Installation, Configuration, and Administration Guide	312572303
HSC 6.1 Operator's Guide	312597201
HSC 6.1 Systems Programmer's Guide	312597301
NearLine Control Solution (NCS) 6.1 Installation Manual	312596801
Introduction to Virtual Storage Manager	MT6002
Virtual Tape Control System Installation and Configuration Guide	312585901
ExLM 6.0 Installation Guide	312558101
ExLM Quick Reference	312558002
ExLM System Administrator's Guide	312558202
Hardware Publications	
Systems Assurance Guide	MT9229*x*
Installation Manual	96138
User's Guide	96154
SL8500 Optimization Checklist	TT0017*x*

All publications listed above are available in portable document format (PDF) online at the Customer Resource Center (CRC).

- The URL for the CRC is http://www.support.storagetek.com
- The CRC is also available through the SunSolve Web site at: http://sunsolve.central.sun.com.

Related Training

Sun Learning Services (SLS) has two tools that employees can use to obtain information about and for training.

1. Learning Management System (LMS) enables you to sign up for classes, access training records, start e-learning courses, and much more.
2. MyLearning Portal allows you to find out about the latest learning offerings, find the right learning for your job, watch training videos, and share and collaborate with peers—all from a single site.

You can access both of these tools through the SunWeb Portal at: http://sunweb.central.sun.com.

Note: All previous StorageTek employee technical courses can be accessed from the **MyLearning** website at: http://mylearning.central.sun.com.

Accessing the Learning Management System

See the following for more information:

Employee Training

Employees can access the LMS by logging into myHR from the SunWeb Portal and myHR, click on the “My Job & Learning” tab and access the new LMS under the “Learning” channel on the page.

Partner Training

Partner training resources are still available through a version of the Sun Training Access Network (SunTAN), which remains available.

Customer Training

Customers can review the Training Catalog that is available through the Sun Web site at: http://www.sun.com.

Click on the Training link at the top of the page. http://www.sun.com/training.

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Sun's External Web Site

The Sun external Web site provides marketing, product, event, corporate, and service information. The external Web site is accessible to anyone with a Web browser and an Internet connection.

The URL for the Sun external Web site is: http://www.sun.com

Customer Resource Center

The Sun StorageTek product Customer Resource Center (CRC) is a Web site that enables members to resolve technical issues by searching code fixes and technical documentation for StorageTek brand products. CRC membership entitles you to other proactive services, such as HIPER subscriptions, technical tips, answers to frequently asked questions, addenda to product documentation books, and online product support contact information. Customers who have a current warranty or a current maintenance service agreement may apply for membership by clicking on the Request Password button on the CRC home page.

- The URL for the CRC is http://www.support.storagetek.com
- The CRC is also available through the SunSolve Web site at: http://sunsolve.central.sun.com.
- Sun employees may also enter the CRC through the SunWeb PowerPort.

Sun Partner Advantage Program

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The URL for partners is: http://www.sun.com/partners/

Hardcopy Publications

Contact a Sun sales or marketing representative to order additional paper copies of this publication or to order other StorageTek-brand product customer publications in paper format.

SL8500 Architecture

1

On the surface, the SL8500 and the PowderHorn libraries may appear similar. Many assume that the SL8500 is just a newer, high-performance, PowderHorn. While this assumption may have been true for the evolution from the original 4400 library to the PowderHorn library—it is only partially true for the evolution from PowderHorn to the SL8500 library.

To fully understand this, it may be helpful to take a more detailed look into the architecture of the SL8500 library with its features and benefits.

PowderHorn—when first released—represented a traditional “brute-force” attempt to improve the performance of the 4400 automated cartridge system by cranking up the speed of the robot. When the engineering team looked into methods to continue and improve overall performance—mainly *cartridge exchange rates*—of the PowderHorn library, it became obvious that there were many “physical” constraints with having such a large robot mass; and just cranking up the speed another notch was not going to provide the kind of increase in performance many customers were seeking—even *demanding*.

SL8500 library—the architecture of the SL8500 library represents a major shift from the single, high-speed, robot to a *multiple*, high-performance, robotic system enhanced with new technologies.

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.

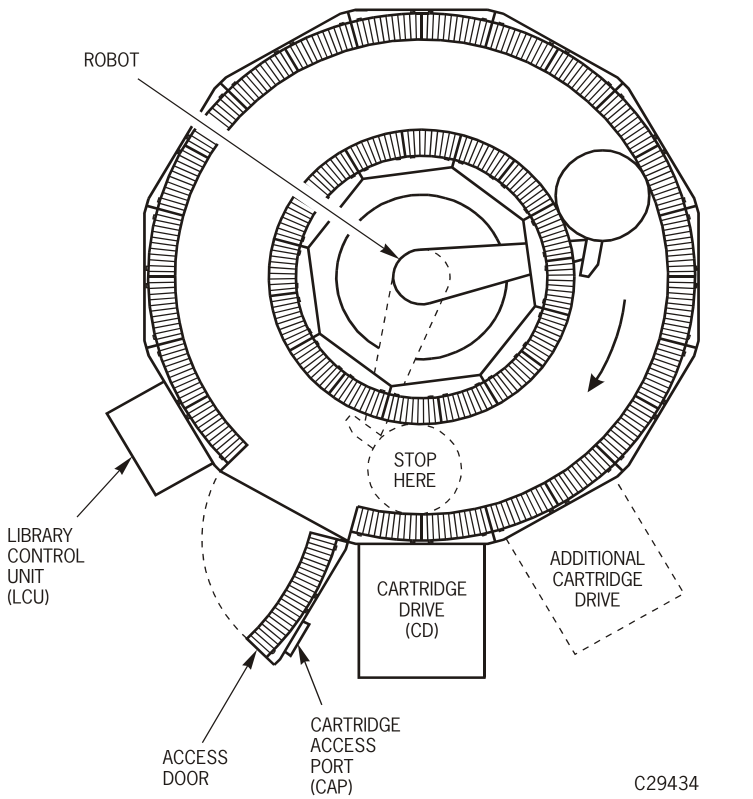
Continuous availability through library management software such as the Host Software Component (HSC) or Automated Cartridge System Library Software (ACSLS) to provide *near continuous operation* and *dynamic configuration utilities* that allow you to change configurations without interruption to the library.

Consolidation and *drive sharing* combine and strengthen 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, and pass-thru ports can be replaced while the SL8500 continues to operate.

Figure 1. PowderHorn—9310 and SL8500 Comparison

Figure 1 shows a comparison between PowderHorn and SL8500 libraries.



Total area 10.3 m^2 (110.8 ft^2)
Total weight with 60 drives 5420 kg (11,950 lb) (80 drives max.)

Consumption
16 drives 3.56 kW
60 drives 10.76 kW

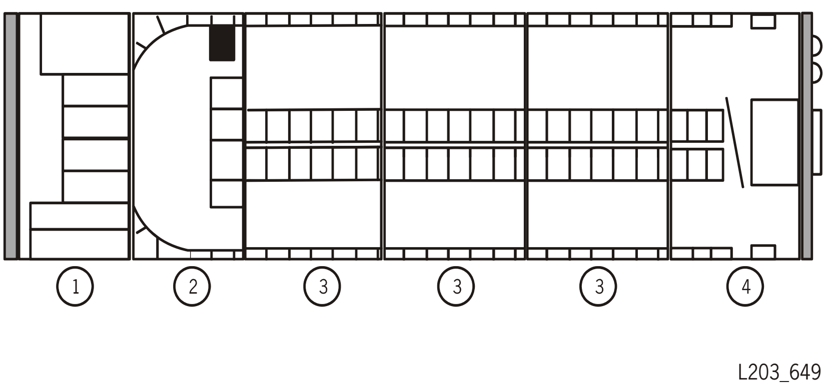
Heat output
16 drives 12,140 Btu/hr
60 drives 36,700 Btu/hr

Power cords 6
Plus each drive (60)

Capacities:
Note: Adding more drive cabinets decreases the cartridge capacity by 340 cells per cabinet

5,500	20 drives
5,160	40 drives
4,820	**60 drives**
4,480	80 drives (max.)

1. Library Storage Module (LSM)
2. Library Management Unit (LMU) Dual configuration, *not shown*
3. Library Control Unit (LCU)
4. 9741E Drive Cabinets (3) (4 cabinets max.)



1. Drive and Electronics Module (DEM) holds up to 64 tape drives
2. Robotic Interface Module (RIM)
3. Storage Expansion Modules (SEM) Currently, up to 3 expansion modules may be added to the base library
4. Customer Interface Module (CIM)

Total area 9.6 m^2 (103.4 ft^2)
Total weight 5250 kg (11,575 lb) (64 drives)

Consumption
16 drives 3.32 kW
64 drives 12.27 kW

Heat output
16 drives 11,320 Btu/hr
64 drives 41,840 Btu/hr

Power cords
2 (3 phase) or 6 (single phase)
Drives power cords are not required

Capacity
Adding more drives has no effect on capacity (and vice-versa)

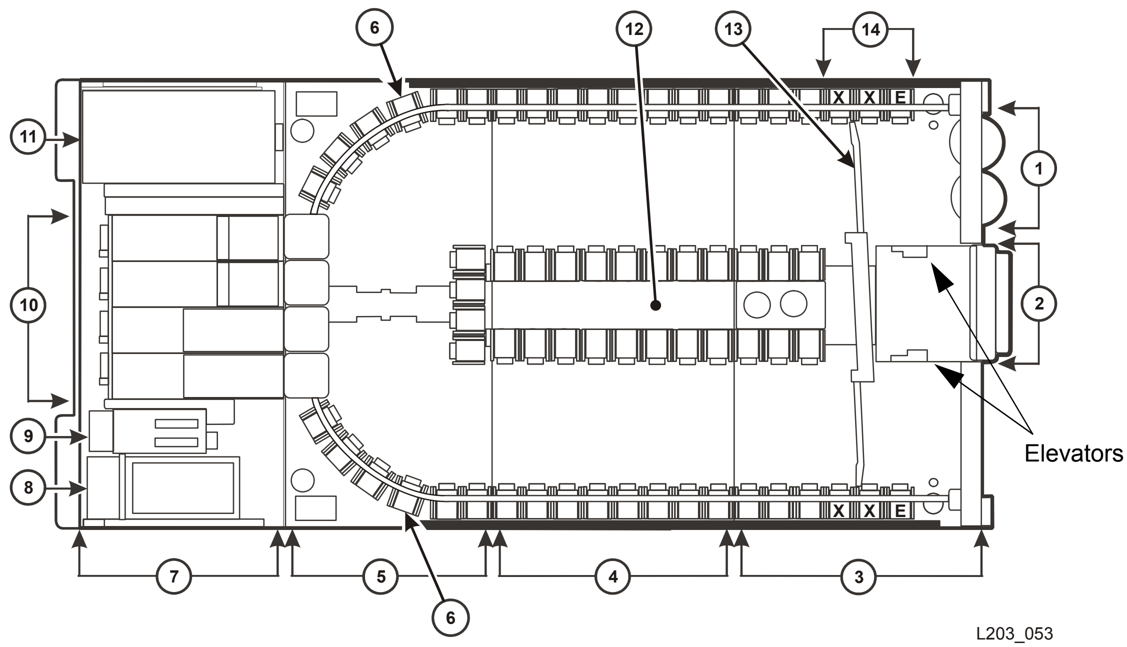
1,448 (Base) 64 drives *per library*
3,176 (1 SEM)
4,904 (2 SEMs)
6,632 (3 SEMs)
8,360 (4 SEMs)
10,088 (5 SEMs)

See Appendix B for more comparisons between the SL8500 and 9310 PowderHorn.

Modules

Figure 2 shows a view of the library with an example of each type of module and the location of certain components.

Figure 2. Library Modules



1. “Cartridge Access Ports” on page 19
2. Facade—may contain up to 2 operator panels (Keypad and the StreamLine 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. Storage Expansion Modules (SEM)—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 14 for more information.
7. Drive and Electronics Module (DEM)——only 1 module per library
8. AC Power and Electronics Control Modules—can have two modules per library
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—may have up to 4 racks that can hold servers, hubs, and switches
12. Inner wall cartridge slots
13. “Service Safety Door” on page 28
14. “Reserved Capacity Slots” on page 5
    - E = End stop
    - X = Diagnostic cartridges

Floor labels can be placed inside the library to help identify column numbers and locations. The part number for these labels is: XSL8500-COL-LABEL.

Table 1. Module Descriptions

Module	**Description**
Customer Interface Module	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 6) • 198 slots for diagnostic and cleaning cartridges (see “Reserved Capacity Slots” on page 5) • 24 end slots (eight 3-slot arrays) for targeting and drop-off cells (see “Reserved Capacity Slots” on page 5) • 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 “Cartridge Access Ports” on page 19 • Two elevator assemblies that can transfer up to four cartridges from one rail to another.
Storage Expansion Modules	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 (see “Library Walls, Arrays, and Slots” on page 6)
Robotics Interface Module	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 6) • Pass-thru ports (see “Pass-thru Ports” on page 14) • One of two robotic configurations (see “Robotic Architecture” on page 12)
Drive and Electronics Module	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 Module • Load sharing DC power supplies • Accessory racks • Slots for 1 to 64 tape drives • *No slots* for data cartridge storage

Capacities

The following tables list the slot capacities for a *single* library.

Data Cartridge Slots

Table 2 lists the customer *data* cartridge capacities.

Table 2. Cartridge Capacity

	Library Configuration	Cartridge Capacity
Basic Library	Drive & Electronics Module	0
	Robotics Interface Module	800
	Customer Interface Module	648
	Starting (Base) Configuration	1,448
Expansion Modules	When adding expansion module, each module adds 1,728 *data* cartridge slots	
	One expansion module	3,176
	Two expansion modules	4,904
	Three expansion modules	6,632
	Four expansion modules	8,360
	Five expansion modules (maximum)	10,088

Note: The total number of cartridges does not include the cartridge slots in the cartridge access port, pass-thru port, or reserved slots.

Reserved Capacity Slots

Table 3 lists the 230 reserved slots that *cannot* to be used for data cartridges. These are reserved for diagnostic cartridges, drop-off slots, and targeting.

Table 3. Reserved Slots

<table>
<tr><th>Slots</th><th>Usage</th><th>Location</th></tr>
<tr><td>198</td><td>Diagnostic cartridges</td><td rowspan="2">Front of the Customer Interface Module in the Service Area</td></tr>
<tr><td>24</td><td>Eight 3-cell arrays intended for:
• Endstop label (top)
• Proximity sensing (middle)
• Drop-off slot for single HandBot (bottom)</td></tr>
<tr><td>8</td><td>Drop-off slot for second HandBot</td><td>Top cell under the pass-thru ports</td></tr>
<tr><td colspan="3">Note: ACSLS and HSC cannot access the reserved slots in the Customer Interface Module, so for any ACSLS or HSC managed cleaning, the cartridges must be placed in the customer usable slots. The reserved slots in the service area may be used, however, for non-ACSLS and HSC managed cleaning using the library’s cleaning and diagnostic functions.</td></tr>
</table>

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

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

- 8-slot arrays in the pass-thru port panels
- 8-slot arrays underneath the stop brackets for the service safety door
- 4-slot arrays on the elevators and pass-thru ports
- 3-slot arrays (end stops) at the ends of each HandBot rail

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

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 retainer clips.

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.

Address Scheme

Cartridge locations in previous libraries were: ACS, Library, *Panel*, *Row*, and *Column* (HLI-PRC). Cartridge slot designations in an SL8500 library uses five parameters: Library, Rail, Column, Side, Row (L,R,C,S,W):

1. **Library:** Is the number of that library or within a library complex

2. **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).

3. **Column:** Indicates the *horizontal* location of a tape cartridge 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.

4. **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

5. **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).

Understanding the Address Scheme

There are differences in the addresses of the SL8500 and other libraries.

- The SL8500 is *one's*-based (1) and uses negative numbers.
- Other libraries use a *zero*-based (0) and *no* negative numbers.
- The SL8500 uses *five* parameters: library, rail, column, side, and row.
- Other libraries use: ACS, LSM, panel, row, and column (HLI–PRC).

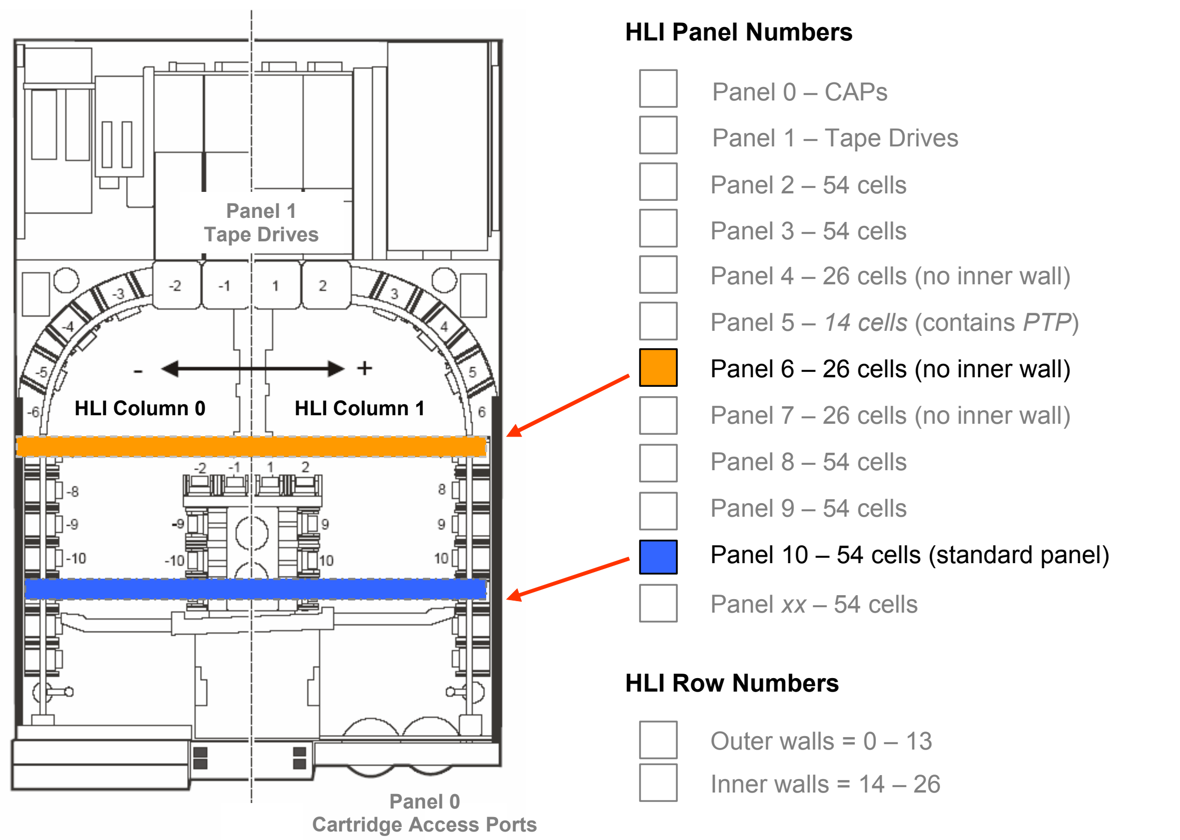
Table 4. Addressing Descriptions

<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.
Note: See Figure 3 on page 8 for an example of a storage panel. The SL8500 does not use panels as an address.
An 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
1. Outer wall
2. Inner wall</td><td>HandBot number
1. Left (–)
2. 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>
<tr><td colspan="4">• Zero-based numbering (as with HLI) starts numbering at 0.
• One's-based numbering (as with the SL8500) starts numbering at 1.
• This is an important difference in the numbering sequences between software (ACSLS or HSC) and hardware (physical SL8500 addresses)</td></tr>
</table>

A 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).

Figure 3 shows how panels match-up to the columns in an SL8500 library.

Figure 3. Panel Numbering



Configuration	Panel Number Ranges						
Base Library	RIM	CIM					
	2 – 7	8 – 10					
One expansion module	RIM	SEM	CIM				
	2 – 7	8 – 15	16 – 18				
Two expansion modules	RIM	SEM	SEM	CIM			
	2 – 7	8 – 15	16 – 23	24 – 26			
Three expansion modules	RIM	SEM	SEM	SEM	CIM		
	2 – 7	8 – 15	16 – 23	24 — 31	32 – 34		
Four expansion modules	RIM	SEM	SEM	SEM	SEM	CIM	
	2 – 7	8 – 15	16 – 23	24 — 31	32 – 39	40 – 42	
Five expansion modules	RIM	SEM	SEM	SEM	SEM	SEM	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 4. Touch Screen Operator Control Panel

The operator panel consists of:

- StreamLine Library Console software
- 12-inch flat screen display (*diagonal* measurement)
- Touch screen interface (no mouse or keypad necessary)
- 20 GB hard drive
- 512 MB memory and 32 MB RAM
- Java applet as the graphical user interface (GUI).

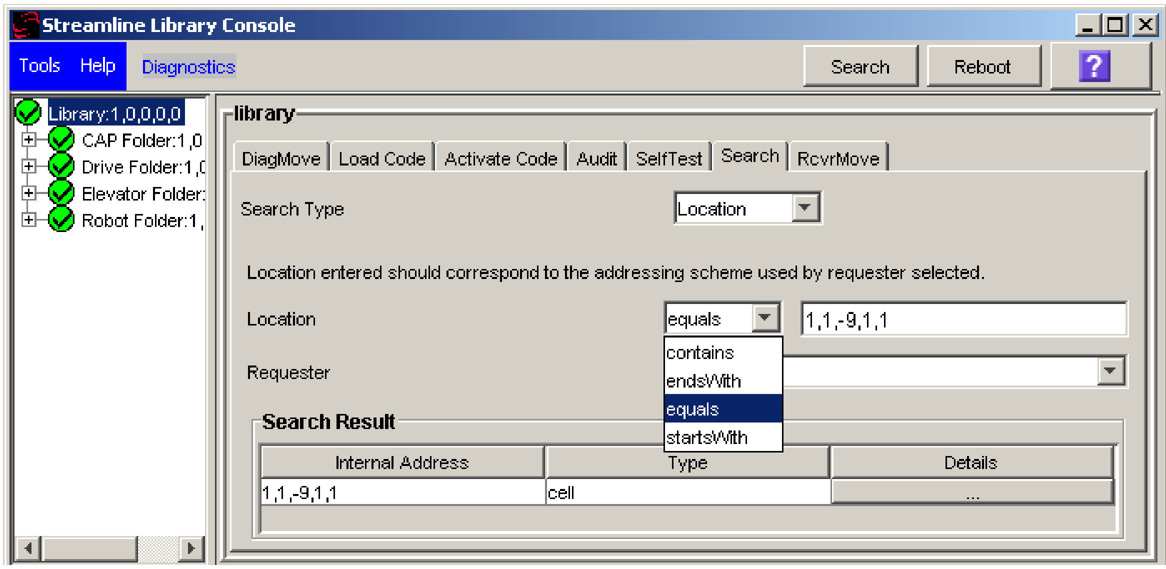
A pen and stylus feature are available for the touch screen interface:

- Pen/Stylus Combo is: XSL-STYLUS-Z
- Holder is: XSL-STYLUSHOLD-Z

Translating Addresses Using the Library Console

You can use the StreamLine Library Console™ (SLConsole) 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 SLConsole, select Diagnostics, and select the Search tab.



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 (see the examples in Figure 5 on page 11).

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.

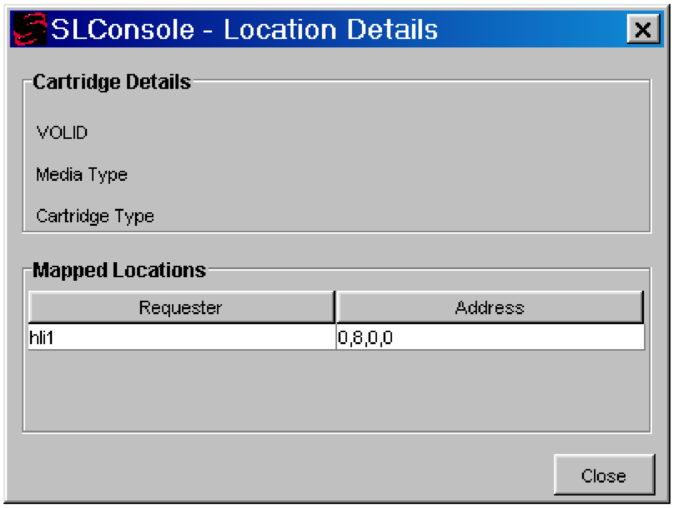
5. Click on the Search button in the top right corner of the SLConsole.
   The search result lists the location by slot-type (cell, drive, or CAP).

6. Click on the *Details* button for more information such as VOLID, media and cartridge type (LTO, SDLTtape, and T-Series; data, cleaning, or diagnostic) and HLI address for cartridges when you specify a *default Requester.*

Note: Refer to the SLConsole Help—*Locating a Cartridge by Address*—for more information.

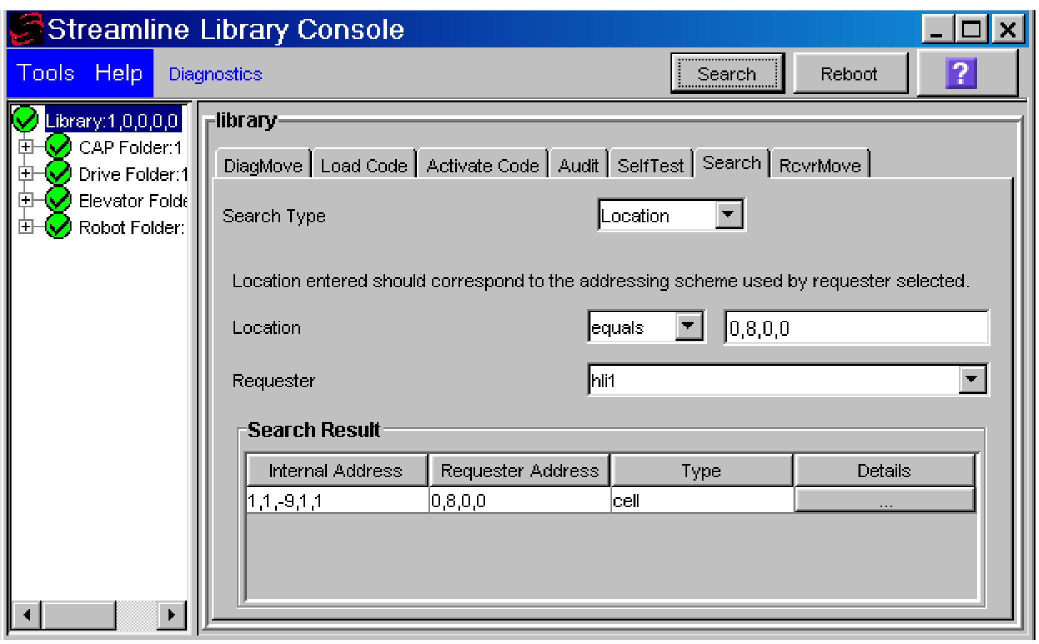
Figure 5. Translating Addresses

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



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

Choosing *hli1* as the Requestor
Displays *both* the internal address and the hli1 Requester address.



Robotic Architecture

Figure 6 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*TM 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.

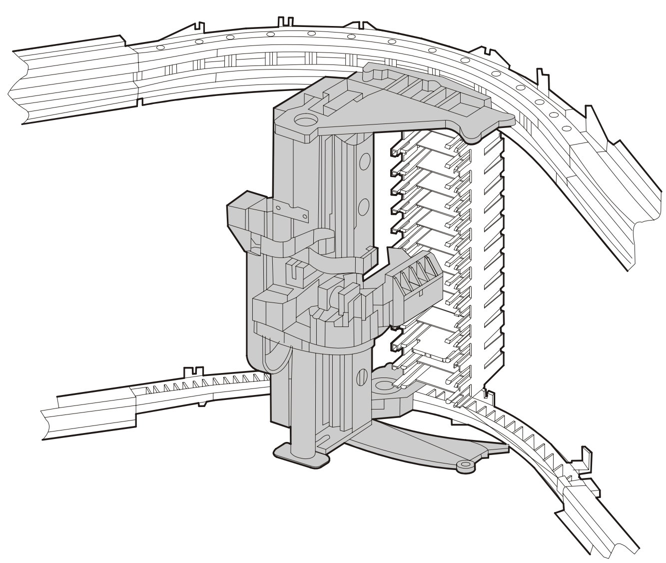
  Rail assemblies—also known as library storage modules—are numbered from top to bottom.

  - Rail numbers are 1 to 4.
  - Corresponding LSM numbers are 0 to 3.

- Each **HandBot** on a rail assembly can service up to 16 tape drives and all of the tape cartridges for that rail. The SL8500 library can have either one or two HandBots *per rail*.

- Spanning across the four rail assemblies are two **elevators**. These elevators perform an *internal* pass-thru operation that allows joining adjacent rails to create larger partitions.

Figure 6. HandBot and Rail Assembly



Note: The HandBots are a *shared* resource of the library and under control of the HBC card (the controller).

Note: When describing the architecture of the SL8500, it may be easiest to think of it as four separate library storage modules (LSMs). This is an important concept to understand about the SL8500 library.

■ Elevators

Figure 7. 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, administrators must specify the elevators as pass-thru ports to each of the adjacent LSMs in the same library.

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

Figure 8. 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
               ...
```

PASTHRU: The lowest numbered LSM is always the master (M). For example:

- LSM0000 is the master (M) to all other LSMs.
- LSM0001 is master to LSM0002, and LSM0003, but slave (S) to LSM0000.
- LSM0002 is master to LSM0003 but slave (S) to LSM0000 and LSM0001.
- Then LSM0003, which is the last LSM, is slave (S) to everything.

ADJACNT: Shows that every LSM is adjacent to all other LSMs because of the elevator.

Tip: 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 an electro-mechanical device that allows 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 9 is an example of a pass-thru port (PTP) mechanism.

Figure 9. Pass-thru Port Mechanism

The SL8500 pass-thru port feature 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 LSM—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.

However, the library complex can grow in the other direction—to the right—but this requires a disruption to the system to renumber the LSMs and reconfigure the management software.

The following are highlights about the PTP feature:

- 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 Robotics Interface Module at columns +6 and –6 near the tape drives for quick access.

- Both ACSLS and HSC support pass-thru port operations—no additional software is needed.
- If service is required, the pass-thru port mechanism slides out of the frame from the rear of the library—not affecting library operations.
- 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.

For and *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.

For example: This is an example of an HSC LIBGEN that shows two SL8500 libraries in a library complex connected together with a Pass-thru Port feature.

- LSM0000 – LSM0003 are in the first library
- LSM0004 – LSM0007 are in the second library—to the left of the first

Figure 10. Pass-thru Port Configuration

```
ACS00    SLIACS ...                                                X
                LSM=(LSM0000,LSM0001,LSM0002,LSM0003,LSM0004,      X
                LSM0005,LSM0006,LSM0007)

LSM0000  SLILSM PASTHRU=((0,M),(0,M),(0,M),(1,M)),                 X
               ADJACNT=(LSM0003,LSM0002,LSM0001,LSM0004),          X

LSM0001  SLILSM PASTHRU=((0,M),(0,S),(0,M),(1,M)),                 X
               ADJACNT=(LSM0003,LSM0000,LSM0002,LSM0005),          X

LSM0002  SLILSM PASTHRU=((0,M),(0,S),(0,S),(1,M)),                 X
               ADJACNT=(LSM0003,LSM0000,LSM0001,LSM0006),          X

LSM0003  SLILSM PASTHRU=((0,S),(0,S),(0,S),(1,M)),                 X
               ADJACNT=(LSM0002,LSM0001,LSM0000,LSM0007),          X
... ... ...

LSM0004  SLILSM PASTHRU=((1,S),(0,M),(0,M),(0,M)),                 X
               ADJACNT=(LSM0000,LSM0005,LSM0006,LSM0007),          X

LSM0005  SLILSM PASTHRU=((1,S),(0,S),(0,M),(0,M)),                 X
               ADJACNT=(LSM0001,LSM0004,LSM0006,LSM0007),          X

LSM0006  SLILSM PASTHRU=((1,S),(0,S),(0,S),(0,M)),                 X
               ADJACNT=(LSM0002,LSM0004,LSM0005,LSM0007),          X

LSM0007  SLILSM PASTHRU=((1,S),(0,S),(0,S),(0,S)),                 X
               ADJACNT=(LSM0003,LSM0004,LSM0005,LSM0006),          X
```

Notice the same rules apply as referenced in Figure 8, Elevator Configuration.

PASTHRU: Master (M) is still the lowest numbered LSM.

ADJACNT: Notice the addition of an adjacent *horizontal* LSM (in **bold**).

When defining adjacent LSMs in a library complex, you need to include all three vertical elevator pass-thru elements plus the pass-thru port mechanisms.

This example shows only two libraries. You may need to configure additional horizontal PTP when other libraries are added (LSM0008 – LSM0011).

Pass-thru Port Considerations

The physical dimensions of the pass-thru port are:

Height:	231 cm (91 in.)
Width:	17.2 cm (6.76 in.)
Depth:	150.8 cm (59.4 in.)
Weight:	121 kg (266 lb) including the mechanisms
Power:	+48 VDC supplied from the home-side library

To implement the pass-thru port feature, you must have:

- Accessory racks: 1 rack (required) 2 racks for power redundancy
- Inter-library Communications kit (PN 314842401)

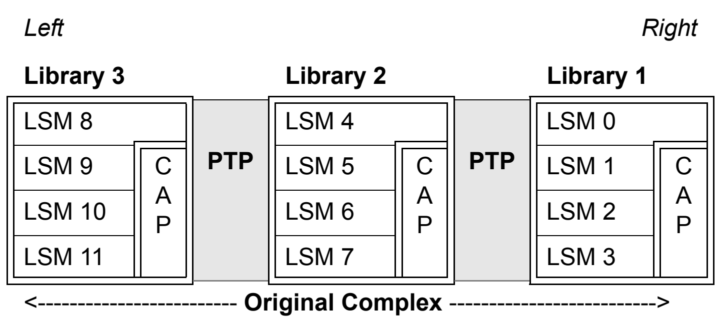
Each kit supports up to 5 libraries that are connected together

- PTP Conversion Instructions (CB 101728), frame, and mechanisms
- Software upgrade and reconfiguration

The following terms and definitions apply to SL8500 PTP operations:

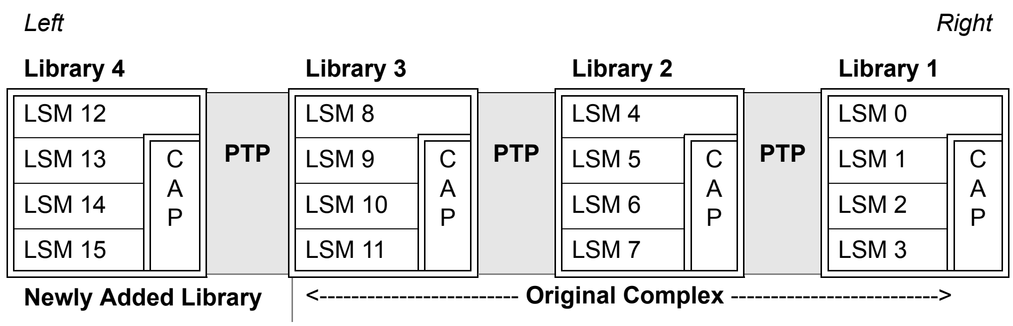
Home library	The library that provides power, signal, and control lines to the PTP mechanisms. This is the library on the right as viewed from the front.
Away library	The library that is always located on the left side of a Home library, as viewed from the front.

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, the customer can dynamically upgrade the configuration of the software (ACSLS or HSC). This upgrade must be done to configure the libraries and tape drives.



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

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 SL8500 Libraries to the *Right*

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

Important:

- Vary the LSMs offline before the reconfiguration (or place ACSLS in diagnostic mode).
- Audit the existing and new libraries in a specific sequence> This sequence helps avoid deleting or marking absent the volumes in renumbered LSMs.

Upgrading ACSLS and HSC Configurations

Existing LSMs must be offline (or ACSLS in diagnostic mode) while upgrading the SL8500 library complex and during the ACSLS or 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, renumbered, LSMs will collide with cartridges already in the cells.

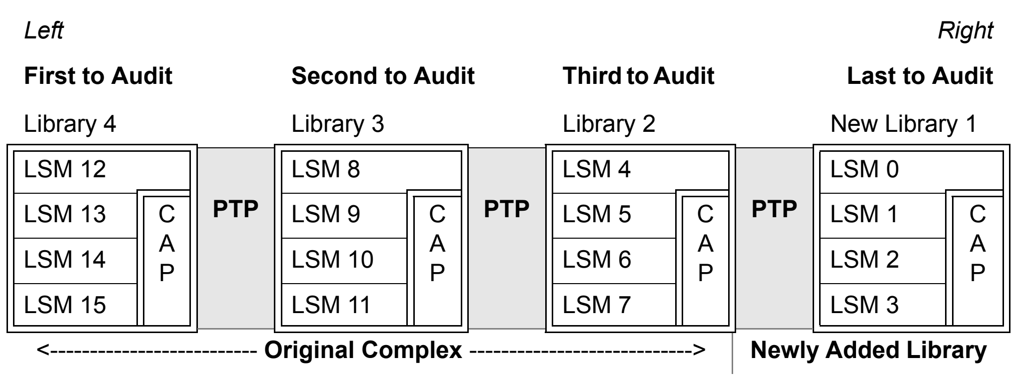
An outline of the steps to upgrade the library complex consists of:

1. Add the new SL8500 library to the complex.
2. Update 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 6.1)
     - LIBGEN, SLICREAT, and MERGEcds** (HSC must be stopped)
3. For renumbered LSMs, the customers must audit the library to update volume locations. The sequence of the audit is:

First:	1. Audit the existing LSMs that were renumbered. 2. Start with the highest LSM numbers (*First to Audit*). 3. Once that audit completes, go to the next lower group of LSMs (*Second to Audit*). 4. Continue with this sequence until you have audited all the older, higher numbered LSMs (*Third to Audit*).
Second:	5. Audit the newly added LSMs *(Last to Audit)*.
Third:	6. 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:

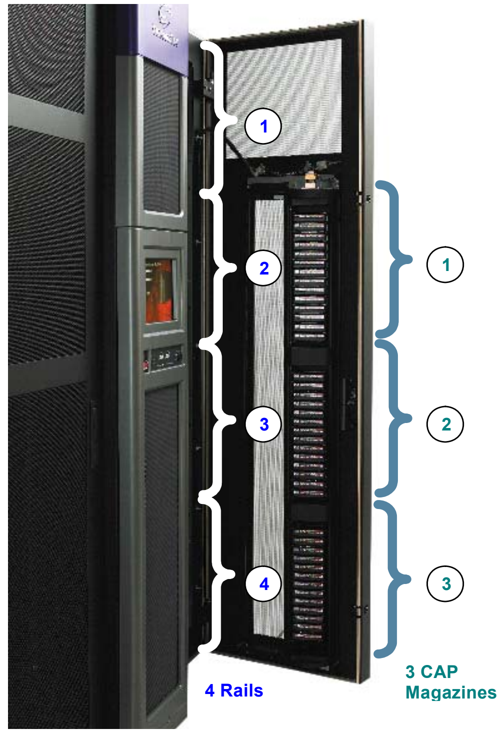


Cartridge Access Ports

Figure 11. 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.
  - 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)
  - Software address is 0 or (`ACS, 1, 0`)
  - Located on the *left* of the access door
- **CAP B** is:
  - Optional CAP (optional feature)
  - Software address is 1 or (`ACS, 1, 1`)
  - Located on the *right* of the 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. The CAP cannot be subdivided.
- For addressing purposes, the CAP needs a location (ACS,LSM,CAP#). The LSM address is associated with the second rails in each library because there is no adjacent CAP magazine for the top rail example:

  `ACS#,1,0` for `CAP A and ACS#,1,1` for `CAP B`
- When loading cartridges in the CAP, slots can be skipped.
- The middle magazine cannot be missing if both the upper and lower or magazines are installed.
- 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 must be aware that if only one CAP will do the job, there is no need to open both CAPs. Opening both CAPs will increase the audit time since all slots are audited once a CAP is opened then closed.

- When a CAP is in use for an enter or eject operation, all 39 slots are reserved for that operation. The CAP cannot be subdivided.
- If the HandBot adjacent to the CAP is inoperative, that portion of the CAP is inaccessible. For more information, see:
  - For HSC: "Working Around an Inoperative HandBot" on page 51
  - For ACSLS: "Working Around an Inoperative HandBot" on page 79

Second CAP

The SL8500 library offers a second, *optional*, CAP feature. The second CAP is located on the *right-hand* portion of the front access door.
Advantages of this second CAP are:

- Doubles the entry/ejection capabilities from 39 to 78 cartridges.
- Increases CAP capacity without the need to replace the access door.

Dual CAP Hardware Requirements

Note: Libraries have always been capable of supporting a second CAP; however, make sure the mounting brackets are in place before installing it (refer to the *Installation Manual* for more information).

Table 5. Second CAP Hardware Requirements

Hardware	**Function**
CAP assembly	Conversion bill: 104300 or 104320 Conversion instructions 142632 Marketing order number: SL8500-UPG-CAPZ Description: 39-slot cartridge CAP
HBZ module	Conversion bill: 104603 Conversion instructions 142633 Required to control the second CAP (SL8500-UPG-HBZ-Z)

Dual CAP Firmware Requirements

Table 6. Second CAP Firmware Requirements

Firmware	**Version** (or above)	**References**
Library	FRS_3.7x	Release Notes
SLC	FRS_3.25	Release Notes
Note: Release Notes are available on the CRC.		

Note: ACSLS must have PUT0701 installed to support dual CAP.
HSC requires a LIBGEN update to indicate that there are 2 CAPs.

Addressing

The second CAP's operation is similar to a single CAP operation, but the numbering scheme changes and addressing is different.

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 7. CAP Library Addressing—Hardware

CAP Magazine	Library	Rail	*Column*[1]	Side[2]		Row[3]
				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

1. 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).
2. 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.
3. 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#.

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. See Figure 11 on page 19 as an example.

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

Table 8. CAP Library Addressing—Software

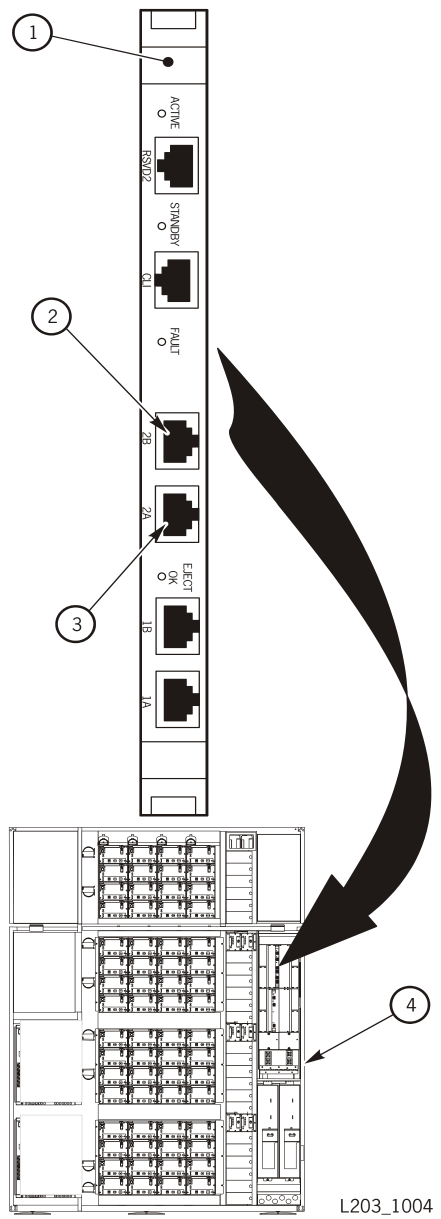
Libraries in a Complex	CAP A			CAP B		
	ACS#	LSM	CAP	ACS#	LSM	CAP
First library	–	**1**	0	–	**1**	1
Second library	–	**5**	0	–	**5**	1
Third library	–	**9**	0	–	**9**	1

Note: See "CAPs and Partitions" on page 134 for more information about cartridge access ports.

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 12. 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.

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. HBC card (controller card)
2. Port 2B—primary TCP/IP host connection
3. Port 2A—secondary, dual TCP/IP host connection
4. Electronics control module

- See “Terminology and Differences” on page 23 for a comparison between the 9310 Dual LMU and the SL8500 Dual TCP/IP.
- See Chapter 9, “Ethernet Connectivity” for more information.

Terminology and Differences

Note: The SL8500 features Dual TCP/IP, which provides *two* public network interfaces—*note: not redundant*—to the library and/or library complex. This feature requires a library firmware of FRS_3.08 or higher.

Important:
There are differences between the terms Dual LMU[1] (from previous libraries) and Dual TCP/IP for the SL8500. Here is an overview between the two.

An overview of Dual LMU (9330 and 4430) and Dual TCP/IP (SL8500).

1. **Dual LMU (9330 and 4430):** Consists of a: 1) Master LMU and a 2) Standby LMU. Each LMU has its own connection to the host.
   - Dual LMU design is an **active/passive** design—the master LMU handles *all* requests from the host.
   - One Library Control Unit (LCU) is required per library storage module or silo (9310 or 4410).
   - The standby LMU monitors the state of the master LMU through a heartbeat between the two units. If the master fails to respond, the standby takes over.
   - The standby LMU can also take over for the master LMU when it receives a switch transmission command from HSC or ACSLS. The switchover process takes about eight minutes and requests in progress may be lost.

     Note: ACSLS and HSC **do not** automatically initiate a switch when communications to the master LMU fails.
   - Both LMUs are capable of being the master, but only one can be the master at a given moment.
2. **Dual TCP/IP (SL8500):** 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.

---

1. LMU = Library management unit

- Currently, there is only one HBC card in the SL8500 library.
- In the SL8500, the HBC card provides *all* of the functions of the LMU, the LCU, and the library communications facility (LCF).
- 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.

Benefits of Dual TCP/IP verses Dual LMU:

- Dual TCP/IP is **active/active**. ACSLS and HSC use both paths. 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.

  Dual LMU is **active/passive**. There is a risk that when the master LMU fails, the standby LMU may not be operational.
- ACSLS and HSC monitor the communication paths and automatically retry communications over the remaining path.

  With Dual LMU, ACSLS and HSC *do not* automatically switch to the standby LMU when they lose communication with the master. An operator must issue a “Switch LMU” command to cause an actual switch from the host software.
- With Dual TCP/IP, ACSLS, HSC or the SL8500 detect a communication path that is unavailable and automatically retry transmissions over the alternate path within seconds. Generally, transactions are not lost.

  When the standby LMU detects that the master LMU is not responding to the heartbeat, it takes about eight minutes for the standby LMU to re-IPL and become the master LMU. Transactions in progress may be lost.
- The SL8500 had redundant hot-replaceable power for the electronics. A power supply failure in the 9330 or 4430 LMU will take down that LMU.

Benefits of Dual LMU verses Dual TCP/IP:

- There is only one Library Controller card in the SL8500 at present. If the Library Controller fails, the SL8500 library complex is unavailable.

  However, none of the electronics in the Library Control Unit (LCU) on the 9310 and 4410 is redundant either.

Operational Differences

For customers familiar with other automated tape libraries, the following are a few operational differences they should consider for the SL8500.

LSM Preferencing

LSM preferencing is basically the same as with other libraries—it is the attempt to minimize any pass-thru operations by the elevators and pass-thru ports. ACSLS and HSC attempt to avoid any unnecessary pass-thru activity when they satisfy these requests:

- Mount scratch tapes—Selects cartridges based on their proximity to a tape drive.
- Query mount—Orders drives by LSM proximity to a cartridge.
- 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.

Mount and Dismount Commands

During a **mount**:

- Client requests specify cartridges by volume serial number (VOLSER) or volume ID (`vol_id`) and
- Specify 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 ejects the cartridge to the CAP magazine adjacent to the LSM.
- 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 of the CAP.
- For HSC, when using an **Ordered Eject**, the software (and library operation) ejects cartridges to CAP cells in VOLSER order.

Optimization Guidelines

Here are a few basic guidelines that can help optimize library performance. See Chapter 2, Library Content Management for more guidelines.

Fast Load

To optimize system performance, the HandBots *automatically* implement the *Fast Load* option.

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.

Cartridge Float

Whenever possible, enable *cartridge float.*

- Cartridge float is a feature that allows ACSLS or HSC 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.
- This feature minimizes elevator pass-thru activity by not requiring the cartridge to be returned to its original slot on another rail.
- This feature minimizes pass-thru port activity by not requiring the cartridge to be returned to its original slot in another library.

Tape Drive Placement

Some ways tape drives can enhance performance of the library are by:

- 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.

Evenly distributing the tape drives across all four rails is *not* necessarily the best approach. In fact, this can increase pass-thru activity by the elevator which may 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.

These requirements could 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.

- Arranging smaller groups of drives for special applications.
  Examples are 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 T9940 capacity-centric tape drives on another.

Front Door Operations

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

Every SL8500 library has two front doors that contain safety interlock circuits. 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.

When the main doors are 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. This can take from 30 minutes up to over an hour depending on the library configuration (number of storage expansion modules installed).

Service Safety Door

Figure 13. Service Safety Door

SL8500 libraries have an internal, service safety door feature that allows the HandBots to continue operation while the main door is open.

This feature is:

- O*ptional* with four HandBot configurations
- *Required* with eight HandBot configurations

The service safety door allows *trained service personnel* to access the reserved area to service the HandBots if a problem occurs.

Note: Only trained service personnel are allowed to activate this feature.

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 HBC card—the library controller.

The physical inventory contains:

- Volume serial numbers (VOLSERs) or identification (VOLIDs)
- Internal address locations (library, rail, column, side, and row)
- Verified status (as 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
- An audit request is made through StreamLine Library 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 HBC card inventory
- Set the status of the cartridge location to true

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

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

Audit Processes

The library performs a physical audit when you:

- Power-on the library
- Open and close the front access door
- Select and invoke a physical audit from the StreamLine Library Console

During the audit, the HandBots:

- Visit all cartridge slots,
- Catalog the VOLIDs with location, and
- Update the HBC cartridge database

The estimated times for such an audit are:

- 10 to 15 minutes for a library containing 1448 cartridges, up to
- 45 to 60 minutes for a fully populated library (6632 cartridges)

Important:
After the initial audit is complete, audits are then performed as background operations—the 10 to 60 minutes relates to the completion time for this background operation to complete.

It is not necessary to wait for an entire audit to complete before using the library.

Shortly after the SL8500 begins initialization—about 5 minutes after closing the front door or powering-on the library—the SL8500 can begin to perform mount and dismount requests to the tape drives.

This is because after the initial audit, the SL8500 uses its existing database from a previous audit to perform any requests.

If cartridges have not been moved, removed, or added, then all subsequent movement requests can proceed without interruption.

Note: Eight HandBots can audit the library quicker than four HandBots.

The SL8500 continues to perform *background audits* and updates the entire cartridge database in-between robotic operations. This background audit helps to insure that the cartridge database is accurate.

- If a particular cartridge has a request pending, and that cartridge has not been re-audited by the background process, the SL8500 will:
  - Audit and verify the cartridge at that location
  - Retrieve it (if it is the correct cartridge) and
  - Satisfy the request.
- When ACSLS or HSC requests an audit of a location in the SL8500 library, the library completes a physical audit of the location before it responds to the ACSLS or HSC request.

Verified Audit

Verified audits are invoked through StreamLine Library Console and *validate* the status of a specific cartridge slot or range of slots. If a cartridge in a slot has a status of “false,” the VOLID is audited and the database is updated.

- At the start of a Verified Audit, all locations are set to “*false*.”
- After the audit is complete, the locations are set to “*true*.”

Virtual Audit

Verified audits are invoked through StreamLine Library Console *and display* the physical inventory (cartridge database) in the Audit Console section of the StreamLine Library Console application.

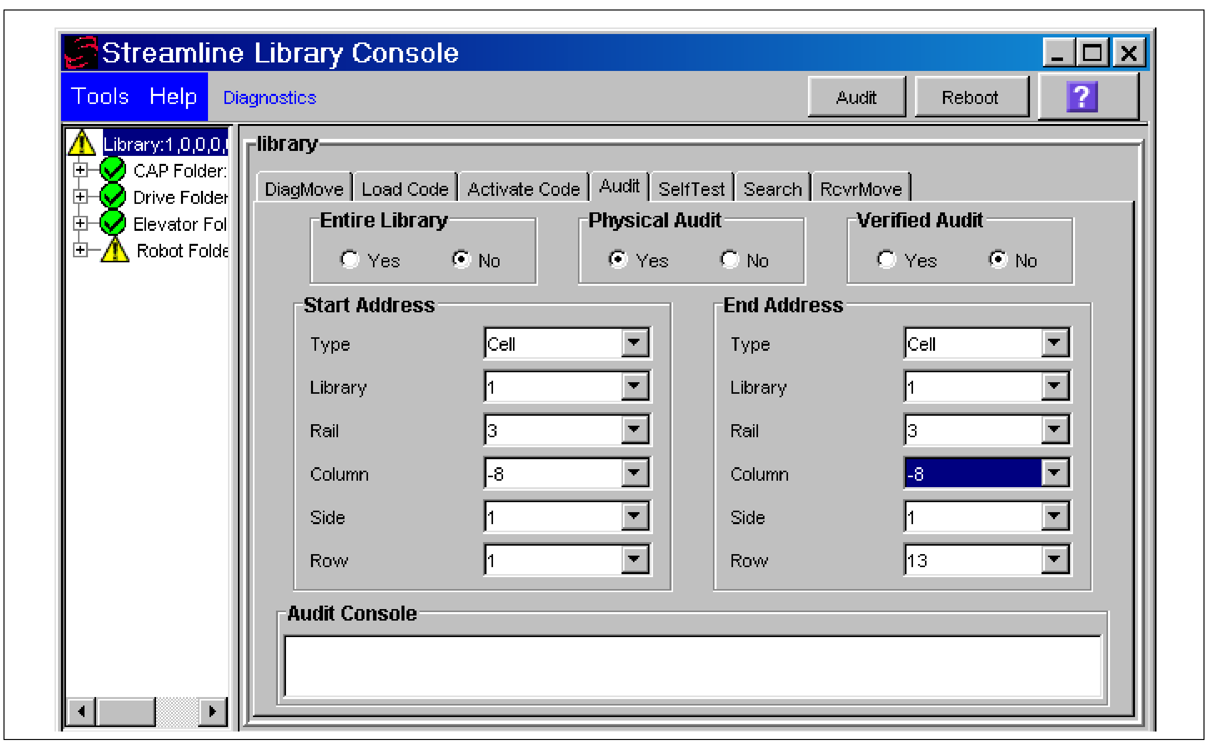
Caution:
***System problems:* The HBC physical inventory and the host’s cartridge record *must* match or system-level problems will occur.**

Remember also that the cartridge locations have unique notations between the SL8500 internal address and the host software’s perspective of HLI-PRC.

Library Console Audit Screen

Figure 14 shows and example of the Library Console Audit screen.

Figure 14. Audit Console



Scan Engine

The SL8500 library utilizes a “line scan” camera technology for reading barcode labels which differs from the PowderHorn “area scan” camera technology.

The scan engine uses a charge couple device (CCD) with an LED light source that is integrated into the cartridge gripping mechanism of the HandBot. These LEDs project a thin strip of light onto the barcode of the label. The white portions of the barcode reflect back an image to a lens that collects and focuses the pattern on to a multi-pixel CCD-imager.

The CCD-imager uses a technology similar to that of digital cameras except this imager uses a single row of sensors where digital camera use multiple rows. In essence, the CCD imager provides a very narrow picture that cuts across the bars in the barcode creating a digitized signal.

Because the SL8500 scan engine uses a light source that illuminates the label, anything that causes a reflection back into the lens could blind the CCD imager and cause barcode read problems. That is why the scan engine is mounted at an angle to the labels and targets to avoid any problems with reflection.

Line scan cameras provide a much higher pixel resolution with very robust barcode decoding algorithms which may be more sensitive to label orientation and placement on a cartridge.

Caution:
The SL8500 is able to scan upside-down LTO[1] or SDLT[2] cartridges and insert them into cells. However, mounts of these upside-down cartridges will fail. Currently, the library returns these cartridges back to the cell and does not eject them through the CAP.

1.LTO = Linear Tape-Open
2.SDLT = Super Digital Linear Tape (DLT)

Labels

The SL8500 library supports four types of barcode labels:

Table 9. 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

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

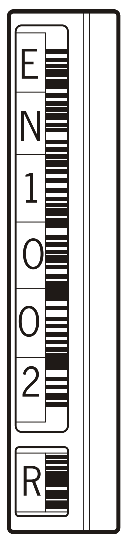
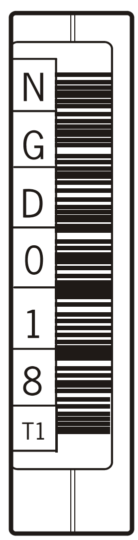
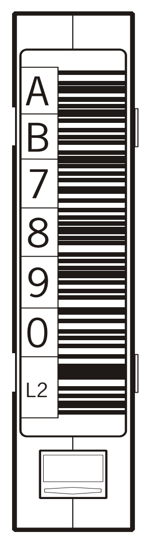
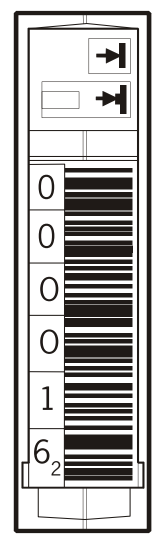
The use of *media ID* labels allows Sun StorageTek to mix tape drive types and media types in a single library or library complex. This provides customers with a true mixed media solution, which is called:

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 15 shows some examples of labels, media domains and IDs.

Figure 15. Label Examples

T9x40 **Six-plus-one**	**T10000** **Eight-characters**	**LTO** **Eight-characters**	**DLT and SDLT** **Seven-characters**
			
T9940 cartridge: P = T9940 Data W = Cleaning **T9840 cartridge:** R = T9840 Data U = Cleaning Implied domain = 0	**T10000 cartridge:** T1 = T10000 Data CT = Cleaning	**LTO data cartridge:** LT = WORM L3 = Gen 3 (400 GB) L2 = Gen 2 (200 GB) L1 = Gen 1 (100 GB) LA = 50 GB LB = 30 GB LC = 10 GB **Cleaning cartridge:** CU = Universal	**SDLTtape cartridge:** S = Super DLTtape I 2 = Super DLTtape II **DLTtape cartridge:** B = DLT1 C = DLTtape III D = DLTtape IV E = DLTtape III-XT *(Note: The SL8500 does not support DLT tapes or drives)* Implied domain = 1

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 will be exported through the CAP.

Upside Down Cartridges

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

For upside down LTO and DLT cartridges: The label can be recognized and may be placed into a slot. When the library tries to load the cartridge, the:

- drive will not allow the upside down cartridge to be inserted,
- cartridge is returned to its original slot, and
- drive posts a load error message to the host.

  The operator should verify if there is an upside down condition by exporting the cartridge through the CAP.

For upside down 9x40 cartridges: These cartridges do not fit correctly into the slots and can cause damage to both the HandBot and the cartridge.

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.

Library Content Management

2

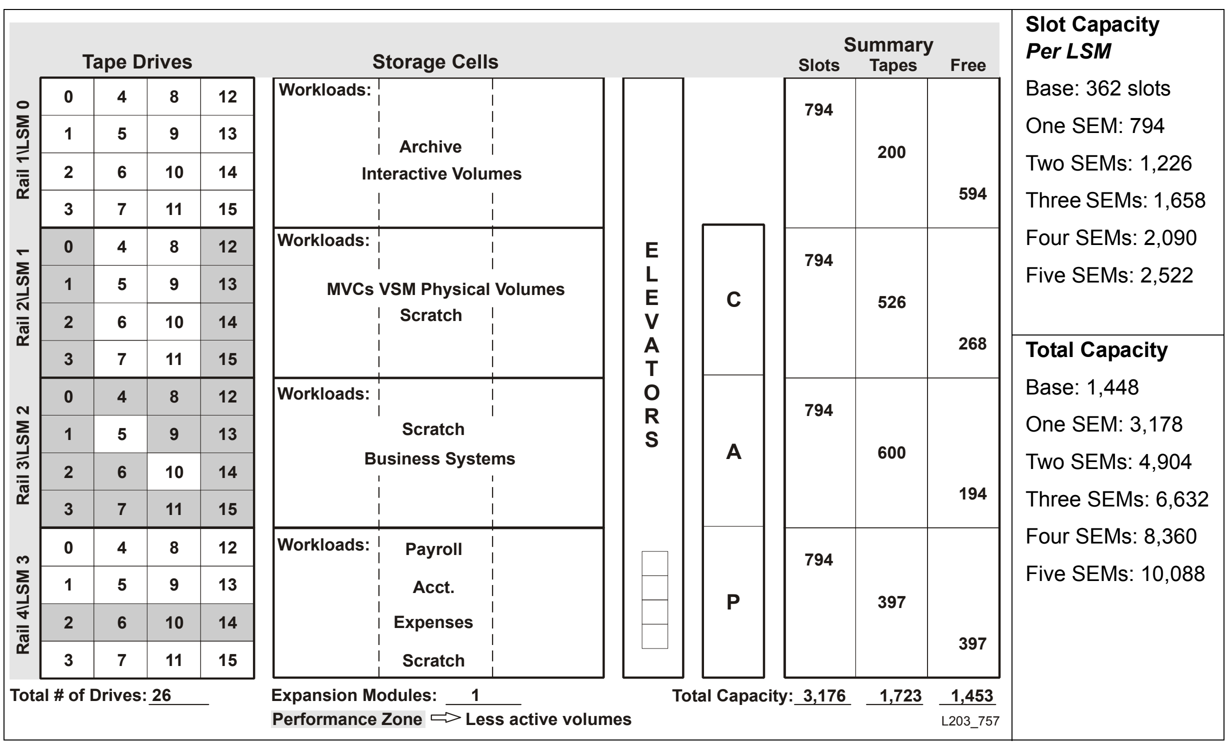
The *most important* change for the SL8500 is the need to *re-evaluate* the content management philosophy with respect to the physical structure and capacities of the SL8500.

- The SL8500 has four LSMs per library that work in *parallel*.
- Each of these four LSMs starts with a capacity of *362* cartridges[2].
- Couple this with a maximum of *16* tape drives per LSM.

The major consideration for content management is to allocate tape application workloads—scratch tapes, data tapes, and free cells—to LSMs with compatible tape drives to support these workloads. This reduces or eliminates pass-thru operations during production cycles.

Figure 16 shows an example of how a content management philosophy might look using the recommendations in this chapter for this configuration.

Figure 16. Content Management Example



2. The basic configuration of an SL8500 library is 1,448 cartridges; spread across four LSMs is equal to 362.

Evaluating the tape application workloads supported by an SL8500 consists of:

- Dedicating rails—separating workloads to specific rails
- Grouping tape drives—logically installing by type, function, and quantity
- Managing cartridges—moving inactive cartridges to archival LSMs or ejecting them
- Minimizing elevator and pass-thru port activity—enabling float and using CAPs

Using these strategies will help to optimize the SL8500 library and enhance performance.

Dedicating Rails

The SL8500 is not just another library. The SL8500 architecture is *four separate library storage modules* that work together in parallel. This architecture offers extremely flexible and scalable configurations that can *StreamLine* automated tape applications.

Instead of distributing cartridges and tape drives evenly across all the rails...

Look at it from a business perspective and logically plan each individual LSM to meet the customer's specific needs and business requirements. Allocate separate tape application workloads to specific library storage modules.

Recommendations include:

❏ **Separating rails**	• Ideally, try to confine each workload to a single LSM to reduce pass-thru activity—this improves performance. If this is not possible because the workload is too large, consider breaking the workload into smaller segments that do fit into a single LSM. • Allocate rails to each major application. *For example*: HSM and VSM both need tape drives and media. Plan separate rails for these types of applications.
❏ **Combining workloads**	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 (PTPs) to a different library
❏ **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*** 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. • For HSC-controlled systems, use the “`TLSM`” parameter on enter commands to direct cartridges to the top rail. • Consider using the top rail as an archival LSM—one that uses *less active* tapes; or as an LSM with *very active* tapes that requires fast access, uses T9840C tape drives, with few enters and ejects.
❑ **Entering and Ejecting cartridges**	• Whenever possible, enter cartridges through the cartridge access ports (CAPs). • 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 to load cartridges to specific rails is to load only the magazines adjacent to that LSM. The HandBot removes the cartridge from the magazine and places it in an empty cell in that LSM. Elevators • **Tip:** Place labels outside the CAP indicating which magazine and LSM gets what type of cartridge. For example: - LSM 1 uses T9840 tape drives, load that magazine with only 9840 tape cartridges - LSM 2 uses LTO tape drives, load that magazine with only LTO tape cartridges This will help operators identify what tape cartridges go to which rail.

Managing Cartridges

Managing cartridges—how cartridges are entered, ejected, handled, and treated—in the library can have an affect on performance. Some considerations include:

❑ **Using management applications (ExLM)**	Use a library management application such as ExLM with HSC to keep active volumes on the same LSMs as compatible drives and to migrate less active volumes.
❑ **Using float**	*Recommendation*: When *float* is on, ACSLS or HSC 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.
❑ **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**	*Recommendation*: Enter cartridges through the CAP. 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 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.
❑ **Ejecting cartridges**	*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 ACSLS or 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.
❑ **Archiving cartridges**	*Recommendation*: When using HSC with ExLM, move the *least recently used* (LRU) cartridges farther out on the rail, away from the tape drives and slots in the Performance Zone. *Note:* ACSLS cannot move cartridges to a panel, only to an LSM. Consider using the *top rail* as an archival LSM if the tape does not require CAP activity—few enters and ejects.
❑ **Managing space**	• Move *inactive* cartridges out of the library or off of an LSM to ensure there is adequate space for *active* cartridges. • Plan for times of *peak activity*. • Free cell management: - If the same drive-type and media-type are on the same rail for specific applications, fewer free cells are required. - If a specific application requires several enters and ejects or pass-thru operations, more free cells are required.
❑ **Supplying scratch cartridges**	Make sure each rail has the correct amount and type of data cartridges *plus* enough scratch cartridges to support the workload.
❑ **Starting the *watch_vols* utility**	The *watch_vols* utility allows you to define, change, assign, or remove ownership (pool_id) of volumes automatically.
❑ **Migrating cartridges**	Migrate the *least recently used* (LRU) cartridges away from tape drives and the performance zone or to archival LSMs. This ensures there will be space for the active cartridges closer to the drives.

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 T9940 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. *Indicating:* There are 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.
❑ **Using the CAP**	Enter tape cartridges so compatible media is on the same rail with the tape drives. *For example*: enter cartridges using a CAP magazine adjacent to the desired rail (LSM) where compatible tape drives are located.
❑ **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**	Use the SE tool TLC/FSM (Tape Library Configurator / Field Simulation Model) to determine the optimal drive configurations. When you supply a configuration and a workload (trace file of the mounts), TLC/FSM can output drive utilization statistics and suggestions. See Chapter 8, TLC/FSM.
❑ **Installing redundant HandBots (8)**	Configuring the SL8500 with eight HandBots (two HandBots per rail) provides redundancy. Install drives in the outer two columns (± 2) first—this allows both HandBots to access drives at the same time.
❑ **Managing tapes**	Use ExLM to help manage tape locations to provide quick access to tape drives.

Minimizing Elevator and PTP Activity

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

- ❑ **Mounting cartridges**

  Mount cartridges in tape drives that are on the same rail (LSM).

- ❑ **Using the float option**

  - Take advantage of the `float` option to limit pass-thru activity.
    - For ACSLS: float is the default
    - For HSC, verify: `MNTD Float ON`
  - Make sure volumes can *float* to locations in other LSMs—after a pass-thru—by maintaining some free cells within each LSM.
  - When dismounting cartridges, and *float* is on, ACSLS and HSC try to avoid an elevator (pass-thru) activity among LSMs by assigning a new home cell—if that cartridge's old home slot is in a different LSM.
  - ACSLS and HSC attempts to put the cartridge away:
    - In the same LSM as the tape drive
    - To the closest LSM to the drive with free storage slots

- ❑ **Entering cartridges**

  Enter cartridges into an LSM that has compatible tape drives for that media-type.

  Note: When entering tape cartridges, place them in the CAP magazine adjacent to the LSM where they will reside.

  For example: you only have T9840 drives on LSMs 2 and 3. You should enter 9840 cartridges in to the CAP slots adjacent to these LSMs.

- ❑ **Maintaining 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.

- ❑ **Keeping free cells**

  Make sure there are adequate free cells in each LSM.

- ❑ **Planning 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 with drive preferencing that the cartridge and drive are on the same rail between two LSMs.

  - Elevators have the capability of passing up to *four* tapes.
  - Currently, elevator pass-thru times are faster than the pass-thru ports.

  PTPs: If the library has high pass-thru activity using the elevator, consider using *adjoining* LSMs and the pass-thru ports.

  - PTPs have the capability of passing up to *two* tapes.

- ❑ **Using ExLM**

  Use ExLM for mainframe operating systems (such as MVS) to manage scratch cartridges.

Cartridge Access Port 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.

❑ **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 will cause 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, load that magazine with only 9840 tape cartridges
  - LSM 2 uses LTO tape drives, load that magazine with only LTO tape cartridges
  - LSM 3 uses cartridges for a specific application or job, load that magazine with the necessary cartridge types

  This will help operators identify what cartridges go to which LSM.

❑ **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 *less active* tapes; or as an LSM with *very active* tapes that requires fast access, uses T9840C tape drives, with few enters and ejects.

❑ **Inserting cartridges**

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.

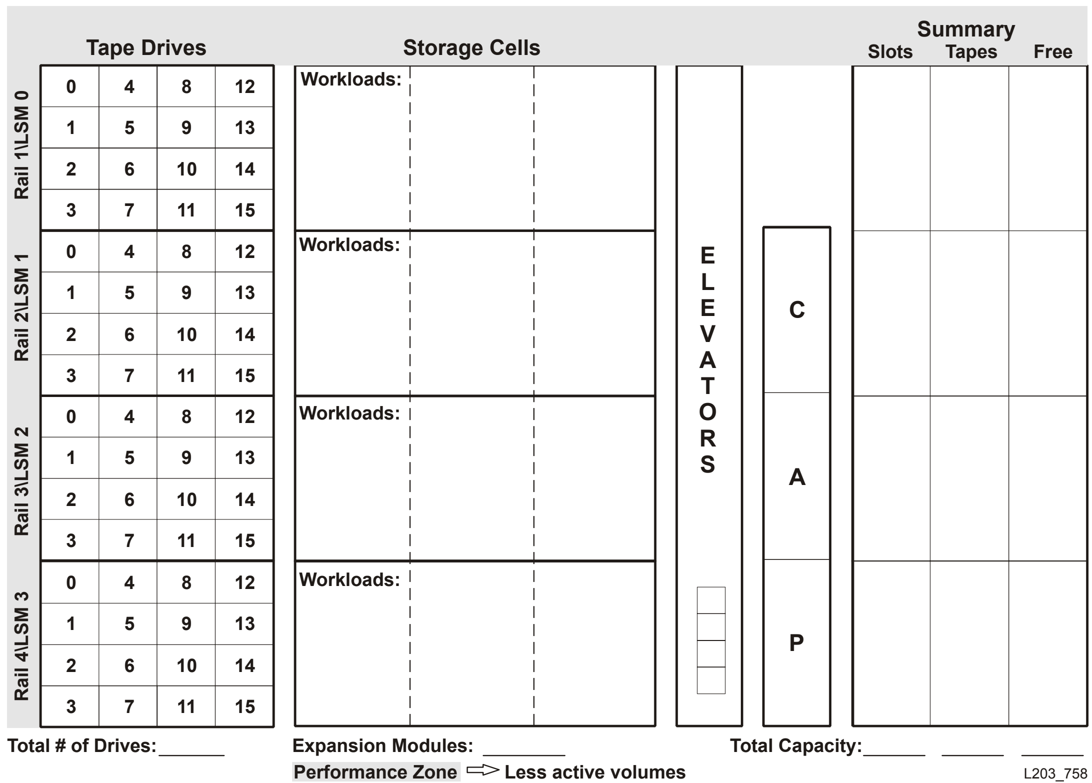
Note: You can skip magazine slots, but make sure all magazine arrays are in place.

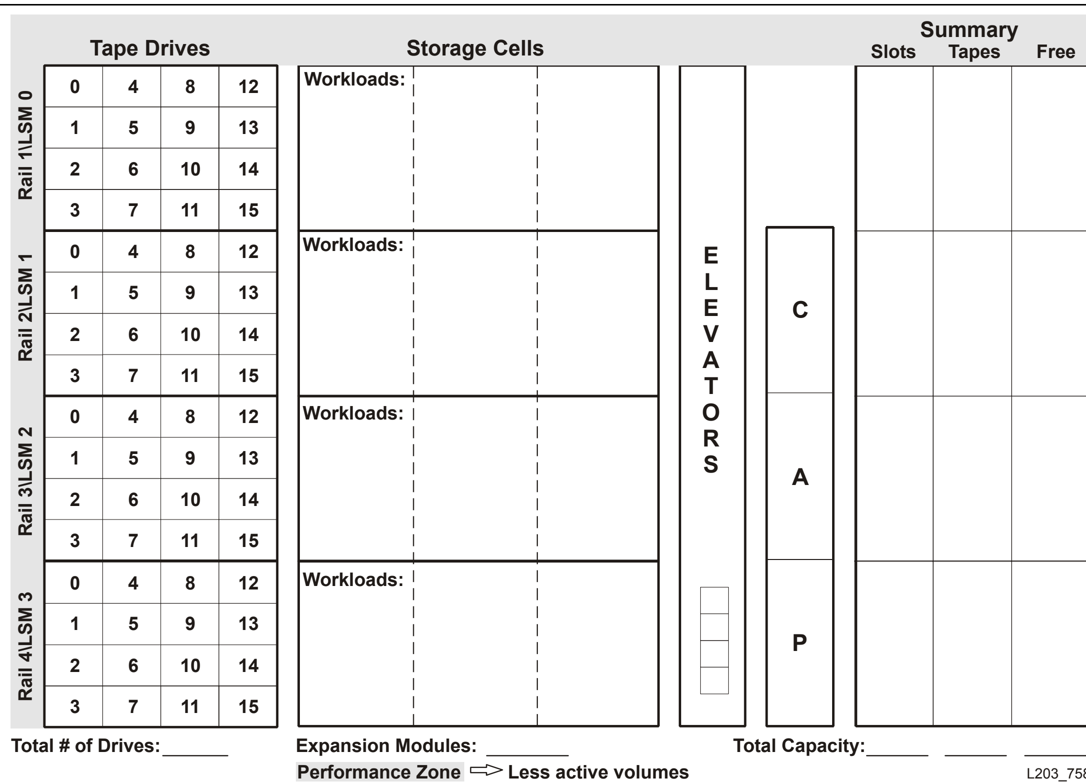
Hub-side

Planning for Content

Using Figure 16 on page 35 as an example, Figure 17 on page 42 provides space that you can use to help plan the content of an SL8500 library.

Figure 17. Content Management Plan





HSC Best Practices

3

This chapter provides HSC best practices for optimizing the StreamLine SL8500 library. These include:

- Minimizing Elevator and PTP Activity
- Configuring Tape Drives
- Managing Cartridge Locations
- Understanding SL8500 Internal Addresses
- Varying the SL8500 Offline
- Using the Service Safety Door
- Working Around an Inoperative HandBot
- Changing the HSC Recording Interval
- Using Dynamic Hardware Reconfiguration
- Before Reconfiguring HSC for the SL8500
- Changing the Configuration
  - Adding New SL8500 Libraries
  - Expanding an SL8500 Library
  - Merging or Splitting SL8500 Libraries

Refer to Appendix B, "HSC Support for the SL8500" in HSC *6.0* or *6.1 Operator's Guide* for more information and procedures.

Supported Software Levels

- HSC 6.0 with PTFs is the minimum level to support the SL8500 library.
- **HSC 6.1** contains additional support for the SL8500—such as Near Continuous Operation (NCO)—that allows the addition and deletion of panels, drives, and LSMs for Capacity on Demand without needing to reconfigure or restart HSC.

Note: Check the Customer Resource Center (CRC) for the latest PTF (program temporary fix) and PUT (program update tape) levels.

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.
- Take advantage of HSC “float” option to avoid 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, however, the default setting is for float to be 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 will be needed. For an SL8500, this means having scratch cartridges available on each rail (LSM) of the library.

  Use ExLM 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 T9940 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 will be 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 will 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 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, HSC 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.

- 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.
- Use a Library Management application (such as ExLM) to keep active volumes on the same LSMs as compatible drives. ExLM can also migrate less frequently used volumes to archival LSMs as directed by ExLM control statements. See Chapter 5, ExLM Best Practices 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 TLCFSM (Tape Library Configurator / Field Simulation Model) to determine the optimal drive configurations.

  When you supply a configuration and a workload (trace file of the mounts), TLC/FSM will output 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 Chapter 2, Library Content Management 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 SLConsole.

   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.

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

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

Understanding SL8500 Internal Addresses

There are differences in the SL8500 internal addresses and HSC addresses that you need to keep in mind. The SL8500 library list cartridge addresses by library, rail, column, side, and row. Other libraries supported by HSC list cartridge addresses by LSM, panel, row, and column.

- **LSM**
  The SL8500 library has four rails on which 4 HandBots travel. HSC considers each SL8500 rail as a separate LSM. From top to bottom, SL8500 rails are numbered from 1-4 while HSC LSMs are numbered from 0-3. For example, SL8500 rail 1 is equivalent to HSC LSM 0.

Table 10. SL8500 and HSC Mapping

HSC Mapping	SL8500 Mapping
LSM 0	Rail 1
LSM 1	Rail 2
LSM 2	Rail 3
LSM 3	Rail 4

- **Panels**
  SL8500 does not include panels.

Table 11. Panel Addressing

HSC Mapping	SL8500 Mapping
Panel 0	CAP
Panel 1	Drives
Panels 2-n The total number of panels depends on the configuration of the library.	Storage cells

- **Rows**
  Within each LSM (rail), rows are numbered consecutively from the top down. These start with 1 for the SL8500 and 0 for HSC.

- **Columns**
  As viewed from the CAP end, SL8500 column numbers are positive starting with +1 to the right of the center line of the drive bays. They are negative starting with -1 to the left of the drive bays. HSC reports two columns for each cell storage panel (columns 0, to the left of the drive, and 1, to the right of the drive).

For details, see "Understanding the Address Scheme" on page 7 and "Translating Addresses Using the Library Console" on page 10.

Translating Addresses

Use the StreamLine Library 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 SLConsole 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 SLConsole, because:

- HSC allows outstanding requests to complete before taking components offline, unless it is a vary offline force. Varying components offline via the SLConsole may cause outstanding requests from the HSC to fail.
- Prior to SL8500 Firmware Version 2.52, the SLConsole offline status is not communicated to the HSC.

  When the SLConsole varies SL8500 components 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 LSMids separated by a dash (such as `00:00-00:03`).

If an LSM (rail) is inoperative

If SL8500 Firmware Version 2.52 or later is not installed, and if an LSM is inoperative, modify the LSM offline:

`MODify LSM` *`lsm-id`* `OFFline`

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.

- Before closing the Service Safety Door on either the left or right side of the SL8500, vary the elevator on that side offline through the SLConsole.

  After the Service Safety Door is opened, vary the elevator on that side back online through the SLConsole.

- 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.

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.

Changing the 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 of **one hour**.

  ```
  INTERVAL(010000)
  ```

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

  ```
  INTERVAL(001500)
  ```

  Note: Customers using VSM 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 6.1, 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 StreamLine Library Console (SLConsole). 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 HSC *6.0 Operator.s Guide*, Appendix B, “HSC Support for the SL8500 LIbrary” or HSC *6.1 Operator.s Guide, “*MODify CONFIG command” and Appendix C, “HSC Support for Near Continuous Operation (NCO).”

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, Sun 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 Tech Tip on the Customer Resource Center:
> *HSC – Procedures to Update SL8500 Configurations*

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

Figure 18 shows an example of this numbering scheme.

Figure 18. Adding and Expanding on Configurations

Left | Right

ACS 0							
LSM 0C		LSM 08		LSM 04		LSM 00	Top
LSM 0D	P	LSM 09	P	LSM 05	P	LSM 01	
LSM 0E	T P	LSM 0A	T P	LSM 06	T P	LSM 02	
LSM 0F		LSM 0B		LSM 07		LSM 03	Bottom

Figure 19 shows and example of *splitting* the configuration above into two separate automated cartridge systems (ACSs).

Figure 19. Splitting Configurations

ACS 1		
LSM 04		LSM 00
LSM 05	P	LSM 01
LSM 06	T P	LSM 02
LSM 07		LSM 03

ACS 0		
LSM 04		LSM 00
LSM 05	P	LSM 01
LSM 06	T P	LSM 02
LSM 07		LSM 03

Figure 18 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 *6.0 Operator.s Guide*, Appendix B, “HSC Support for the SL8500 Library,” “Adding and Configuring SL8500s,” or HSC *6.1 Operator.s Guide,* Appendix C, “HSC Support for Near Continuous Operation (NCO),” “Adding and Configuring SL8500s.”

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, the customer 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 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 HSC can update the CDS with the new addresses of these cartridges.

For more information and procedures, refer to HSC *6.0* or *6.1 Operator's Guide*, Appendix B, "HSC Support for the SL8500 Library."

Refer to the Tech Tip on the Customer Resource Center:

- *HSC – Auditing an Expanded SL8500*

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 HSC *6.0* or *6.1 Operator.s Guide*, Appendix B, "HSC Support for the SL8500 Library," "Merging ACSs" and "Removing PTPs and Splitting ACSs."

VSM Best Practices

4

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

Configuring VSM for SL8500 Library

The number of real tape drives (RTDs) that attach to a single Virtual Tape Storage Subsystem (VTSS) is typically *8*—although there can be up to a maximum of *16*. This pool of tape drives is relatively small compared to large user native drive pools. HSC drive preferencing has always been available for native tape users; and, with a large number of drives per LSM, it has been very effective in reducing pass-through activity.

With only 8 RTDs typically available for migration and recall in a single VSM environment, customers can see a relatively low number of RTDs sitting idle. This has an impact on the opportunities for selecting the ideally placed RTD. As such, customers can experience high pass-through activity when more than one LSM is used. This is true in any library type configuration, but may be seen to a higher degree in an SL8500 because of the lower number of cells in each logical LSM; and, to some extent, due to the maximum number of 16 tape drives per logical LSM. The reason for this is, even with Virtual Tape Control System (VTCS) 6.1 LSM preferencing algorithms in place, the next drive allocated depends heavily on an RTD being available in the LSM where the Multi-Volume Cartridge (MVC) resides.

There is a very common misconception that having more than one LSM in any VSM configuration improves reliability by increasing redundancy. In fact, it does exactly the opposite in a VSM environment.

By increasing the number of LSMs that house RTDs attached to a single VTSS, the chance of Virtual Tape Volume (VTV) recall failure increases.

This is because, in the event of a failure in a two-LSM, single ACS configuration with simplexed VTVs, VTCS will usually be able to continue migration—since there should be available MVCs in each LSM—but about half of the VTVs will have become unavailable for recall back into the VSM buffer.

In the event of a failure in a two-LSM, single ACS configuration, VTCS will usually be able to continue migration—again since there should be available MVCs in each LSM—but about half of the VTVs will have become unavailable even with duplexed VTVs. This is true 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 does not completely address this issue because the MVCs can still be moved from one LSM to the other depending on RTD allocation.

In a two-LSM, multi-ACS environment with duplexed, triplexed or quadplexed VTVs, the customer 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.

■ Considering VTCS Maintenance

Customers should ensure that they have all of the latest PTFs applied to VTCS and HSC.

■ Configuring the LSMs and RTDs

The SL8500 is a new Library architecture. This is not new news—but, it is worth repeating because it means changing the way we currently think about VSM configurations. There is a smaller capacity per logical LSM, less tape drives per logical LSM, multiple storage elements available to consider, and both vertical and horizontal pass-thru capability.

The ideal configuration for RTDs in an SL8500 library to achieve optimum performance is to have all RTDs and all MVCs reside in one logical LSM, if possible, and to duplex to a separate ACS. This would eliminate any pass-through activity and allow for VTV redundancy and availability in the event of a failure in one ACS. For a customer with one to four VTSSs, with a typical RTD configuration of 8 RTDs per VTSS, this would mean occupying one logical LSM in each of two ACSs. This would be accomplished by connecting four RTDs to the local ACS and four RTDs to the remote, or second ACS, from each VTSS.

If this configuration cannot be achieved, because the customer has either more than four VTSSs and/or greater than 8 RTDs per VTSS, or because the number of MVCs cannot be housed within a single LSM, then the recommendation is to use as few LSMs as possible. Also, any LSMs used should be vertically adjacent to each other as far as possible. Vertical pass-thru tends to be faster than adjacent pass-through to another SL8500 library at the present time.

■ 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 (this would be the second best)
  - CDS (this is the 3rd choice and is the default)

  In a VSM environment, 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 the 9310 Powderhorn ACSs as the first ACSs in the definition, if they exist in the environment, followed by the Streamline SL8500 ACSs. Please refer to the *HSC Systems Programmer's Guide* for information on this HSC command.

- **VTCS Coupling Facility**
  If the VTCS Coupling Facility is used, which is implemented via the Coupling Facility Lock Structure parameter, LOCKSTR on the VTCS Config Global statement, and supporting HSC and VTCS PTFs applied:

L1H12E4	SOS6000	HSC 6.0
L1H12E6	SWS6000	VTCS 6.0
L1H12J3	SOS6100	HSC 6.1
L1H12J4	SWS6100	VTCS 6.1

  then all of 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, the customer must review their VTCS Migration Policies to ensure that they are appropriately set to accomplish their goal in optimizing performance of VSM in an SL8500 library complex.
- Parameter definitions to be reviewed are:
  - **TAPEREQ**
    To ensure that VTVs are being assigned the proper Management Class.
  - **Management Class**

    ACSlist parameter, if used, to designate ACSs instead of MIGPOL.

    MIGPOL parameter to ensure the correct numbers of 1 to 4 VTV copies are being directed to the appropriate ACSs.
  - **Storage Class**
    ACS parameter to specify which ACS is to be used for each Storage Class.
  - **MVCPool**
    If Named MVCPools are being used, to achieve MVC separation of volumes.
  - **VTSSSEL/VTSSLST** and **STORSEL/STORLST**
    These parameters, introduced in VTCS 6.0, allow the customer to specify lists of VTSSs and Storage Classes and their corresponding preferencing for certain functions within VSM to minimize MVC pass-thru operations by specifying VTSSs and ACSs.
- **Named MVCPools**
  The most efficient use of MVCs is not to use Named MVCPools. However, if the customer is separating and maintaining their VSM workloads in separate LSMs within an SL8500, then they should consider using Named MVCPools to complete MVC separation by having a Named MVCPool for each logical group. They should then use ExLM to manage the location of the MVCs within the ACS to ensure that they continue to reside in the desired rail.

  Note: If Named MVCPools are defined, please make sure that a default MVCPool is also defined.

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

Considering VSM Workload Separation

A customer's VSM workload should ideally be confined to a single LSM to avoid pass-thru operations.

If this is not possible because the workload is too large for a single LSM, then customers 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, which were introduced in VTCS 6.0, can be used to preference VTSSs and ACSs for zero pass-through, 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 the *VTCS Command and Utility Reference* for instruction on the use of these VTCS parameters.

A better way for planning workload separation for VSM in a SL8500 is to logically separate the workload by determining “active” groups of MVCs and “extended store” groups of MVCs.

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

Managed by ExLM, this will:

- Allow VTCS to take advantage of 6.1 RTD preferencing to have the more active MVCs and RTDs housed together on the same rails.
- Minimize internal elevator pass-thru operations and optimize performance.
- Require some analysis of the customer's VSM workload to achieve.

Analyzing Workloads and Separating MVCs

To analyze VSM workloads and logically separate MVCs into active and inactive MVC groupings:

- Identify active groups of MVCs:
  - Scratch MVCs
  - Usable MVCs with space available
  - MVCs with Last Use Date < x days old
  - MVCs with high defragmentation percentage
  - Place those MVCs in LSM 1 (where all RTDs reside)
- Remaining MVCs will then be the inactive or less active MVCs:
  - Full MVCs
  - Read-only MVCs
  - Backup Volumes
  - MVCs with Last use Date > x days old
  - Place those MVCs in LSMs 0, 2 and 3
- Run an ExLM Volume Report to obtain a history of the 9310 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.

VSM Configuration Hierarchy

Use the following VSM configuration hierarchy to determine RTD and MVC placement within a SL8500 Library:

- Determine total # MVCs
- Multiplexing (2, 3, 4 VTV copies)
- Location of multiplexed copies (different/same ACS)
- Determine # logical LSMs required to fit MVCs
  - If multiplexing to different ACSs, then focus on one copy first
  - If same ACS, then focus on all copies
- Determine # RTDs that can fit in one SL8500
  - Divide total RTDs for each VTSS by number of ACSs
- Determine logical LSMs for one SL8500 required
- Consider workloads
  - Analyze “active” versus “extended store”
- Determine RTD & MVC placement based on above criteria

Placing RTDs and MVCs within the Library

The ideal MVC placement is within one LSM.

If capacity requirements force the user to use more than one LSM, then the recommendation is that the customer

- Duplex to separate ACSs,
- Implement 6.1 for device preferencing, and
- Consider over-configuring the number of RTDs.

Duplexing will protect against media failure and, in a different ACS, will also provide protection against robotic failure.

Identify MVCs to place in the “active” LSM (I am referring to it as LSM1)

- Scratch MVCs
- Usable MVCs with > 3% space available (still in migration pool)
- MVCs with MDAYS < x days old—review ExLM Volume Report to determine what the x days old should be (this is customer specific)
- MVCs with high defragmentation %—Review MVC Report
- Place those MVCs in LSM1

Place all remaining MVCs (inactive, or less active) in the “extended store” LSMs (LSMs 0, 2 and 3).

Consider loading LSM 0 with the inactive groups of MVCs first by using all three CAP magazines and the TLSM parameter to move the MVCs to LSM 0.

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 ExLM to manage the continual rotation of scratch MVCs and to move MVCs from “extended store” LSMs to the “active” LSMs where the RTDs reside and also to move MVCs from the “active” LSMs to “extended store” when they exceed MDAYS.

Implement VTCS 6.1 to take advantage of RTD preferencing.

Consider over-configuring RTDs if requirements for “active” MVCs are greater than one LSM.

Set FLOAT(ON) to ensure that an MVC remains on the rail where the RTD is located.

RTD Preferencing

Prior to VTCS 6.1, there was no RTD device preferencing. In 6.1, VTCS first selects the target MVC and then will attempt 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, then VTCS attempts no further preferencing and RTDs residing in other LSMs are selected randomly, based on migration policies that are in place.

Keep in mind that, even if VTCS device preferencing were to be architected to achieve shortest path, like HSC does today, because of the limited number of RTDs that can be connected to each VTSS, even if over-configured to a maximum of 16, the chances of an RTD being available in the LSM where the MVC resides is much less likely than it would be in a native tape environment.

ExLM Best Practices

5

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

This chapter provides the current best practices for using Expert Library Manager (ExLM) with the StreamLine SL8500 library.

These include:

- Adjusting Content Management Philosophies
- Using Pass-thru Mechanisms
- Ejecting Cartridges and Entering Cartridges
- Using the Performance Zone
- Locating Physical Tape Cartridges
- Changing Configurations

Note: The current software level for ExLM is 6.0.0

Selection Criteria

Planning for an ExLM solution should focus on how the customers uses their automated tape libraries, such as:

- How many scratch volumes do they use in an average day?
- When do operators enter volumes?
  - At the beginning of the day
  - Throughout the day as necessary
  - During each shift
- Does the customer 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 they 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 ExLM 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[3].
- Couple this with 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 will be mounted is why ExLM is an important tool that can help optimize the performance of the SL8500.

In addition, to support the SL8500, ExLM 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.
- Added an option—called Eject Sequence (`EJSEQ`)–to the Eject Utility that allows HSC to ignore the ExLM specified eject order to minimize pass-thru operations.
- 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

3. The basic configuration of an SL8500 library is 1,448 cartridges; spread across four LSMs is equal to 362.

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.

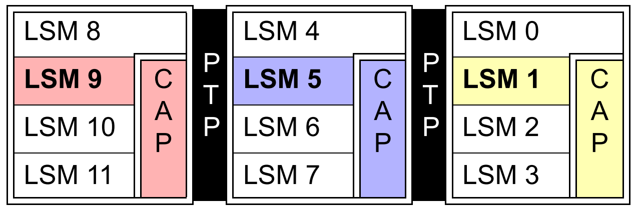
Pass-thru ports: Provide *horizontal* pass-thru operations between libraries. These mechanisms are located in the rear of the library for quick access to an available tape drive.

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. In some cases, it is simply not possible to eliminate pass-thru operations as the minimum number of active volumes or tape drives used exceeds the capacity of a single SL8500 LSM. That does not mean that there are still opportunities for reducing the aggregate pass-thru rate.
Consideration:	If pass-thru operations are required, which type of pass-thru is best?
Recommendation:	That it depends. The design of ExLM is to place workloads so that the volumes and the tape drives are on the same LSM. If the workload requires two LSMs, ExLM 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. The Tape Library Configurator and Field Simulation Model (TLC/FSM) is an SE tool that 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. Horizontal or combinations of both vertical and horizontal moves would result in several pass-thru operations for a single mount.

■ Ejecting Cartridges

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

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



ExLM directs all cartridge ejects to those specific CAPs on the appropriate LSMs. The CAP on other LSMs is simply non-existent, meaning:

- Ejects directed to those LSMs will fail.
- Ejects directed to the nearest CAP will use the CAP owned by LSM01.

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

As ExLM ejects volumes in the specified sequence—the default is by ascending volume serial number—the result can be a significant number of vertical pass-thru operations.

Important:
ExLM 6.0.0 provides an option specific to the SL8500 that allows HSC to ignore the ExLM 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 ExLM run.

- `EJSEQ` requires HSC to honor the ExLM 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 ExLM specified sequence) and may require manual sorting to restore the volumes in the proper sequence.

Because the top rail (LSMs 00, 04, 08, 0C, 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[4].

---

4. **Aggregate backup and recovery support (ABARS)**. 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, ExLM 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 `ExLM Sync` run after all enters are complete to ensure proper scratch status.

Using the Performance Zone

ExLM support for the SL8500 implemented the concept of the Performance Zone (PZ). The performance zone is an area within an SL8500 LSM that is closest to the tape drives. Because of the physical location of the PZ, volumes in this zone have faster access and response times to the tape drives.

- The size of the PZ is limited to 362 slots—making it too large would negate the effect—the capacity of one LSM in a basic SL8500 library configuration.
- 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 2) Eject(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.

Non-PZ volumes are moved out of this area to make room for specific volumes until the PZ zone is full. These volumes would extend into the storage expansion modules.

Locating Physical Tape Cartridges

Many ExLM 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);
```

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

Changing Configurations

The overall ExLM 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 ExLM.

- Placement of volumes with ExLM is a function of the control statements and options selected for the ExLM management run.
- Change the control statements and options for the new configurations.
- During the next run, ExLM 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.

ACSLS Best Practices

6

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

Note: Refer to the *ACSLS 7.1 Installation, Configuration, and Administration Guide* for more information and procedures.

Supported Software Levels

ACSLS 7.1 with PUT0502 has many fixes and enhancements, plus this is a prerequisite for all future maintenance.

This level of software with the SL8500 library firmware of 2.52 is not limited to eight HandBot enhancements—the SL8500 returns “LSM Not Ready” messages when inoperative, degraded, or offline.

Note: Check the Customer Resource Center (CRC) for the latest PTF (program temporary fix) and PUT (program update tape) levels.

Minimizing Elevator and PTP Activity

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

Mounting cartridges	Whenever possible, when mounting a tape, use cartridges and tape drives that are in the same LSM. 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
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 T9940 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 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.

Understanding SL8500 Internal Addresses

See Chapter 1, "SL8500 Architecture" and "Understanding the Address Scheme" on page 7 for a detailed discussion.

Translating Addresses

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

See Chapter 1, "SL8500 Architecture" for information about "Translating Addresses Using the Library Console" on page 10.

Finding Missing Cartridges

Caution: 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 (see "Library Console Audit Screen" on page 31 for an example).

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 SLConsole.
   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 StreamLine Library Console to vary components offline to ACSLS (such as ACSs, LSMs, and CAPs).

- Varying components offline using SLConsole in essence is like using a "force" command and may cause requests in progress to fail.
- The SLConsole 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`.
- Prior to SL8500 firmware version 2.52, the "LSM Not Ready" (offline) status is not communicated to ACSLS. In this case, you must vary components offline to ACSLS.

When to Vary Components Offline to ACSLS

- Before opening the access door, vary the ACS or all four LSMs offline.
  - For a standalone SL8500, vary the ACS offline:

    `vary acs *acs_id* offline`

  - For a SL8500 connected through PTPs, vary all four LSMs (in the SL8500 whose access door will be opened) offline using the following command four times (once for each of the four LSMs):

    `vary lsm *lsm_id* offline`

- If an LSM (rail) is inoperative.

  Prior to SL8500 firmware version 2.52, the "LSM Not Ready" (offline) status is not communicated to ACSLS. In this case you must vary components offline to ACSLS with:

  `vary lsm *lsm-id* offline`

  With version 2.52, the SL8500 library notifies ACSLS that the LSM is not ready (inoperative).

- If a CAP is inoperative, vary it offline:

  `vary cap *cap_id* offline`

Using the Service Safety Door

Important:
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 the SLConsole:

Before closing the Service Safety Door on either the left or right side:

- Vary the *elevator* on that side offline
- After the door is opened, vary the elevator on that side back online

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:

- 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.

Updating ACSLS after a HandBot Installation

When you go from four to eight HandBots in the library, you need to update the ACSLS library configuration to reflect their presence.

You can select one of the following ways to do this:

- Install the following PTFs so ACSLS can dynamically update the database with new records for the HandBots. With this option the library always remains online. This is the preferred method.

  - Solaris
    PTF835924S and PTFmsgs710S which updates the message file with a new message (2559)

  - AIX
    PTF835924A

  For installation instructions, refer to the documents associated with the tar files for the PTFs on the Customer Resource Center (CRC) Website.

- If you have not installed these PTFs, you must update the ACSLS library configuration by:

  1. Shutting down ACSLS.
  2. Running `acsss_config`.

     This updates the ACSLS configuration to reflect the presence of the eight HandBots.

  3. Starting ACSLS.

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 ACSLS 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 ACSLS.
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 - ACSLS will place cartridges only in the top magazine.

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

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 StreamLine 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 ➪ 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.

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

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

Without PTPs, ACSLS will not know that the SL8500 rails are connected.

Refer to the *ACSLS 7.1 Installation, Configuration, and Administration Guide - CRC Update* 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.

CAUTION: ***Do not*** **add SL8500 libraries with more than one Storage Expansion Module using dynamic configuration.**

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, Sun 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.
>
> Refer to the Tech Tip on the Customer Resource Center:
> *ACSLS – Procedures to Update SL8500 Configurations*

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

Figure 20 shows an example of this numbering scheme.

Figure 20. 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

Figure 21 shows and example of *splitting* the configuration above into two separate automated cartridge systems (ACSs).

Figure 21. Splitting Configurations

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

Figure 20 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 7.1 Installation, Configuration, and Administration Guide - CRC Update* - appendix “ACSLS Support of the SL8500” - section “Adding new SL8500s “.

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, the customer 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 7.1 Installation, Configuration, and Administration Guide - CRC Update* - appendix “ACSLS Support of the SL8500”.

Refer to the Tech Tips on the Customer Resource Center:

- *ACSLS – Auditing an Expanded 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 7.1 Installation, Configuration, and Administration Guide - CRC Update* - appendix “ACSLS Support of the SL8500” - sections “Merging ACSs” and “Removing PTPs and Splitting ACSs”.

Using ACSLS HA

ACSLS HA (High Availability) is a software/solution offered by Professional Services. This solution is available for the Solaris 8 and 9 platforms.

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. 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
```

and can contain 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.

CAUTION: **Setting this variable to “0” is NOT recommended in environments with multiple libraries. If this is set in environments with multiple libraries, failing over will impact all libraries.**

- 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.

Note: Please refer to the Readme for PTF830785 for a complete description of the FAIL_OVER variable.

Independent Software Vendors 7

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?

Do the different network components support each other?

Check out the Interoperability Tool at:

https://extranet.stortek.com/interop/interop

The Interop Tool is designed for connectivity information on all supported products sold through Sun Microsystems, Inc. regardless of whether Sun branded or third party branded. The configurations listed are reflective of the most up-to-date information reported from various sources, including Sun testing labs and our technology partners.

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

■ Characteristics

Table 12 discusses some of the characteristics for software applications.

Table 12. 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 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 display the status of media-compatible tape drives for a specified data volume or scratch pool (and, optionally, with a specific volume within that pool).
Usage of the '`float`' option	Determining when setting `float` on benefits an application and if it does not.

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.

For 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.

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 Veritas 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.

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

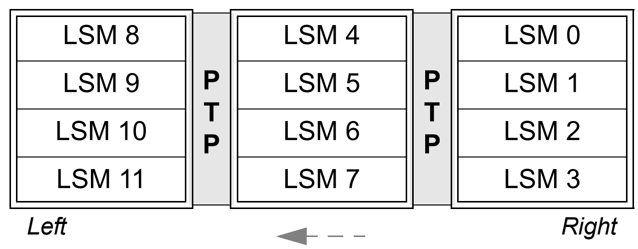
   This is an example of the ISV software trying to minimize elevator movement.

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.



Note that the quickest way to get a tape from LSM 1 to LSM 5 is not vertical but horizontal using the pass-thru ports between the libraries.

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

Fencing or Pooling

Some ISV software is capable of associating a drive and media in the same LSM to a specific pool which enables the user to associate only those drives with that media in an LSM.

This also prevents LSM moves. It requires the number of drives within that LSM to be greater than the number of concurrent jobs being run to that LSM. 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 does not run.

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 display the status of the tape drives attached to the same ACS as the volume and compatible with the media type. The compatible tape drives are in order by proximity to the specified volume.
Example	To display the proximity status of tape drives for volume STK012; Enter: `query mount STK012`

query mount *

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`

■ Other ISVs

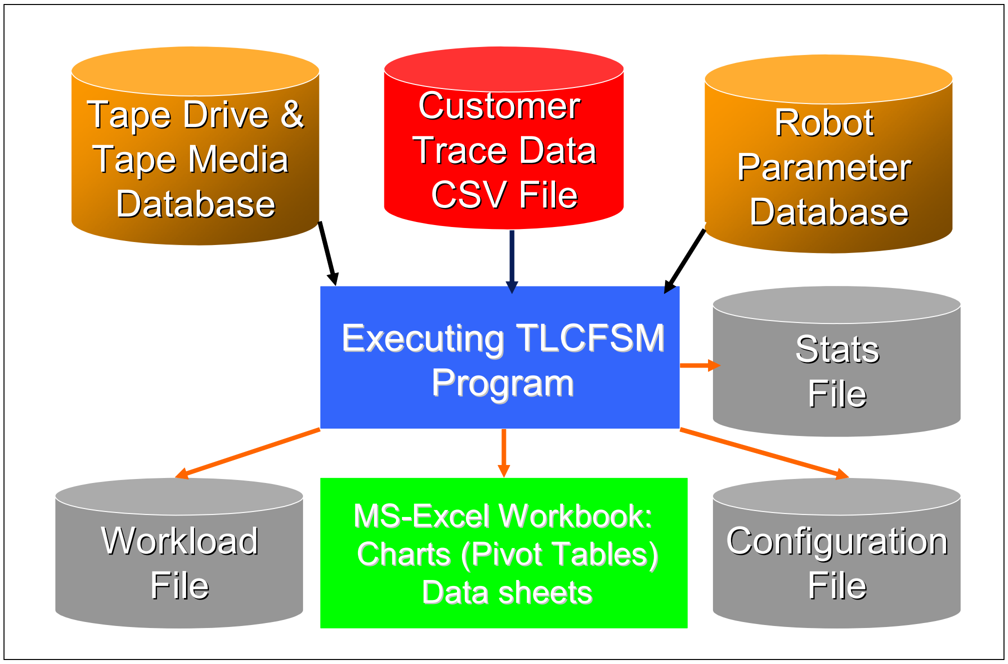
Some ISV software is capable of associating a drive and media in the same LSM to a drive/media pool which enables the user to associate only drives and media within that LSM. This also prevents LSM moves. It requires the number of drives within that LSM to be greater than the number of concurrent jobs being run to that LSM. 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 does not run.

TLC/FSM

8

This chapter provides an introduction to the Tape Library Configurator Field Simulation Model (TLC/FSM). This model is a discrete event simulator that analyzes historical customer trace data for modeling and configuring tape library systems.

Figure 22. Tape Library Configurator Field Simulation Model



There are a few ways of downloading the tool.

Go to Sun Microsystems SE Support Tools:

- Click on: http://xmen.east/setools/TLC_FSM/tlc_content.html or
- Click on: http://xmen.east/setools/index.html#TLC and scroll to the TLC Field Simulation Model (TLCFSM)

■ 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)` is 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.

Ethernet Connectivity

9

This chapter provides network examples for the Dual TCP/IP feature—a feature that provides two separate TCP/IP connections to an SL8500 library.

Note: These connections are not redundant, they are two separate, active/active interfaces that must *not* connect to the same subnet.

Each example provides a drawing with routing tables and the CLI commands used to configure each example.

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 the customer's 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, the customer's network and their desired topology are ultimately the determining factors. When a more complicated setup is required, consultation between the system administrator and Sun professional services may be necessary and are available.

TCP/IP Important Considerations

Connections:
When you create an SL8500 library complex by connecting libraries together with pass-thru ports, all hosts must connect to only **one** library in the complex—preferably to the first or right-most library.

Multiple host communication connections to more than one SL8500 library will cause problems.

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, devices that are communicating with the library 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 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 13. Network Entries

Description		IP Address
Port 2A	Host name to Port 2A	
	HBC Card Port 2A	
	Gateway Port 2A	
	Netmask	
Port 2B	Host name to Port 2B	
	HBC Card Port 2B	
	Gateway Port 2B	
	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 Sun Storage TSC Tape Library Team before the installation.
- ❑ Service also recommends TSC involvement during all Dual TCP/IP installation, planning, and implementation phases.
- ❑ Technical support will be limited to those configurations approved by the Sun Storage TSC Tape Library team.
- ❑ Any services provided for Dual TCP/IP installations not approved by Services will be billed on a time and materials basis.

ACSLS and Dual TCP/IP Support

The purpose of dual TCP/IP is to automatically recognize and avoid a failing communication path. Since this is automated, there is no need for you to manually switch from an inoperative connection. The best solution is having ACSLS keep two connections to the library open because ACSLS will use all active connections. If one connection is inoperative, ACSLS will just use the remaining operative connection, while continuing to try to reestablish communication on the failing connection.

ACSLS provides the ability to configure two TCP/IP connections to a single library using "`acsss_config`" or the Dynamic Configuration "`config`."

> When configuring libraries, the user is asked how many connections there are to the library and then the name of the devices (IP addresses).

In order to take full advantage of Dual TCP/IP support on the SL8500, use the "`route`" command to manipulate the routing tables on the ACSLS server.

Is there a preferred configuration?
The preferred configuration for Dual TCP/IP implementations is two network interfaces on two separate subnets for the ACSLS server. This provides maximum throughput and minimum resource contention with regard to network communications while adding a second physical connection improving reliability.

For more information about ACSLS, the SL8500, and Dual TCP/IP, refer to the *ACSLS Installation Configuration and Administration Guide* (ICAG).

Notes:

- Always refer to the Customer Resource Center (CRC) for the latest Tech Tips, code updates, and information.
- **Make sure you use and reference the ACSLS documentation to configure the routing tables on the ACSLS server to support Dual TCP/IP.**

The minimum level of software required is:

For ACSLS 7.1 for Solaris on SPARC or AiX.

- Apply PUT0601 and the following PTFs:
  - ACSLS 7.1.0 for Solaris on SPARC: PTF849144S
  - ACSLS 7.1.0 for AiX:PTF849144A

For ACSLS 7.1.1 for Solaris on X86.

- Apply PTF849144*x*

For ACSLS HA.

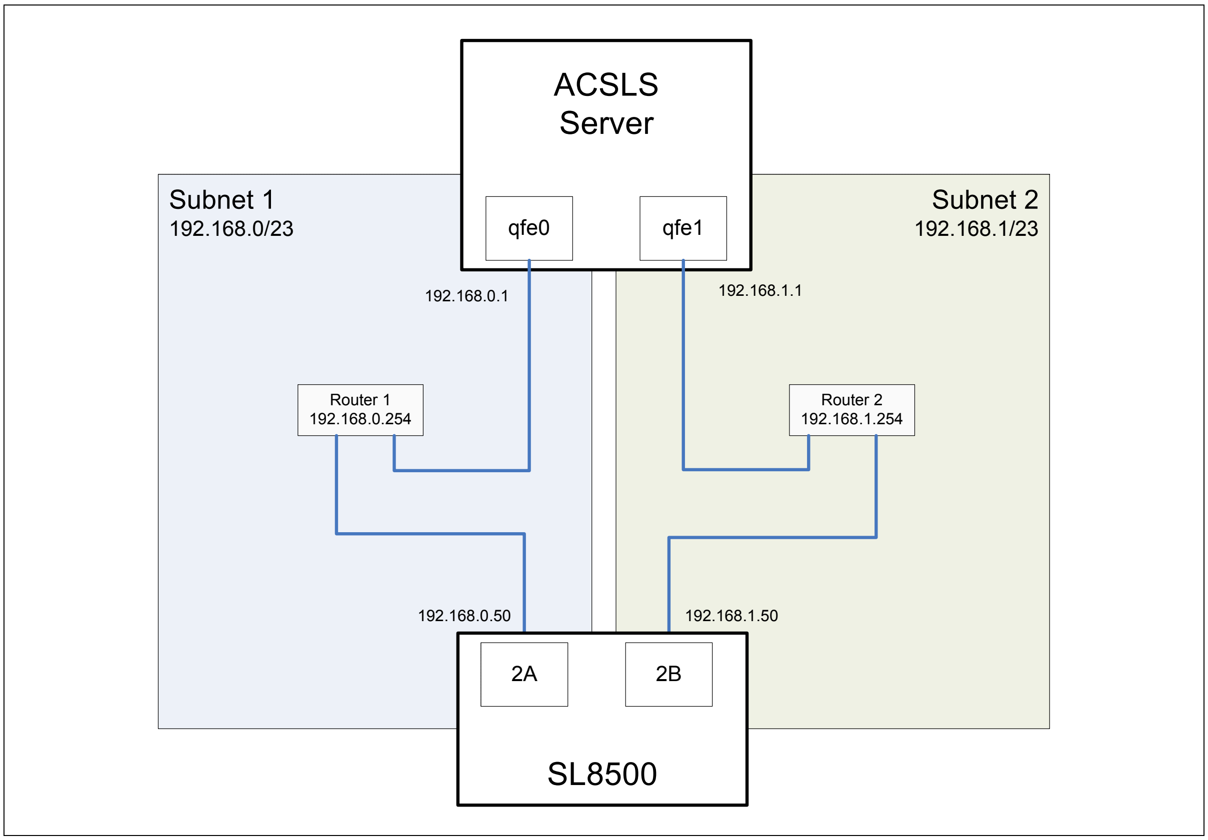
- Refer to the ACSLS documentation for information about Dual TCP/IP.
- Contact Sun Professional Services to configure HA systems

ACSLS Configuration One

The following example is one of the preferred configurations for ACSLS with the Dual TCP/IP feature.

In this configuration, the ACSLS server contains two network interfaces that reside on two separate subnets—both going directly to the SL8500 library on the same two subnets as the server, one port each.

Figure 23. ACSLS Configuration One



In this example, the SL8500 uses a one-to-one relationship with the network interfaces on the ACSLS server in which the:

- qfe0 interface communicates with the 2A interface on the SL8500
- qfe1 interface communicates with the 2B interface on the SL8500

Note: *qfe0* and *qfe1* are simply network interface card (NIC) identifiers for these ACSLS examples.

Using the UNIX “route” commands, you force this relationship. To do this:

- For Solaris: as user root, enter the following commands:

```
# route add 192.168.0.50 -ifp qfe0 192.168.0.254
# route add 192.168.1.50 -ifp qfe1 192.168.1.254
```

- For AIX: as user root, enter the following commands:

```
# route add 192.168.0.50 -if qfe0 192.168.0.254
# route add 192.168.1.50 -if qfe1 192.168.1.254
```

The first route command routes any communication with 192.168.0.50 to go through qfe0 on the ACSLS server and then go through Router 1.

The second command routes any communication with 192.168.1.50 to go through qfe1 on the ACSLS server and then go through router 2.

- To validate the routes in the routing table, enter:

```
# netstat -r
```

Table 14. Routing Table ACSLS Configuration One

Destination	Gateway	Flags	Ref	Use	Interface
192.168.0.50	192.168.0.254	UGH[1]	1	0	qfe0
192.168.1.50	192.168.1.254	UGH	1	0	qfe1
192.168.0.0	192.168.0.1	U	1	7	qfe0
192.168.1.0	192.168.1.1	U	1	0	qfe1
BASE-ADDRESS.MCAST.NET	192.168.0.1	U	1	0	qfe0
default	192.168.0.254	UG	1	33	
localhost	localhost	UH	4	77	lo0

1.U = User, G = Group, H = Host

You can see the first two entries are the ones that were just added. All communication with 192.168.0.50 will go through qfe0 and communication with 192.168.1.50 will go through qfe1.

Remember: You must also configure the SL8500 routing tables. Refer to the *Dual TCP/IP Technical Brief*, TM0019 or the *SL8500 Installation Manual*, PN 96138 for more information.

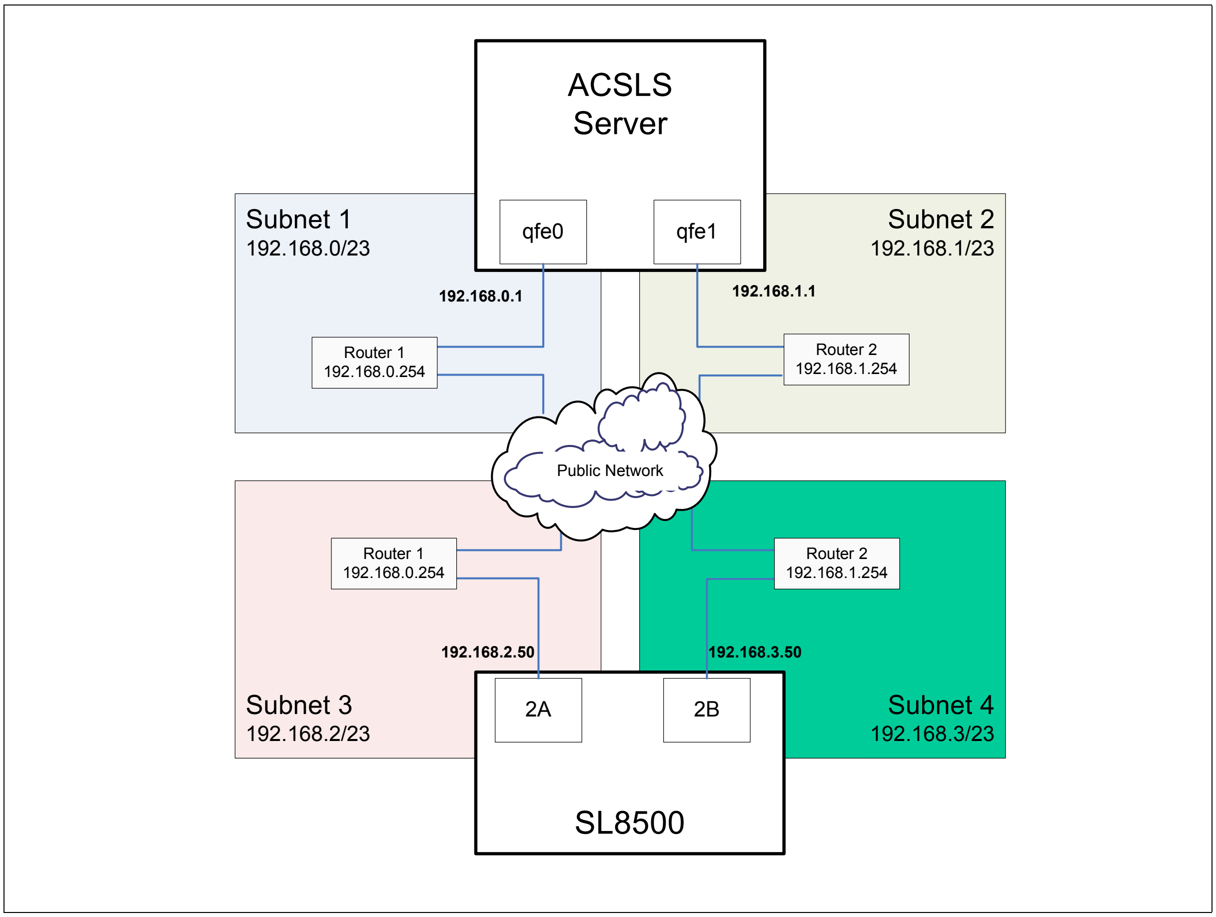
ACSLS Configuration Two

The following is another preferred example of an ACSLS configuration with Dual TCP/IP.

In this configuration, the ACSLS server contains two network interfaces that reside on two separate subnets, same as the previous example. However, both interfaces pass through a public network and into two different subnets before connecting to the SL8500 library.

Even with this difference, the commands stay the same.

Figure 24. ACSLS Configuration Two



In this example, the SL8500 uses a one to one relationship with the network interfaces on the ACSLS server in which the:

- qfe0 interface communicates with the 2A interface on the SL8500
- qfe1 interface communicates with the 2B interface on the SL8500

Using the UNIX "route" commands, you force this relationship. To do this:

- For Solaris: as user root, enter the following commands:

```
# route add 192.168.0.50 -ifp qfe0 192.168.0.254
# route add 192.168.1.50 -ifp qfe1 192.168.1.254
```

- For AIX: as user root, enter the following commands:

```
# route add 192.168.0.50 -if qfe0 192.168.0.254
# route add 192.168.1.50 -if qfe1 192.168.1.254
```

The default routes for the ACSLS remain the same as configuration one.

The routes within the subnets know how to route communication to the SL8500 through the public network and still enforce the one-to-one relationship between the interfaces.

- To validate the routes in the routing table, enter:

```
# netstat -r
```

Destination	**Gateway**	**Flags**	**Ref**	**Use**	**Interface**
192.168.0.50	192.168.0.254	UGH[1]	1	0	qfe0
192.168.1.50	192.168.1.254	UGH	1	0	qfe1
192.168.0.0	192.168.0.1	U	1	7	qfe0
192.168.1.0	192.168.1.1	U	1	0	qfe1
BASE-ADDRESS.MCAST.NET	192.168.0.1	U	1	0	qfe0
default	192.168.0.254	UG	1	33	
localhost	localhost	UH	4	77	lo0

1.U = User, G = Group, H = Host

Remember: You must also configure the SL8500 routing tables. Refer to the *Dual TCP/IP Technical Brief*, TM0019 or the *SL8500 Installation Manual*, PN 96138 for more information.

ACSLS High Availability Configuration

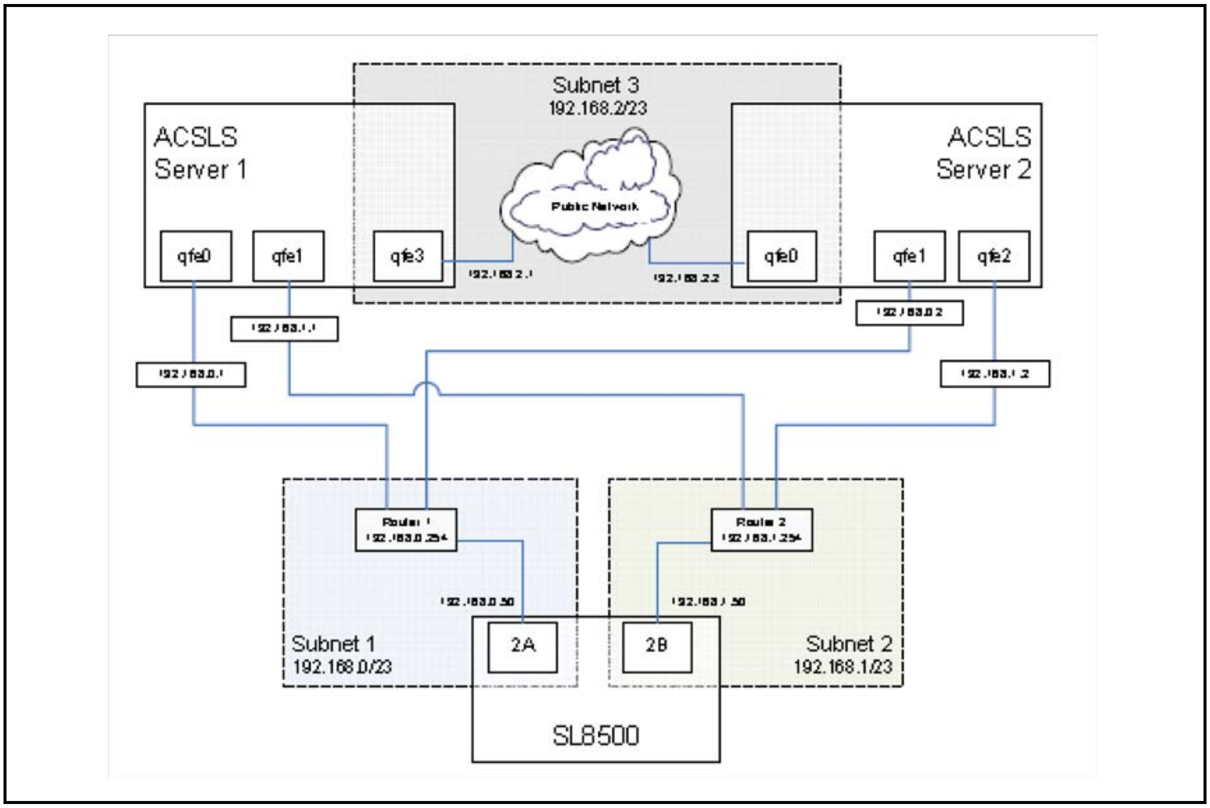
The following example is a preferred configuration for an ACSLS High Availability (HA) environment.

The purpose of the High Availability environment is to build in redundancy and eliminate single points of failure by using and connecting together two ACSLS servers.

In this configuration, two ACSLS servers connect six network interfaces (three on each server) to two separate subnets.

A third subnet inter-connects the two ACSLS servers through a public network.

Figure 25. ACSLS HA Configuration



The big difference with this configuration is that ACSLS HA uses two different servers—each using different network interfaces. This means that custom route entries must be added to both ACSLS servers.

For the Solaris user:

- On ACSLS server 1, enter:

```
# route add 192.168.0.50 -ifp qfe0 192.168.0.254
# route add 192.168.1.1 -ifp qfe1 192.168.0.254
```

- On ACSLS server 2, enter:

```
# route add 192.168.0.2 -ifp qfe1 192.168.0.254
# route add 192.168.1.2 -ifp qfe2 192.168.1.254
```

You must add the IP addresses for both servers to the SL8500 configuration.

It is important that you separate the SL8500 network interfaces over two different subnets when using ACSLS HA.

Remember: You must also configure the SL8500 routing tables.

Retaining Customized Routing Table Entries

Important:
Any customized routing table entries will be lost after a system reboot. This is the nature of the system routing tables and is an expected behavior. In order to support the Dual TCP/IP feature on the SL8500, it is necessary to add custom entries to the routing tables. There are a couple ways to handle this:

1. Create scripts to add custom routes to be initialized at boot time. These scripts can then be placed in the *rc directory structure* for automatic execution at boot time. Refer to the system documentation for information about how to implement these scripts.
2. Install the appropriate PTFs for the operating system. Refer to the PTF README files for installation instructions. This allows the ACSLS startup script to add the custom routing entries at boot time. The PTFs include new script entries that check for customized route table entries.

Removing Special Routing Commands

Use the route command to remove any special routing commands that have been added erroneously or are no longer needed to the earlier configuration.

Example: As the user root, type the following commands:

```
# route delete 192.168.0.50 192.168.0.254
```

This command removes the route to 192.168.0.50 (the SL8500) using the default route of 192.168.0.254. The route is then removed.

■ HSC and Dual TCP/IP Support

HSC provides support to configure two TCP/IP connections using the **LMUPATH** control statement. This statement allows users to define network LMU attachments in a dual TCP/IP environment for an SL8500.

You must also specify a second LMUADDR parameter to define the dual TCP/IPs. HSC then automatically determines whether the connection is dual TCP/IP or dual LMU.

Once this is completed, vary the ACS offline and back online to pick up the revised LMUPATH statement that includes the second connection.

For more information about HSC, the SL8500, and Dual TCP/IP, refer to the:

HSC Systems Programmer's Guides

Notes:

- Always refer to the Customer Resource Center (CRC) for the latest Tech Tips, code updates, and information.
- **Make sure you use and reference the HSC Programmer's Guide to configure the routing tables on the mainframe systems to support Dual TCP/IP.**

The minimum level of software required is:

NCS 6.0 or 6.1 with the appropriate PTFs (below):

- **HSC/MVS/VM:**
  - SOS600 L1H131L
  - SMS600 L1H131K
  - SOS610 L1H131N
  - SMS610 L1H131M
- **MSP:**
  - MSP PTF LF61005 includes MVS PTF L1H131N

Dual IP Connection

The LMUPATH control statement allows users to define network LMU attachments. In a Dual TCP/IP connection environment for an SL8500, specify a second LMUADDR parameter to define dual IP. The HSC automatically determines whether or not the connection is dual IP or dual LMU.

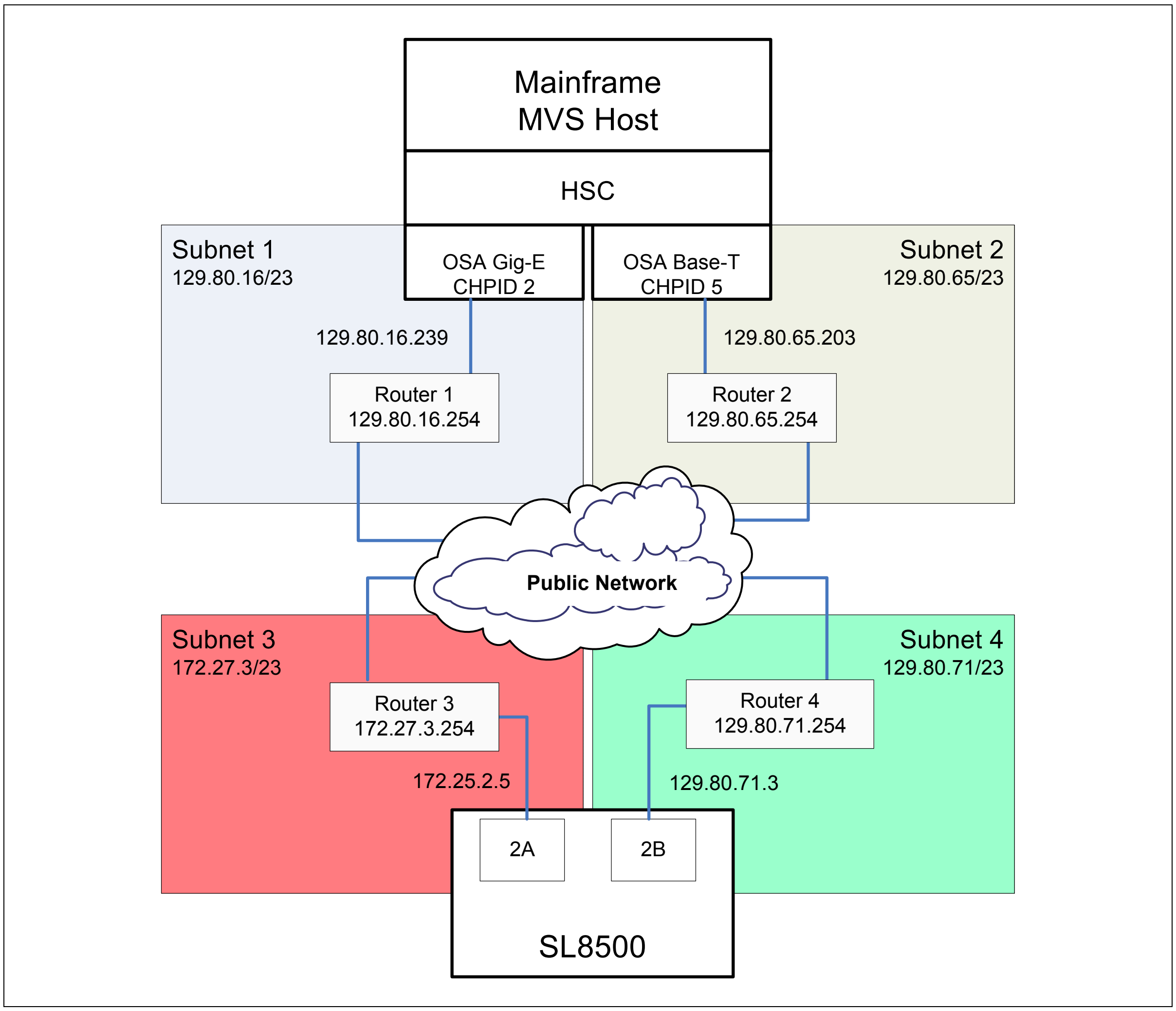
Note: Vary the ACS offline and back online to pick up the revised LMUPATH statement that includes the second connection.

HSC Configuration One

The following is a preferred configuration for mainframe systems using Dual TCP/IP.

In this configuration, the mainframe host contains two network interfaces that reside on two separate subnets go through a public network; then connect to two different subnets before connecting to the SL8500 library.

Figure 26. HSC Configuration One



1. Complete a Network Entries Worksheet for each port of the SL8500.

Table 15. Network Entries

Description		IP Address
Port 2A	Host name to Port 2A	129.80.16.239
	HBC Card Port 2A	172.27.2.5
	Gateway Port 2A	172.27.3.254
	Netmask	/23
Port 2B	Host name to Port 2B	129.80.65.203
	HBC Card Port 2B	129.80.71.83
	Gateway Port 2B	129.80.71.254
	Netmask	/23

2. Define a second DEVICE and LINK statement in your TCP/IP profile data set for a second mainframe network connection:

```
; OSA CARD #1
DEVICE ECCQD01 MPCIPA NONROUTER AUTORESTART
LINK ZIPBMVS IPAQENET ECCQD01
; OSA CARD #2
DEVICE ECCQA01 MPCIPA NONROUTER AUTORESTART
LINK ZIPB2MVS IPAQENET ECCQA01
```

3. Define a second home address in your TCP/IP profile data set.
   For example:

```
HOME
129.80.16.239 ZIPBMVS
129.80.65.203 ZIPB2MVS
```

4. Define a second router on the second subnetwork in the routing paragraph of your TCP/IP profile data set. For example:

```
BEGINROUTES
; NETWORK MASK FIRSTHOP LINKNAME PACKETSIZE
ROUTE 129.80.16.0/24 = ZIPBMVS MTU 1492
ROUTE 129.80.65.0/24 = ZIPB2MVS MTU 1492
ROUTE 172.27.2.5 HOST 129.80.16.254 ZIPBMVS MTU 1492
ROUTE 129.80.71.83 HOST 129.80.65.254 ZIPB2MVS MTU 1492
ROUTE DEFAULT 129.80.16.254 ZIPBMVS MTU 1492
ROUTE DEFAULT 129.80.65.254 ZIPB2MVS MTU 1492
ENDROUTES
; NETWORK MASK ROUTER LINKNAME PACKETSIZE
ROUTE Sl8500-port-2A-IP-Address HOST 129.80.16.254 MVSHOST1
MTU 1492
ROUTE Sl8500-port-2B-IP-Address HOST 129.80.64.254 MVSHOST2
MTU 1492
BEGINROUTES
; NETWORK MASK FIRSTHOP LINKNAME PACKETSIZE
ROUTE 129.80.16.0/24 = ZIPBMVS MTU 1492
ROUTE 129.80.65.0/24 = ZIPB2MVS MTU 1492
ROUTE 172.27.2.5 HOST 129.80.16.254 ZIPBMVS MTU 1492
ROUTE 129.80.71.83 HOST 129.80.65.254 ZIPB2MVS MTU 1492
ROUTE DEFAULT 129.80.16.254 ZIPBMVS MTU 1492
ROUTE DEFAULT 129.80.65.254 ZIPB2MVS MTU 1492
ENDROUTES
```

5. Define two dedicated static routes to the SL8500 destination port (2A and 2B) IP addresses over two different routers.

6. Start the second mainframe network connection device.

```
V TCPIP,tcp-stc-name,START,device_name
```

7. Define a second LMUADDR parameter for the port 2A IP address.

```
LMUPATH ACS(00) LMUADDR(129.80.71.83,172.27.2.5)
```

8. Enter the LMUPDEF command containing the LMUPATH statements that define the host name or IP address for each ACS.

```
LMUPDEF DSN(“xxx.xxx.xxx(xxx)”)

LMUPDEF DSN(“YOUR.DSN(MEMBER)”)
```

   In this example, LMUPDEF loads the LMUPATH parameters from “YOUR.DSN(MEMBER)”.

9. Allow the trained SL8500 service representative to enter the network connections to the SL8500 library for either port 2A and 2B, whichever is applicable.

10. Vary the ACS offline and back online to pick up the revised LMUPATH statement that includes the second connection. This can be done one host at a time to minimize down time.

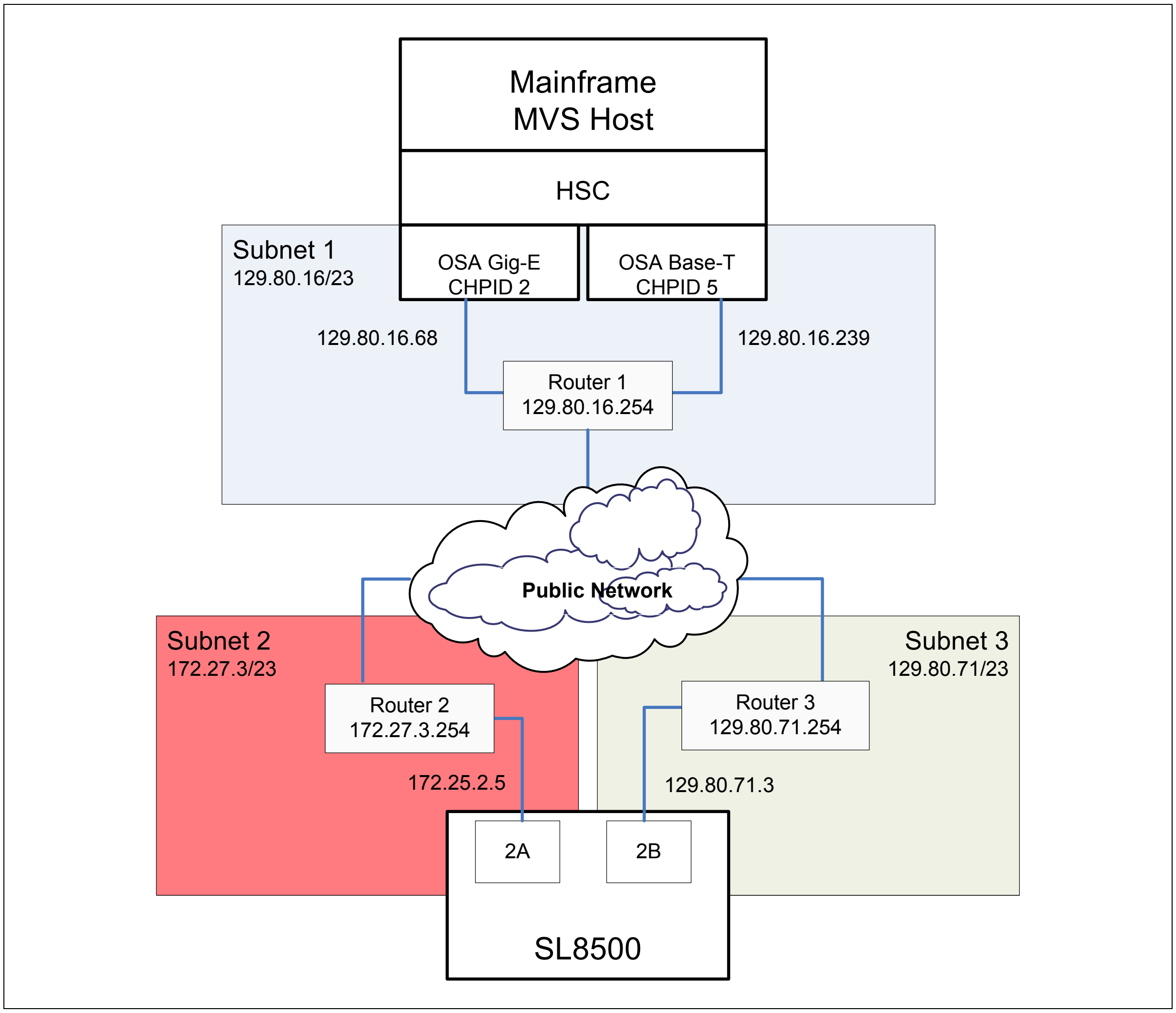
```
.vary acs xx, offline

.vary acs xx, online
```

HSC Configuration Two

The following is a preferred configuration for mainframe systems using Dual TCP/IP. In this configuration, one mainframe address connect to two SL8500 connections.

To establish one host IP route from the HSC to two routes to the SL8500, use the process described in this section.

Figure 27. HSC Configuration Two



1. Complete the Network Entries Worksheet (see Table 26 for a sample) for each set of routes to the SL8500.

	Description	IP Address
Port 2A	Host name to Port 2A	129.80.16.239
	HBC Card Port 2A	172.27.2.5
	Gateway Port 2A	172.27.3.254
	Netmask	/23
Port 2B	Host name to Port 2B	129.80.16.239
	HBC Card Port 2B	129.80.71.83
	Gateway Port 2B	129.80.71.254
	Netmask	/23

2. Define two dedicated static routes to the SL8500 destination port (2A and 2B) IP addresses over one router.

```
BEGINROUTES
; DESTINATION FIRSTHOP LINKNAME PACKETSIZE
ROUTE 129.80.16.0/24 = &SYSNAME.MVS MTU 1492
ROUTE 172.27.2.5 HOST 129.80.16.254 &SYSNAME.MVS MTU 1492
ROUTE 129.80.71.83 HOST 129.80.16.254 &SYSNAME.MVS MTU 1492
ROUTE DEFAULT 129.80.16.254 &SYSNAME.MVS MTU 1492
ENDROUTES
```

3. Define a second LMUADDR parameter for port 2A IP address.

```
LMUPATH ACS(00) LMUADDR(129.80.71.83,172.27.2.5)
```

4. Enter the LMUPDEF command containing the LMUPATH statements that define the host name or IP address for each ACS.

```
LMUPDEF DSN(“xxx.xxx.xxx(xxx)”)
LMUPDEF DSN(“YOUR.DSN(MEMBER)”)
```

   In the following example, LMUPDEF loads LMUPATH parameters from YOUR.DSN(MEMBER).

5. Allow the trained SL8500 service representative to enter the network connections to the SL8500 library for either port 2A and 2B.

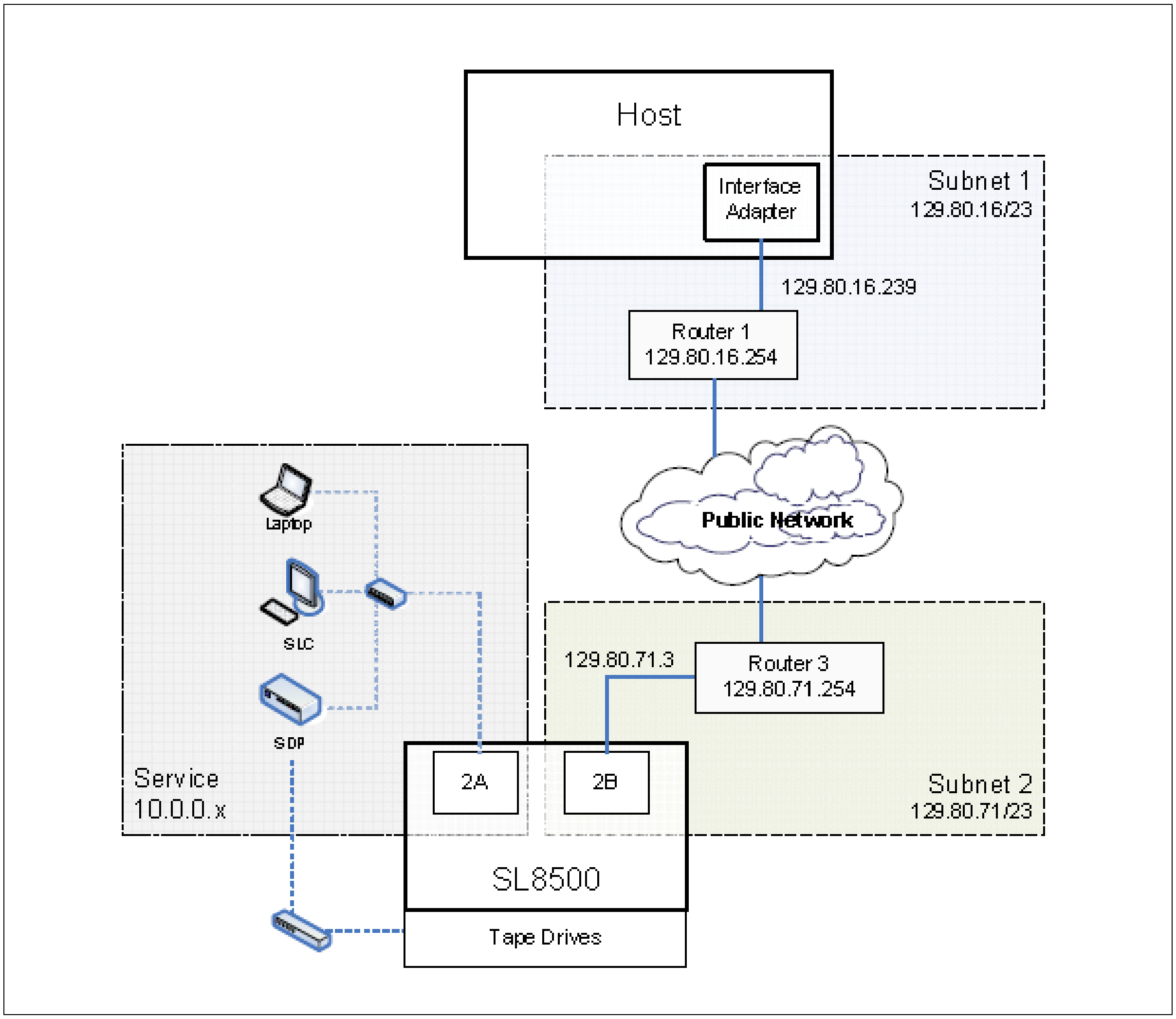
6. Vary the ACS offline and back online to pick up the revised LMUPATH statement that includes the second connection. This can be done one host at a time to minimize down time.

```
.vary acs xx, offline
.vary acs xx, online
```

Service Connectivity

If the customer is only using one connection into the SL8500, the second port (2A) can be used as a connection for service.

Figure 28. Service Connections



Example connections include:

- Service Delivery Platform (SDP).

  In the past, SDP connections to an SL8500 library used the customers public network—which often changed the customers reasoning to have an SDP connection.

  With the Dual TCP/IP feature and enabling Port 2A, a service connection can be created to provide a private—separate—network for SDP connectivity to the SL8500 and appropriate T-Series tape drives.

- StreamLine Library Console (SLC).

  With the Dual TCP/IP feature and enabling Port 2A, a service connection can be created to provide a remote SLC connection at the *rear* of the library.

- Laptop diagnostic connections.

  With the Dual TCP/IP feature and enabling Port 2A, a service connection can be created to provide connection for the command line interface (CLI) *and* TCP/IP connection to:

  - Configure the library (using PuTTY),
  - Perform diagnostic functions (load and unload drives), and
  - Initiate an audit

Partitioning

10

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 four physical partitions.

■ Purpose

Partitioning the SL8500 library means the customer 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

This chapter:

- Contains guidelines and essential elements for SL8500 partitions.
- Provides templates to help plan the partitioning of the library.
- Describes how to license and enable the partitioning feature.
- Shows how to partition the rails in the library.
- Describes how to override reserved cartridge access ports (CAPs)

Guidelines

Essential elements for understanding partitions are:

- Clear communication between the system programmers, network administrators, both ACSLS and HSC administrators, and Sun 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—the customer—what 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.*
- Customers 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[1].
  - Maximum capacity of 2,522 cartridges[2].
  - From 1 to 16 tape drives.
- 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*.
- 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 cannot connect to more than one partition within the same SL8500 library; however, you can have one partition from each library in the same CDS. If you have two partitions in a library, you must also have two CDS; three partitions, three CDS.
- When partitioned, the library controller reports rails assigned to another partition within the library as “unallocated” (HSC) or as a new “SL8500_Unalloc LSM” (ACSLS). This provides two things:
  - It displays the entire library, and
  - If partitioning is changed (rails added to or removed from a partition), cartridge locations remain constant.

---

1. The basic configuration of an SL8500 library is 1,448 cartridges; spread across four LSMs provides 362 cartridges per rail.
2. The maximum configuration of an SL8500 library is 10,088 cartridges; spread across four LSMs provides 2,522 cartridges per rail.

Remember:

- Partitioned LSMs will not recognize other LSMs within the library unless they are in the same partition.
- Elevators and CAPs are *shared resources*—each partition can fully use these resources for enter and eject operations.
- No elevator pass-thru operations will occur between LSMs unless they are defined in the same partition, except when using the CAP to service Rail 1, regardless of its configured 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 can 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 134 for more information.
- Automatic mode is not supported in a partitioned library.
- Duplicate VOLSERs[3] 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 on different ACSLS servers.
- All drives, storage slots and cartridges within a partition are solely owned by that host or host group.
- 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.
- Rails do not need to be included in a partition, they can remain unassigned to allow for future growth.

3. VOLSER = volume serial number—the cartridge tape label.

Software and Firmware Requirements

Requirements for partitioning the SL8500 library include:

- Order number: SL8500-UPG-PART
- Upgrade number: XSL8500-UPG-PART
- Library firmware FRS_3.7x or higher
- StreamLine Library Console (SLC) at Version FRS_3.25 or higher
- ACSLS Versions 7.1 and 7.1.1 with PUT0701
- ACSLS HA 2 also requires PTF 6514766
- NCS (NearLine Control Solution) Version 6.1
- HSC (MVS) Version 6.1 with PTF L1H13GW and L1H13JK
- HSC (VM) Version 6.1 with PTF L1H13GX and L1H13JJ
- VSM (Virtual Storage Module) Versions 3, 4, or 5
- ExPR (Expert Performance Reported) with PTF L1E025H
- ExLM (Expert Library 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 PUTs and PTFs will not be able to bring a partitioned ACS online.

Always refer to the Customer Resource Center (CRC) for the latest versions of software, firmware, and documentation.

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.

■ Capacities

Figure 29 shows an example of an SL8500 library with the capacities of each module; partition capacities per rail and per library configuration, plus drive modules (from 1 to 16 tape drives) for each rail.

Figure 29. Partition Planning and Capacities

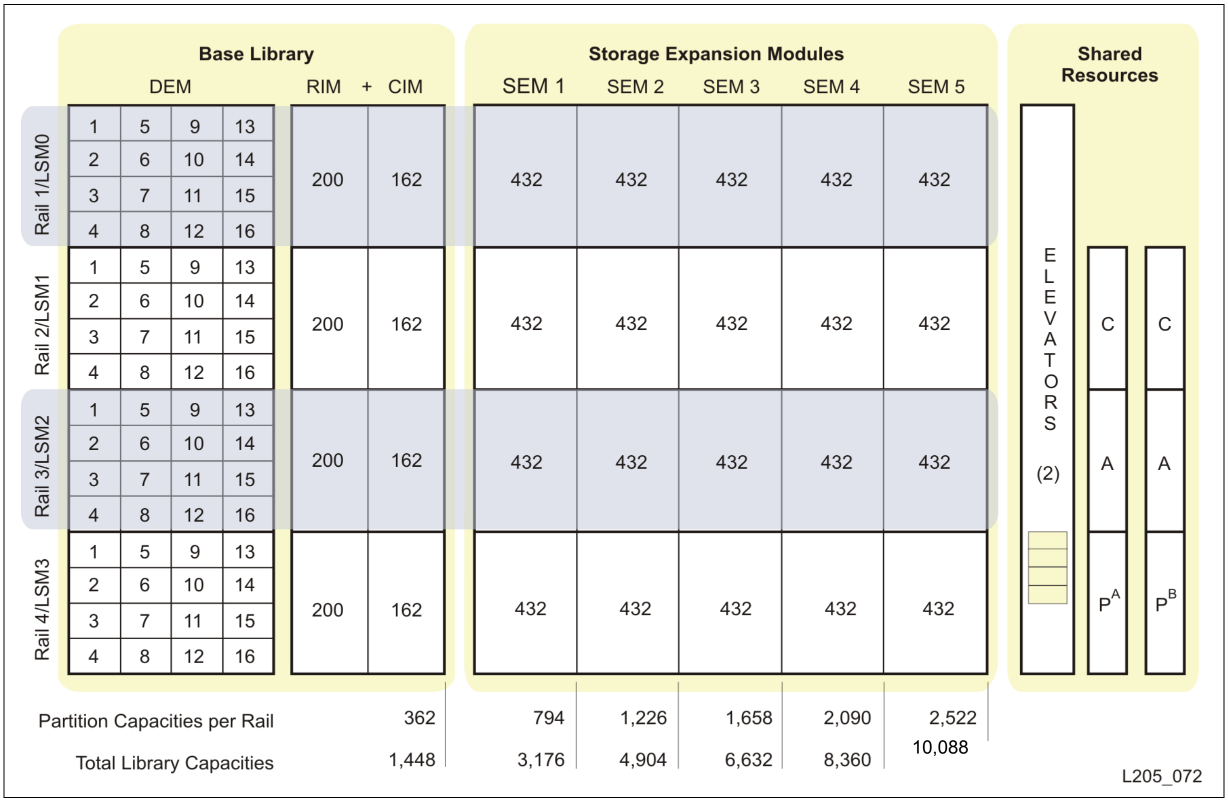


Table 16. Partitioned Capacities

Library Configuration		Partition Capacity per Rail
Basic Library	Drive & Electronics Module	0
	Robotics Interface Module	200
	Customer Interface Module	162
	Base configuration per rail (total)	362
Expansion Modules	When adding expansion module, each *rail* gets **432** additional *data* cartridge slots	
	One expansion module	794
	Two expansion modules	1,226
	Three expansion modules	1,658
	Four expansion modules	2,090
	Five expansion modules (maximum)	2,522

Getting Started

Table 17. Steps and Tasks for Partitioning

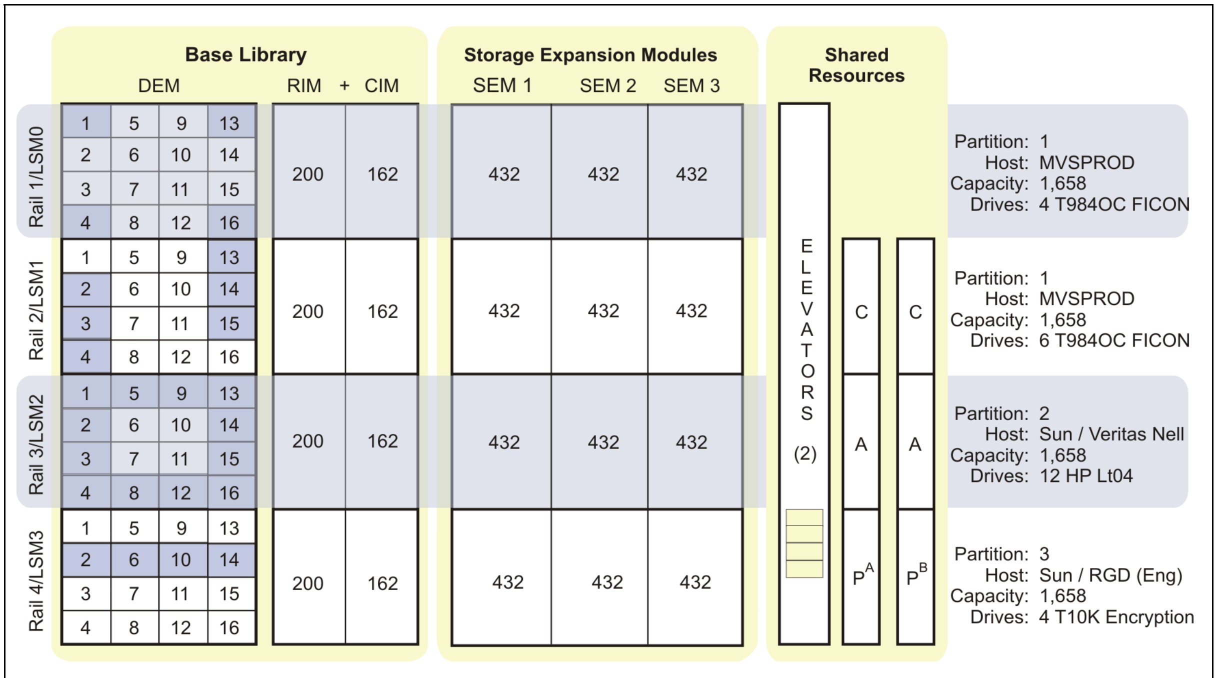
✓	Step	Task	Reference	Responsibility*
❏	1. Team	Create a Team. When planning for partitions, using a process similar to that of the system assurance process, which is the exchange of information among team members. Team members should include representatives from both the customer and Sun Microsystems to ensure that all aspects of the process are planned carefully and performed efficiently.		• Customer • Sun SE, PS • Sun Service
❏	2. Codes	Review the software and firmware requirements. Update as required.	"Software and Firmware Requirements" on page 118	• Customer • Sun SE, PS • Sun Service
❏	3. Planning	• Create a planning team • Define the customer expectations • Complete the assessment • Identify the configurations • Complete the planning diagrams	"Planning" on page 121	• Customer • Sun SE, PS • Sun Service
❏	4. Media	• Verify the distribution of cartridges and required tape drives are available and ready.		• Customer
❏	5. Library	• Convert a library complex (if necessary).		• Sun Service
❏	6. Enable	• License and enable partitioning.	"Enabling Partitions" on page 129	• Sun Service
❏	7. Hosts	• Momentarily stop all host activity. • Make the hosts inaccessible.	"Host Software Precautions" on page 129	• Customer
❏	8. Use	Instruct the customer how to: • Partition and re-partition the library • Override a CAP reservation	"Assigning Partitions" on page 130	• Customer • Sun Service
• SE = Systems engineer • PS = Professional services representative • Service = Service representative (Svc) • Customer = System administrators, network administrators, system programmers, operators				

■ Planning

Team members should include representatives from both the customer and Sun Microsystems to ensure that all aspects of the process are planned carefully and performed efficiently. Tasks include: • Identify and define the customer 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 rails are there going to be for a partition? Remember to configure the elevator for use between partitions.	1. 2. 3. 4.
What is the name and purpose for each partition?	1. 2. 3. 4.
What type of operating systems for each partition?	1. 2. 3. 4.
What type of library management software for each partition? Make sure the customer has the latest versions and updates. See page 118 for information.	1. ACSLS: ❑ HSC: ❑ 2. ACSLS: ❑ HSC: ❑ 3. ACSLS: ❑ HSC: ❑ 4. ACSLS: ❑ HSC: ❑
What type of applications are being used?	1. 2. 3. 4.
How many cartridges are needed for each partition?	1. 2. 3. 4.
How many free slots are needed for each partition?	1. 2. 3. 4.
What are the tape drive types and quantities?	1. 2. 3. 4.
• Complete a plan using the figures in this chapter as an example. • Place this information with the library.	

Figure 30 provides an example to show the flexibility that partitions provide for host connections, applications, capacities, tape drive types and interfaces.

Figure 30. Partition Planning Example



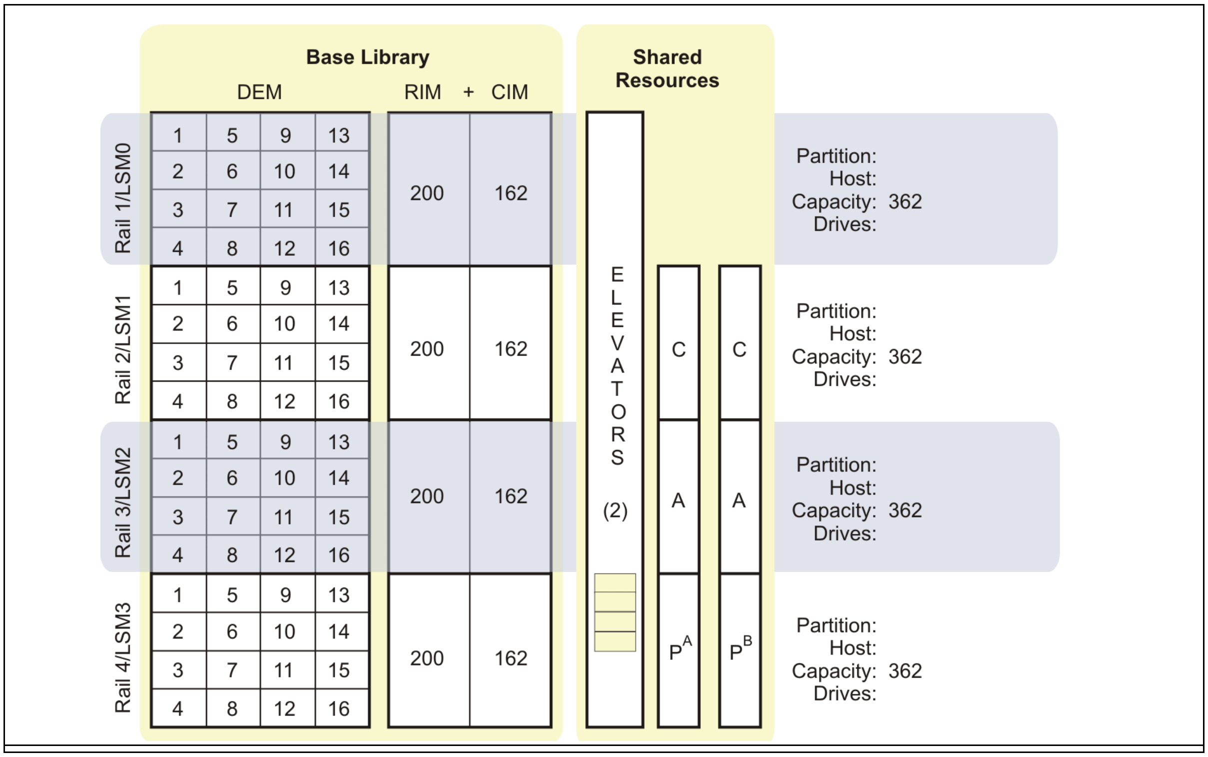
Rail 1 and Rail 2 Combined as one Partition (ACS 0)			
Partition ID	**hli1** / MVS combined	Partition ID	**hli1** / MVS combined
Hosts	z/OS V1R1	Hosts	z/OS V1R1
ACSLS or HSC	HSC Version 6.1	ACSLS or HSC	HSC Version 6.1
Applications	Tivoli Version 5.3	Applications	Tivoli Version 5.3
Cartridge capacity	1,000	Cartridge capacity	580
Free slots	658	Free slots	1,078
Tape Drive types	4 T9840 C FICON	Tape Drive types	6 T9840 C FICON

Rail 3 (ACS 1)		**Rail 4 (ACS 2)**	
Partition ID	**hli2** / Open Systems	Partition ID	**hli3** / Encryption
Hosts	Solaris 9	Hosts	Solaris 10
ACSLS or HSC	ACSLS	ACSLS or HSC	ACSLS
Applications	Veritas NBU 4.5 Media Manager DataCenter	Applications	Oracle, Siebel, SAP, SQL, NetWorker
Cartridge capacity	1106	Cartridge capacity	830
Free slots	552	Free slots	828
Tape Drive types	12 HP LTO 3, 2Gb FC	Tape Drive types	4 T10K, 4Gb FC, Crypto

Figure 31 on page 123 through Figure 36 on page 128 provide work sheets for planning partitions with the six different library configurations.

Make copies as necessary.

Figure 31. Base Library Partition Planning



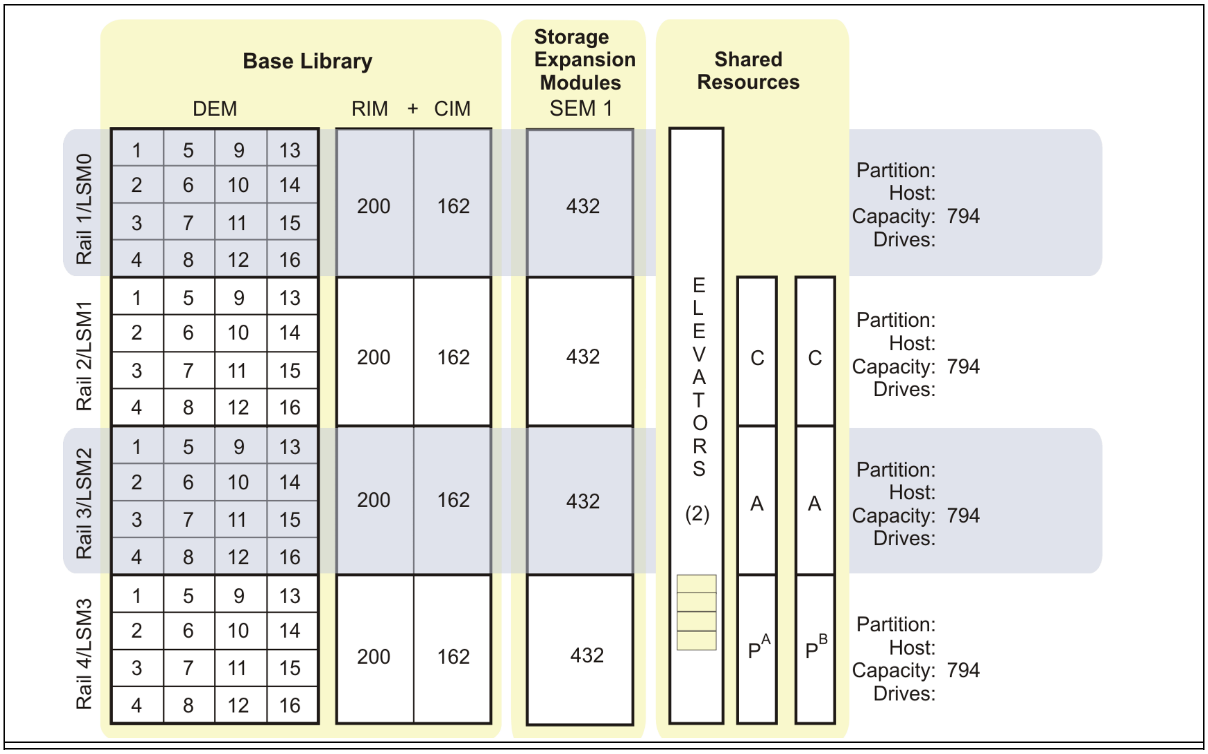
Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Figure 32. One Expansion Module Partition Planning



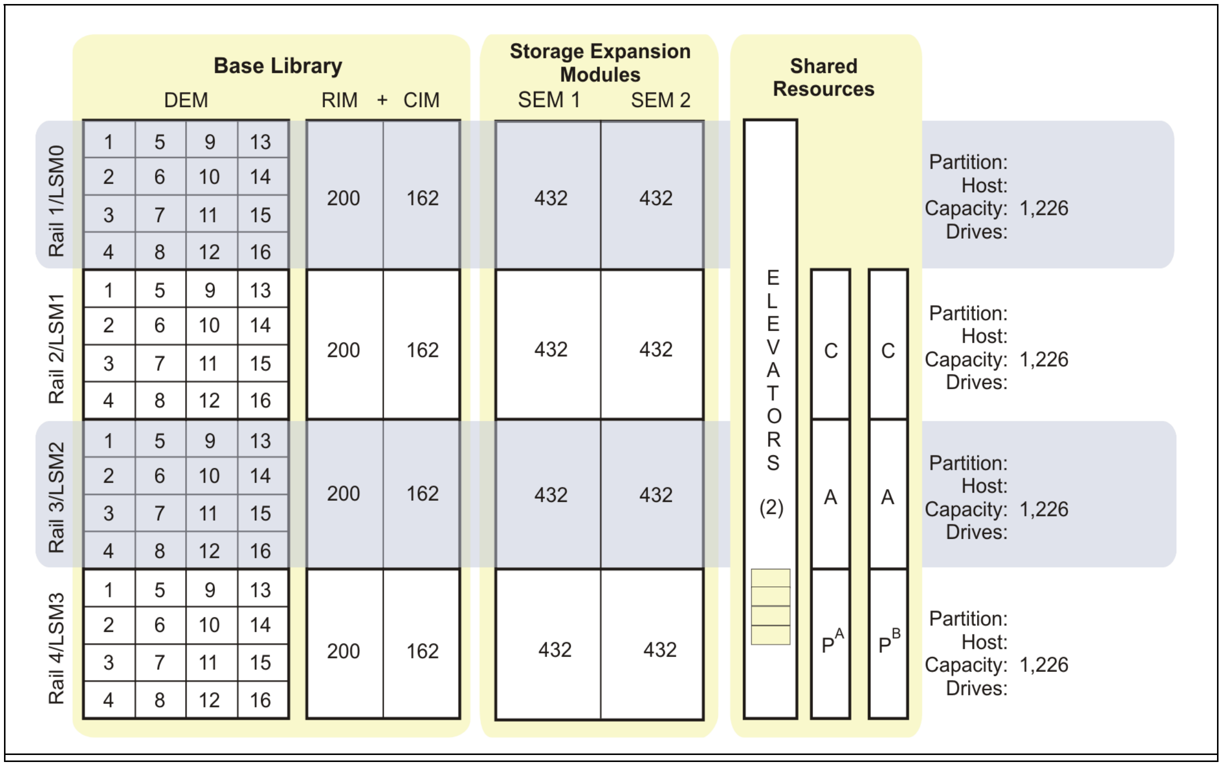
Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Figure 33. Two Expansion Modules Partition Planning



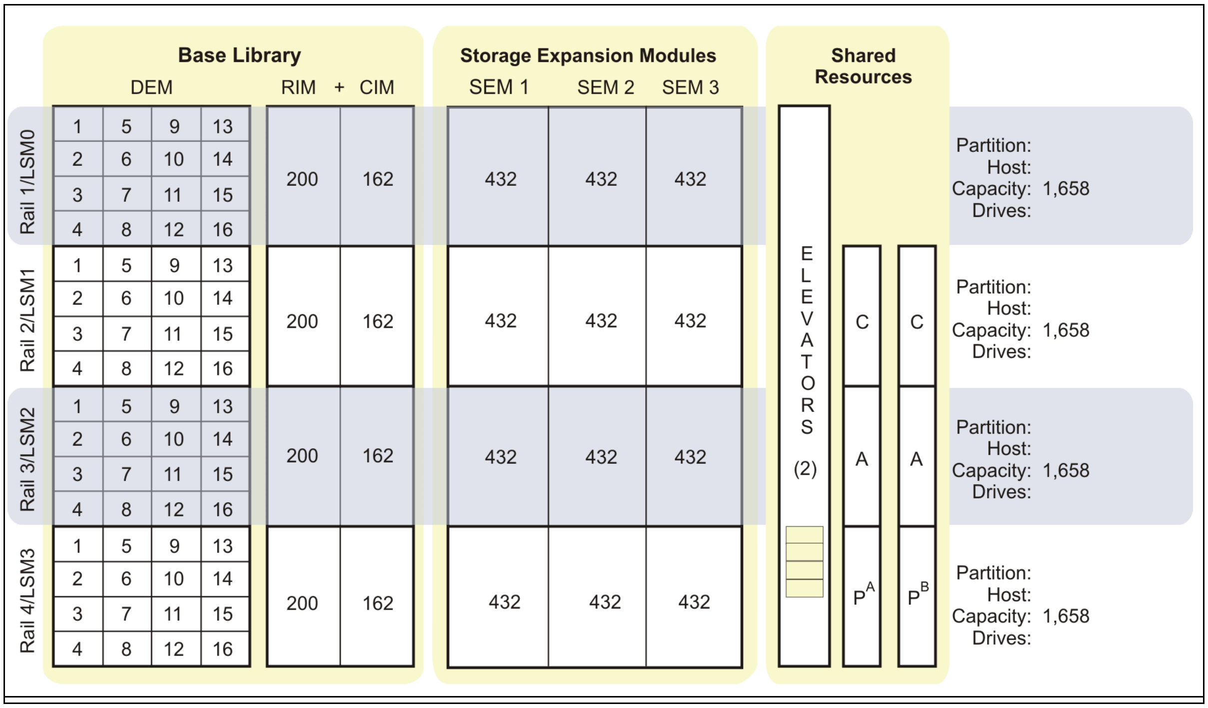
Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Figure 34. Three Expansion Modules Partition Planning



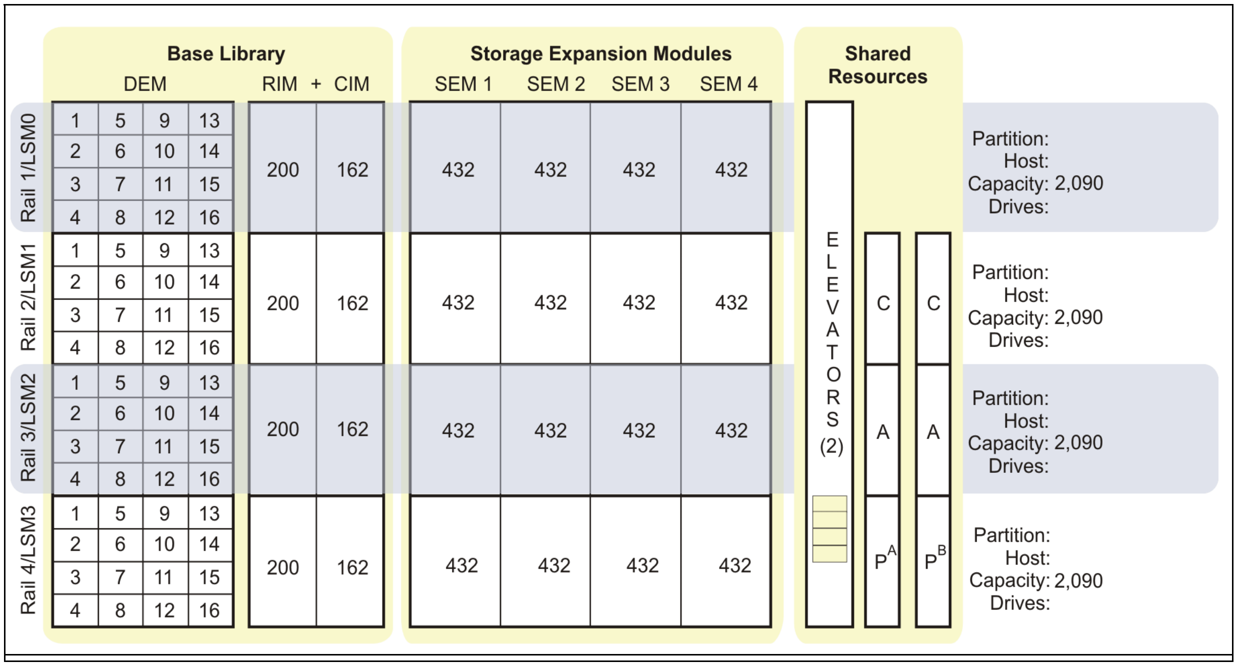
Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Figure 35. Four Expansion Modules Partition Planning



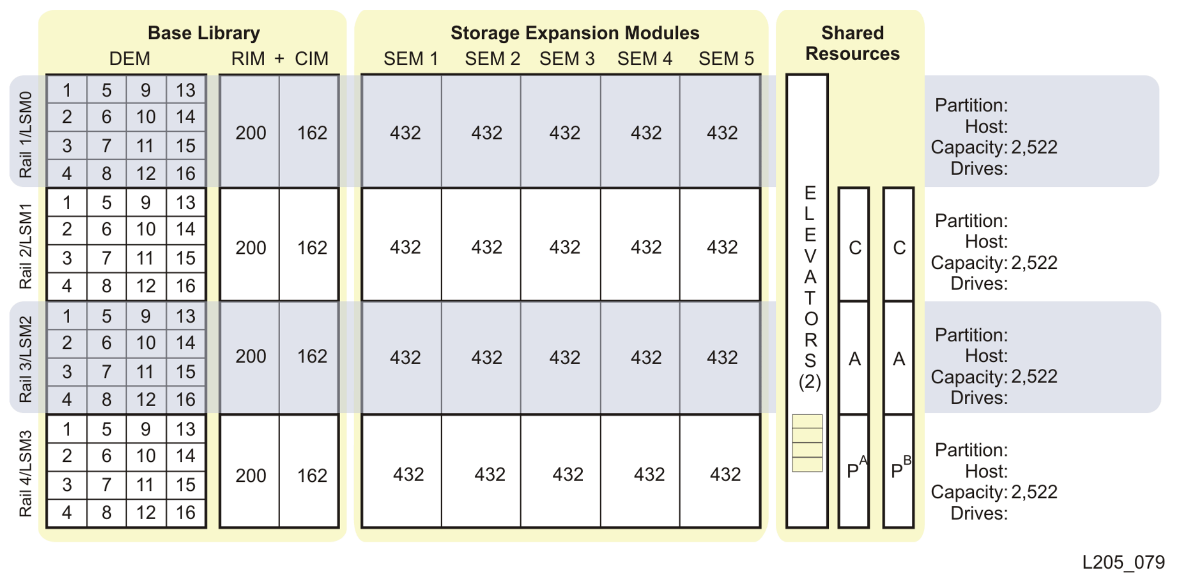
Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Figure 36. Five Expansion Modules Partition Planning



Rail 1	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 2	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 3	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Rail 4	
Partition ID	
Hosts	
ACSLS or HSC	
ACS, LSM Address	
Applications	
Cartridge capacity	
Free slots	
Tape Drive types	

Enabling Partitions

Partitioning is an optional feature that the customer can purchase.

Once purchased, a qualified Sun service representatives can connect to the SL8500 library service interface—command line interface (CLI)—and:

- License and Enable the partitioning feature

License Command

The license commands allows a service representative to:

- List all of the licensed features in the library controller database.
- Import a license file and add it to the library database.
- License the partitioning feature.

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 will go offline temporarily. For this reason, it is best to minimize any disruptions to the operating systems and library management software before you partition.

Notes:

- The amount of time the library goes offline is minimal, less than 2 to 3 seconds.
- 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. Momentarily stop all host activity (such as mounts and dismounts, enters and ejects, any moves, plus any tape drive activity).
3. Make the hosts inaccessible to the library (such as vary the ACS offline).
4. Using the touch screen operator panel or remote SLC software, change the partitioning configuration.
5. Make the hosts accessible to the library (vary the ACS back online).

   Note: It may be necessary for some host software to obtain a new inventory of the library to keep an accurate database.

6. Restart the host activity.

■ Assigning Partitions

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.

This panel provides a graphical user interface (GUI) to all library functions:

- Status, monitoring, and functional information
- Instructions and help information
- Diagnostic capabilities
- Configurations, **including assigning partitions**

Note: If no touch screen operator control panel is available, you can use the Remote SLC software, which is installed on a PC and connected to an SL8500 Ethernet port.

Figure 37. Touch Screen Operator Control Panel

The operator panel consists of:

- StreamLine Library Console software
- 12-inch flat screen display (*diagonal* measurement)
- Touch screen interface (no mouse or keypad necessary)
- 20 GB hard drive
- 512 MB memory and 32 MB RAM
- Java applet as the graphical user interface (GUI).

Partitioning

To assign or create partitions:

1. Log in to the StreamLine Library Console.
2. Select Tools ➪ Partitions.
3. Select the Partition ID and desired rails for that partition. For example:

Table 18. Partitioning Examples

This example has no partitions created;

all of them are unassigned.

Partition ID Screen

	1	2	3	4	Unassigned
Rail 1					X
Rail 2					X
Rail 3					X
Rail 4					X

Disable All

This example has two partitions.

- Rails 1 and 2 create Partition 1.
- Rail 3 creates Partition 2.
- Rail 4 is still unassigned.

Note: Rails must adjacent to join them and create a single partition.

Partition ID Screen

	1	2	3	4	Unassigned
Rail 1	X				
Rail 2	X				
Rail 3		X			
Rail 4					X

Disable All

4. Click Apply to implement the partitions.

Important: A message appears that states:

This operation will take the library offline temporarily. Do you wish to continue? OK or Cancel.

Removing Partitions

To remove partitions:

1. Momentarily stop (quiesce) all host activity (such as mounts and dismounts, enters and ejects, any moves, plus any tape drive activity). See the ACSLS and HSC documentation for details.
2. Select Tools ➪ Partitions.
3. Select Unassigned for each rail you want to remove from a partition, or select Disable ALL Partitions to remove all rails from all partitions.:

Table 19. Removing Partitions

This example removes Partition ID 2 from the previous example.

Partition ID Screen

	1	2	3	4	Unassigned
Rail 1	X				
Rail 2	X				
Rail 3					X
Rail 4					X
					Disable All

- Select Apply to apply the updates and continue to Step 4.
- Select Refresh to cancel the updates and restore the screen settings.

4. A dialog displays, “This operation will take the library offline temporarily. Do you wish to continue?”
   - Select OK to make the updates. The library goes offline and all host connections are dropped while the updates are made.
   - Select Cancel to cancel the updates and return to Step 2.
5. Reconfigure all library hosts to activate these updates. See the ACSLS and HSC documentation for details.

■ Partitioning Contact Sheet

After creating the partitions, complete a contact sheet similar to Table 20 with information that will be useful if you need to override a CAP or contact administrators. Make copies as necessary.

Table 20. Partition Contact Sheet

Partitions in this library?		
Library **TCP/IP addresses**	**Port 2A** **Port 2B**	• •
Partition ID 1 **(hli1)**	Rails	1 ❑ 2 ❑ 3 ❑ 4 ❑
Contact Information:	ACSLS: ❑ HSC: ❑	
	Operating System:	
	Connectivity:	
	Location:	
Partition ID 2 **(hli2)**	Rails	1 ❑ 2 ❑ 3 ❑ 4 ❑
Contact Information:	ACSLS: ❑ HSC: ❑	
	Operating System:	
	Connectivity:	
	Location:	
Partition ID 3 **(hli3)**	Rails	1 ❑ 2 ❑ 3 ❑ 4 ❑
Contact Information:	ACSLS: ❑ HSC: ❑	
	Operating System:	
	Connectivity:	
	Location:	
Partition ID 4 **(hli4)**	Rails	1 ❑ 2 ❑ 3 ❑ 4 ❑
Contact Information:	ACSLS: ❑ HSC: ❑	
	Operating System:	
	Connectivity:	
	Location:	
• **Unassigned**	Rails	1 ❑ 2 ❑ 3 ❑ 4 ❑
	Comments:	

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 being doing an enter, while another partition is doing an ejector 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 customers.

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.

Unreserving the CAP

If for some reason a CAP reservation is not released, the CAP will be unavailable to all other partitions and cartridges.

- In this case, you must identify the host holding the CAP reservation and then terminate the enter or eject operation from that host.
  This ensures a “clean” release of the CAP.

  This is the best and recommended way to release the CAP; using either a *cancel* (ACSLS) or *drain* (HSC) command.

  Note: A reservation of the CAP can be released or overridden by any host joined to the same partition using HLI, not just the host that issued the reserve.

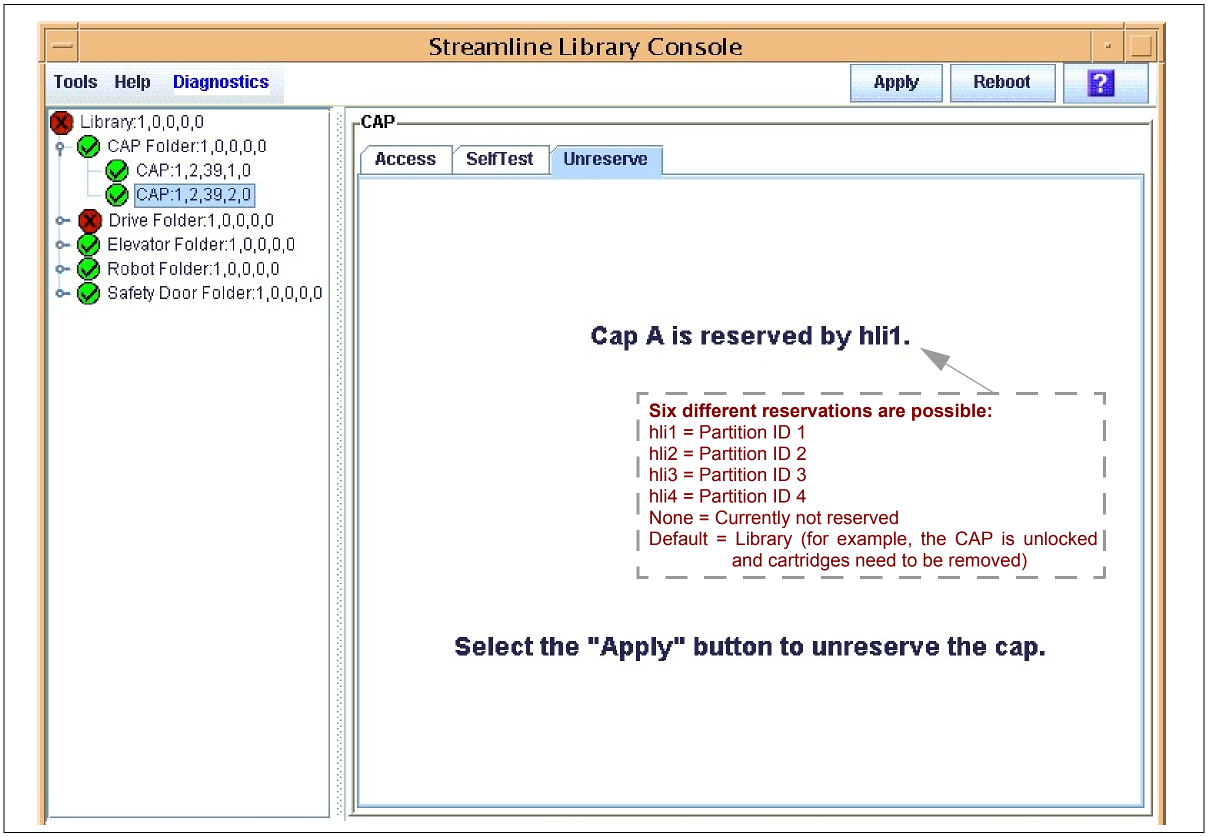
- In some cases, however, you may not be able to access the host holding the reservation and therefore cannot perform a “clean” release of the CAP.

  In these cases, you can use the StreamLine Library Console (SLC) to *override* the CAP reservation.

Note: You can use the SLC to both identify the host and override a CAP reservation. If a library is not partitioned, CAP reservations can only be released through ACSLS or HSC.

Figure 38 shows an example of how to identify a host and CAP reservation.

Figure 38. CAP Reservations



Overriding a CAP Reservation

Caution:

Use extreme care when using SLC to override a CAP reservation. In the event that a host cannot release the CAP, the StreamLine Library Console is the only avenue for “*overriding*” a reservation.

- When a CAP reservation must be overridden, any cartridges within the CAP must be removed to prevent them from being entered into another host's partition or lost.

- If you do not complete the following procedure, the CAP could be left unavailable to all partitions.
- Use this procedure only when a host has reserved a CAP, but the reservation cannot be released through ACSLS or HSC.

To override a reservation:

1. At the StreamLine Library Console, select Tools ➪ Diagnostics.
2. Select the CAP Folder on the device tree to expand it.
3. Select the CAP whose reservation you want to override.
4. Select the Unreserve tab. See Figure 38 on page 135 for an example.
   - The SLC displays the partition ID that held the CAP reservation.
   - The library sets the CAP user to “Default,” which makes the CAP unavailable to all partitions.
5. Click Apply to override the reservation.
   The CAP will remain in Default until it is closed, locked, and empty.
   - If the CAP is *empty*, proceed to Step 6.
   - If the CAP *contains cartridges*, follow this procedure:

   a. At the SLC, select: CAP ➪ Diagnostics ➪ Access.
   b. At the Locked drop-down select False to unlock the CAP.
      Click OK.
   c. Open the CAP by pressing the appropriate (A or B) CAP Open button on the operator panel.
   d. Remove all the cartridges.
   e. Identify the cartridge VOLSERs with the partition ID and with as much additional information as possible. This is to avoid any data integrity issues, being entered into another partition, or getting lost.
   f. Close the CAP.
      The CAP, locks automatically, audits the CAP to verify that it is empty, and sets the CAP user to “None;” making it available to all partitions.
   g. Consult with the owner of the removed cartridges regarding their disposition.
   h. Complete a “Partitioning Contact Sheet” on page 132.
      This information will be very useful if you need to override a CAP.

6. Go to Tools ➪ System Detail and click Refresh.
7. Select the CAP Folder ➪ CAP ➪ Unreserve tab and verify that the CAP is not reserved (None).

Structural Elements

A

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 retainer clips.

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):

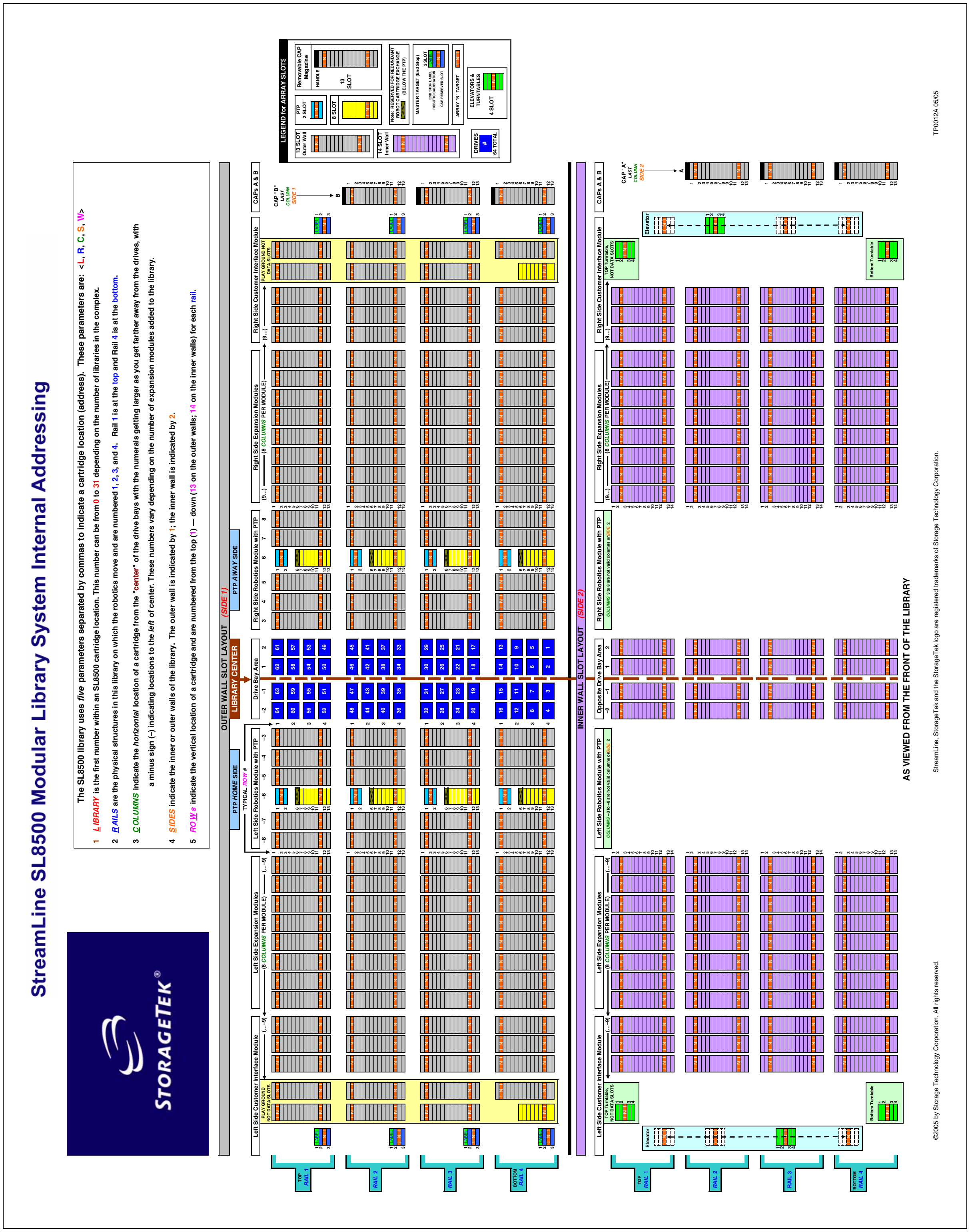
1. **Library:** Is the number of that library or within a library complex
2. **Rail:** Rails are numbered top down from 1 – 4 with rail 1 being on top.
   - Each rail is considered a separate library storage module (LSM).
   - LSMs are numbered 0 – 3 (top down).
3. **Column:** Indicate the *horizontal* 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.
4. **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
5. **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 39 on page 139 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 39. 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 21 shows the addressing scheme for the tape drives.

Table 21. Tape Drive Numbering . (Looking at the rear of the library)

Library[1]	**Rail**[2]	**Column**[3]				**Side**[4]	**Row**[5]
		2	**1**	**-1**	**-2**		
1 - 32	**1**	61	62	63	64	**1**	**1**
		57	58	59	60		**2**
		53	54	55	56		**3**
		49	50	51	52		**4**
	2	45	46	47	48		**1**
		41	42	43	44		**2**
		37	38	39	40		**3**
		33	34	35	36		**4**
	3	29	30	31	32		**1**
		25	26	27	28		**2**
		21	22	23	24		**3**
		17	18	19	20		**4**
	4	13	14	15	16		**1**
		9	10	11	12		**2**
		5	6	7	8		**3**
		1	2	3	4		**4**
		2	**1**	**–1**	**–2**		
Library[1]	**Rail**[2]	**Column**[3]				**Side**[4]	**Row**[5]

Notes:

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. Row, 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 22 shows the **internal**—software—mapping (viewed from looking *inside* the library at the tape drives), and

Table 23 shows the **external**—physical—numbering of the drives (looking *outside* at the rear of the Drive and Electronics Module).

Table 22. Software Drive Numbering

LSM	ACSLS or HSC—Drives Numbers			
Rail 1	**Drive 0**	Drive 4	Drive 8	Drive 12
LSM 0	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15
Rail 2	Drive 0	Drive 4	Drive 8	Drive 12
LSM 1	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	**Drive 15**
Rail 3	Drive 0	Drive 4	Drive 8	Drive 12
LSM 2	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15
Rail 4	Drive 0	Drive 4	Drive 8	Drive 12
LSM 3	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	**Drive 7**	**Drive 11**	**Drive 15**

Table 23. Physical Drive Numbering

External—Physical Drive Numbers			
Drive 61	Drive 62	Drive 63	**Drive 64**
Drive 57	Drive 58	Drive5 9	Drive 60
Drive 53	Drive 54	Drive 55	Drive 56
Drive 49	Drive 50	Drive 51	Drive 52
Drive 45	Drive 46	Drive 47	Drive 48
Drive 41	Drive 42	Drive 43	Drive 44
Drive 37	Drive 38	Drive 39	Drive 40
Drive 33	Drive 34	Drive 35	Drive 36
Drive 29	Drive 30	Drive 31	Drive 32
Drive 25	Drive 26	Drive 27	Drive 28
Drive 21	Drive 22	Drive 23	Drive 24
Drive 17	Drive 18	Drive 19	**Drive 20**
Drive 13	Drive 14	Drive 15	Drive 16
Drive 9	Drive 10	Drive 11	Drive 12
Drive 5	Drive 6	Drive 7	Drive 8
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.

Comparisons

B

This appendix provides additional comparisons between the SL8500 modular library system and the 9310 PowderHorn.

■ Terminology

Table 24. Differences in 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).
Elevators	Devices that transports cartridges vertically, across rail boundaries. This amounts to pass-thru operations. Two elevators are standard.
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.
Storage expansion module (SEM)	One to five expansion modules can be added to the basic configuration.
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.
Power rail	One of four sections in a library that provides: • Power and communications for HandBot electronics • A path for HandBots to put and get cartridges to or from a slot or tape drive • A physical partition that is equivalent to an LSM for single or multiple hosts
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.
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 RaceTrack^{TM} architecture.
StreamLine RaceTrack^{TM}	HandBots move along U-shaped tracks or rails.
Turntable assemblies	Devices that transport cartridges laterally from one HandBot to another. One, lower turntable is standard and a second (upper) is available as an option. Turntables are not currently used.

Contrasts Between Libraries

Many concepts and terms used for earlier libraries apply to SL8500 libraries. However, many terms for the SL8500 have been modified from their original meanings. As the SL8500 library product is substantially different from earlier Sun StorageTek library products, a general list of terms that relate old with new concepts is supplied in Table 25.

Table 25. Old versus New Terminology

9310 PowderHorn	SL8500 Modular Library System
Automated Cartridge System (ACS): An LMU and its associated LSMs.	**Library complex:** Two or more libraries joined together with PTPs
Audit: The process of reading and cataloging all cartridges within an LSM or ACS; this is done through the Host Software Component (HSC) and the updated data is sent to the Control Data Set (CDS).	**Physical audit:** Cartridge volume identifiers (VOLIDs) and locations are stored within the library's memory—at power-on or when access doors are closed. **Verified audit:** By a StreamLine Library Console^{TM} command, cartridge VOLIDs and locations are validated. **Virtual audit:** Cartridge database is displayed through StreamLine Library Console. Audit is described in "Audit Types" on page 29.
Cartridge Access Port (CAP): Standard 21-slot or optional 80-slot, access door	**CAP:** Located on the right access door. CAP A is standard (39-slots); CAP B is optional.
Dual LMU: A master LMU that controls operation of the LSMs and a standby LMU that monitors the master; if a master LMU failure occurs, the standby LMU assumes control.	**Library complex:** Two or more libraries joined together with PTPs. SL8500 libraries in this configuration operate as peer-to-peer—there are no longer "master" or "standby" designations.
Enter: Enter a cartridge through the CAP	**Import:** Enter a cartridge through the CAP.
Eject: A specified cartridge is placed into the CAP by the robot for removal by the operator.	**Export:** A specified cartridge is placed into the CAP by a HandBot for removal by the operator.
Hand: The component that reads cartridge VOLIDs, stores, and retrieves cartridges; cartridge VOLIDs are read before retrieval by the robot.	**HandBot:** The component that stores and retrieves cartridges; it reads cartridge VOLIDs: • When entered through a CAP • During an audit • When retrieved through a PTP Since the location and VOLIDs of cataloged cartridges are resident on the HBC card, VOLIDs are not read during normal mount/dismount activities; mounts/dismounts are done by "dead reckoning."

Table 25. Old versus New Terminology (Continued)

9310 PowderHorn	SL8500 Modular Library System
Library: All software and hardware related to Automated Cartridge Systems.	**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* storage expansion module may be added.
Library Control Unit (LCU): The power source and robotic controller for an LSM.	An LCU is *not* attached to the library; its function is now contained within library's HBC and HBT controller cards.
Library Management Unit (LMU): The controller of all LSMs connected to it; the interface between the LSMs and the host. The term is still used in relation to addressing.	An LMU is no longer housed in a separate unit; its function is now contained within library HBC (controller) cards. See also "Library Complex" on page page 143.
Library Storage Module (LSM): Storage module, up to sixteen per ACS (LMU).	**Rail:** Each rail within an SL8500 is designated as one LSM (4 LSMs per SL8500 Library) by host software.
Master PTP: The controlling PTP; its commands originate from the LCU that contains the LP/LPP card.	**Home library:** *Home* denotes the library supplying power and communication to the PTP. Power and communication originate from the *left* side (as viewed from the front) of the home library; either library may initiate a PTP activity. Two SL8500 libraries are joined together by *four* PTPs because there are four rails per library. An SL8500 library PTP cannot perform a pass-thru operation to or from a 9310 or L5500 LSM. **Note:** Internal racks and Ethernet switches are required for PTP operations.
Robot: A component that revolves around a central point in a circular LSM.	**HandBots:** Components that move linearly along rails and vertically along the hand's Z column. A single library can have from four to eight HandBots.
Size/capacity: Determined by firmware and number of installed arrays; approximately 6,000 cartridges per LSM.	**Size/capacity:** Determined by the number of modules installed: three are required (1448 cartridges), but an additional *five* storage expansion modules can be added (10,088 cartridges each). Slots are enabled to allow "capacity on demand."

Table 25. Old versus New Terminology (Continued)

9310 PowderHorn	SL8500 Modular Library System
Standby PTP: The LSM whose PTP mechanism does not contain the PTP motor or LP/LPP card (LCU).	**Away library:** *Away* denotes the library *not* supplying power or communication to the PTP. Away libraries are on the *left* side (as viewed from the front) of the home library; either library may initiate a PTP activity. SL8500 libraries are joined together by four PTPs because there are four rails. **Note:** Internal racks and Ethernet switches are required for PTP operations.
Tape drive capacity: Up to 80 (with 9741e cabinets).	**Tape drive capacity:** From 1 to 64, with 16 per drive array assembly
Theta: Describes the circular path of the robot.	Because the path for the HandBots is no longer circular, the term “theta” motion does not apply.
Wrist: Describes outer-to-inner wall hand motion.	**Wrist:** Describes outer-to-inner wall HandBot motion.
Z motion: Describes the vertical path of the robot (4410) or hand (9310/L5500)	**Z motion:** Describes the vertical path of a HandBot hand assembly.

Capacity Comparison with 9310 Libraries

The advantages of the SL8500 library can be seen when compared to a 9310 ACS that contains three, dense pack library storage modules (LSMs).

Three 9310 LSMs provide storage for 33 cartridges per 0.1 m^2 (1 ft^2), whereas an SL8500 library complex, composed of three SL8500s provides storage for 59 cartridges per 0.1 m^2 (1 ft^2).

Library Comparisons

Because the SL8500 is a new library, a comparison between the existing Powderhorn, 9310 might help to put things into perspective.

- Table 26 compares libraries between weights, measures, and capacities
- Table 27 compares power requirements

Table 26. Comparisons Between PowderHorn and the SL8500 Library

9310 PowderHorn		**SL8500**	
Measurements			
Storage Module (LSM)		**Modular Library**	
Height	235 cm (92.5 in.)	Height:	236.6 cm (93.15 in.)
Diameter	325 cm (128.0 in.)	Width:	170.8 cm (67.25 in.)
Control Unit (LCU)		Length:	
Height	161 cm (63.5 in.)	Base library	276.9 cm (109 in.)
Width	39.1 cm (15.4 in.)	1 expansion module	372.1 cm (146.5 in.)
Length	58.1 cm (22.9 in.)	2 expansion modules	467.4 cm (184 in.)
Management Unit (LMU)		3 expansion modules	562.6 cm (221.5 in.)
Height	93.0 cm (36.6 in.)	4 expansion modules	657.8 cm (259 in.)
Width	74.4 cm (29.3 in.)	5 expansion modules	753.1 cm (296.5 in.))
Length	59.7 cm (23.5 in.)		
Drive Cabinet (9741e)		**Note:** One of the benefits of the SL8500 is the consolidation LMU, LCU, Drive Cabinets, and LSM within the SL8500.	
Height	183 cm (72.0 in.)		
Width	74.9 cm (29.5 in.)		
Length	58.4 cm (23 in.)	*Plus* additional consolidation with internal rack space for network components.	
Drives per cabinet	20 drives		
Total Area (60 drives)	10.3 m^2 (110.8 ft^2)	**Total Area** (64 drives)	9.6 m^2 (103.4 ft^2)
Weight			
LSM		Base library	
Empty	2449 kg (5,400 lb)	Empty	1497 kg (3,300 lb)
Fully Loaded	3810 kg (8,400 lb)	Loaded	2835 kg (6,250 lb)
		1 expansion module	1883 kg 4,150 lb)
LCU	136 kg (300 lb)	Loaded	3640 kg (8,025 lb)
LMU	113 kg (250 lb)	2 expansion modules	2268 kg (5,000 lb)
		Loaded	4445 kg (9,800 lb)
9741e Drive Cabinet	186 kg (410 lb)	3 expansion modules	2654 kg (5,850 lb)
One T9940 drive	7.7 kg (17 lb)	Loaded	5250 kg (11,575 lb)
9741e with 20 drives	340.2 kg (750 lb)		
9741e with 40 drives	680.3 kg (1,500 lb)	4 expansion modules	3039 kg (6,700 lb)
9741e with 60 drives	1020.5 kg (2,250 lb)	Loaded	6055 kg (13,350 lb)
9741e with 80 drives	1361 kg (3,000 lb)		
		5 expansion modules	3425 kg (7,550 lb)
		Loaded	6860 kg (15,125 lb)
Total Weight (60 drives)	5420 kg (11,950 lb)	**Total Weight** (64 drives)	5250 kg (11,575 lb)

Table 26. Comparisons Between PowderHorn and the SL8500 Library (Continued)

9310 PowderHorn		**SL8500**	
Service Clearances			
LSM (door opening)	86.36 cm (34 in.)	Front	66 cm (26 in.)
LCU	39.0 cm (15.4 in.)	Rear	85 cm (33.5 in.)
LMU	81.3 cm (32.0 in.)	Pass-thru ports	15.25 cm (6 in.)
9741e Drive Cabinet	81.3 cm (32.0 in.)	Door width	10.16 cm (4 in.)
Planning Requirements			
Raised Floor Loading	244-293 kg/m^2 (50-60 lb/ft^2)	Raised Floor Loading	260 kg/m^2 (120 lb/ft^2)
Loading per pad	454 kg (1,000 lb)	Loading per pad	454 kg (1,000 lb)
Distribution pads	18 (per library)	Distribution pads	26 (with 3 expansions)
Assembly area	35 m^2 (400 ft^2)	Assembly area	56 m^2 (600 ft^2)
Power Requirements			
Voltage (selectable)	200 to 240 VAC	Voltage	200 to 240 VAC
Frequency	47 to 63 Hz	Frequency	47 to 63 Hz
Phases (Current)	Single	Phases (Current)	
LCU/LSM LMU	12 Amps 8 Amps	Single Phase	*3 inputs* (24 Amps) *6 redundant*
9741e Drive Cabinet	20 Amps	Three Phase: (*recommended*)	Delta (40 Amps) Wye (24 Amps) SUVA (24 Amps)
Power Consumption LCU/LSM LMU 9741e Drive Cabinet	 1.5 kW 0.126 kW 1.47 kW	Power Consumption (maximum loading**)	13.0 kW
Heat Output LCU/LSM LMU 9741e Drive Cabinet	 3,750 Btu/hr 2,050 Btu/hr 8,047 Btu/hr	Heat Output (maximum loading**) ** Maximum loading = 64 tape drives, 4 fully loaded racks, 8 HandBots, all front frame components, plus redundant control modules	44,380 Btu/hr
Minimum system (16 drives)	3.56 kW 12,140 Btu/hr	Minimum system (16 drives)	3.32 kW 11,320 Btu/hr
Maximum system (60 drives, 3 x 9741E)	10.76 kW 36,700 Btu/hr	Maximum system (64 drives, plus 8 HandBots, 4 racks)	12.27 kW 41,840 Btu/hr
Note: See Table 27 on page 150 for additional comparisons for power requirements			

Table 26. Comparisons Between PowderHorn and the SL8500 Library (Continued)

9310 PowderHorn		**SL8500**	
Capacities			
Tape drives (max)		Tape drives (max)	
single library	80 (four 9741e)	single library	64
ACS	960	complex	2,048
Tape cartridges (max)		Tape cartridges (max)	
single library	6,000 (5,500)	single library	6,632
ACSLS managed	144,000	complex	greater than 200,000
NCS/HSC managed	96,000		
Storage Density	33 cartridges per 0.1 m^2 (1 ft^2)	Storage Density	59 cartridges per 0.1 m^2 (1 ft^2)
Libraries in an ACS	24 (ACSLS control) 16 (HSC control)	Libraries in a Complex	31 (ACSLS) or 32 (HSC)
Cartridge Access Ports	21-cells standard 80-cells *optional*	Cartridge Access Ports	39-slots standard 39-slots *optional* 78 total
Storage (Tape Cartridges)			
Single Library	1,500 cartridges (min.)	**Single Library**	1,448 cartridges (min.)
T9840 A (20 GB)	30 TB	T9840 A (20 GB)	29 TB
T9840 B (20 GB)	30 TB	T9840 B (20 GB)	29 TB
T9840 C (40 GB)	60 TB	T9840 C (40 GB)	58 TB
T9940 B (200 GB)	300 TB	T9940 B (200 GB)	290 TB
LTO Gen 2 (200 GB)	300 TB	LTO Gen 2 (200 GB)	290 TB
ACS (*24 libraries*)	84,000 cartridges	**Complex** (*32 libraries*)	300,000 cartridges
T9840 A (20 GB)	1.68 PB	T9840 A (20 GB)	6 PB
T9840 B (20 GB)	1.68 PB	T9840 B (20 GB)	6 PB
T9840 C (40 GB)	3.36 PB	T9840 C (40 GB)	12 PB
T9940 B (200 GB)	16.8 PB	T9940 B (200 GB)	60 PB
	132,000 cartridges	LTO Gen 2 (200 GB)	60 PB
LTO Gen 2 (200 GB)	26.4 PB		
Performance (Tape Drives)			
Single Library	80 drives	**Single Library**	64 drives
T9840 A (10 MB/s)	2.9 TB/hr	T9840 A (10 MB/s)	2.3 TB/hr
T9840 B (19 MB/s)	5.5 TB/hr	T9840 B (19 MB/s)	4.4 TB/hr
T9840 C (30 MB/s)	8.6 TB/hr	T9840 C (30 MB/s)	6.9 TB/hr
T9940 B (30 MB/s)	8.6 TB/hr	T9940 B (30 MB/s)	6.9 TB/hr
LTO Gen 2 (32-35 MB/s)	10 TB/hr	LTO Gen 2 (32-35 MB/s)	8.1 TB/hr
ACS (24 libraries)	960 drives	**Complex** (32 libraries)	2,048 drives
T9840 A (10 MB/s)	34.56 TB/hr	T9840 A (10 MB/s)	74 TB/hr
T9840 B (19 MB/s)	65.56 TB/hr	T9840 B (19 MB/s)	140 TB/hr
T9840 C (30 MB/s)	103.68 TB/hr	T9840 C (30 MB/s)	221 TB/hr
T9940 B (30 MB/s)	103.68 TB/hr	T9940 B (30 MB/s)	221 TB/hr
LTO Gen 2 (32-35 MB/s)	120.96 TB/hr	LTO Gen 2 (32-35 MB/s)	258 TB/hr

Table 27. Power Requirement Comparisons
Between PowderHorn and the SL8500 ~ A Quick Reference

9310 PowderHorn				SL8500 modular library system						
2 Hands		Watts		4 Robots		Watts		8 Robots	Watts	
Component	**Qty**	**Idle**	**Max**	**Component**	**Qty**	**Idle**	**Max**	**Qty**	**Idle**	**Max**
LCU & LSM	1	200	1500	Modular Library	1	200	1500	1	400	3000
LMU	1	126	126	Control Module	1	100	100	1	100	100
Dual LMUs	1	252	252	Control Module	2	200	200	2	200	200
				Rack space (base)			1440	—	—	1440
Rack space (9741)	each	—	490	Rack space (redundant)			2880	—	—	2880
Tape Drives:				**Tape Drives:**						
T9x40	4	554	642	T9x40	4	344	432	4	344	432
	16	1586	1938		16	1370	1728	16	1370	1728
	20	1930	2370		20	1720	2160	20	1720	2160
	40	3860	4740		40	3440	4320	40	3440	4320
	64	6134	7542		64	5504	6192	64	5504	6192
LTO/SDLT	4	390	490	LTO/SDLT	4	180	280	4	180	280
	16	930	1330		16	720	1120	16	720	1120
	20	1110	1610		20	900	1400	20	900	1400
	40	2220	3220		40	1800	2800	40	1800	2800
	64	3510	5110		64	2880	4480	64	2880	4480
Example (maximum case): For a Powderhorn LCU, LSM with 2 LMU's and 16 T9X40 drives: 1500 + 252 + 1938 = 3690 watts				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 SL8500 library related publications.

This glossary defines terms and abbreviations used in this publication.

A

aggregate backup and recovery support (ABARS) 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.

Automated Cartridge System (ACS) A system that automatically mounts cartridges into tape drives in response to requests from host software.

B

back up To copy information for safekeeping.

C

cache A block of memory that temporarily collects and retains data that allows quicker retrieval of frequently-used data to improve overall system performance.

cartridge A protective container that consists of magnetic tape on supply and take-up reels.

control data set (CDS) The host software component (HSC) database. This data set contains all configuration and volume information that the host software uses to control the functions in an automated library.

D

Data Facility Storage Management Subsystem (DFSMS) An operating environment that helps automate and centralize the management of storage. To manage storage, DFSMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

DFSMShsm A DFSMS functional component or base element of z/OS that provides functions for backing up and recovering data, and managing space on volumes in the storage hierarchy. *See Hierarchical Storage Management (HSM)*.

E

Expert Library Manager (ExLM) Software that manages the contents of LSMs and provides virtual tape management functions.

F

fast load Once a HandBot successfully inserts a tape cartridge into a drive, it is immediately available for the next operation and does not wait until the drive reports that the cartridge has been loaded.

H

Hierarchical Storage Management (HSM) A data storage system that automatically manages and distributes data between high-cost and low-cost storage devices.

The objectives are to minimize access time to data and maximize media capacity.

In effect, HSM turns the fast disk drives into caches for the slower storage devices such as tape drives. Hierarchical storage management is implemented in Tivoli Storage Manager, AS/400, and z/OS in combination of the storage management subsystem (SMS). *See also Virtual Storage Manager (VSM)*.

L

LIBGEN The process of defining the configuration of the library to the host software.

library A robotic system that stores, moves, mounts, and dismounts tape cartridges that are used in data read or write operations.

LibraryStation Software that allows MVS hosts to share Automated Cartridge System (ACS) facilities with heterogeneous network client systems.

library storage module (LSM) A housing that contains tape cartridges and robotics systems that moves the cartridges between storage cells and tape drives.

M

migration (1) The movement of data from one storage subsystem to another. Examples are hierarchical storage management (HSM) and virtual storage manager (VSM).

multiple volume cartridge (MVC) A physical tape cartridge in a library that contains one or more virtual tape volumes. The information about the MVC is stored in the HSC control data set (CDS).

N

N+1 an SL8500 power configuration that provides AC power and redundant DC power by adding a second DC power supply to each DC bus.

P

PTF Program Temporary Fix.

PUT Program update tape. As in PUT 0502 for ACSLS.

R

real tape drive (RTD) The physical tape drive attached to the library.

recall The process of moving or returning a migrated data set.

reclaim The ability of a multiple volume cartridge to recover space from removed virtual tape volumes.

restore To return a backup copy to the active storage location for use.

S

symmetric multiprocessor (SMP) A system in which functionally-identical multiple processors are used in parallel, providing simple and efficient load-balancing.

System Modification Program/Extended (SMP/E) An IBM licensed program to install software and software changes on z/OS operating systems. A basic tool for installing, changing, and controlling changes to programming systems.

T

tape cartridge A protective container that consists of magnetic tape on supply and take-up reels.

TAPEREQ An HSC control statement that defines a specific tape request and consists of two parts, input and output.

- Input: job, step, program, and data set names, expiration date or retention period, and an indication for specific requests or nonspecific (scratch) requests
- Output: media type and recording technique capabilities.

V

Virtual Storage Manager (VSM) A storage solution that virtualizes volumes (tape cartridges) and tape drives in a virtual tape storage subsystem (a disk buffer or cache) to improve media and tape drive usage.

The hardware in this solution includes a virtual tape storage subsystem (VTSS)—the disk buffer, and real tape drives (RTDs)—the library and physical tape drives.

The software in this solution includes Virtual Tape Control System (VTCS)—an HSC-based host software, and VTSS microcode. *See also hierarchical storage management (HSM).*

virtual tape A virtual device with the characteristics of a tape cartridge.

Virtual Tape Control System (VTCS) The software that controls the activity and coordinates operations between the host operating system and the virtual tape storage subsystem, virtual tape volumes, real tape drives, and multiple volume cartridges.

VTCS software operates in the same address space and communicates closely with the host software component (HSC).

Virtual Tape Drive (VTD) The emulation of a physical tape drive in virtual tape storage subsystem. The data written to a VTD is really being written to disk.

Virtual Tape Storage Subsystem (VTSS) The disk buffer that contains the virtual tape volumes and emulates the virtual tape drives.

VTSS is a RAID 6 disk subsystem with microcode that enables emulation of up to 32 and 64 tape drives.

Virtual Tape Volume (VTV) A portion of the disk buffer that appears to the operating system as a real tape volume (RTV).

Virtual Telecommunications Access Method (VTAM) An IBM host-resident communications software for communications between processors. For use with HSC and VSM when defining the communications path (COMMPATH).

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