HP Extends StorageWorks Enterprise Tape Library Family
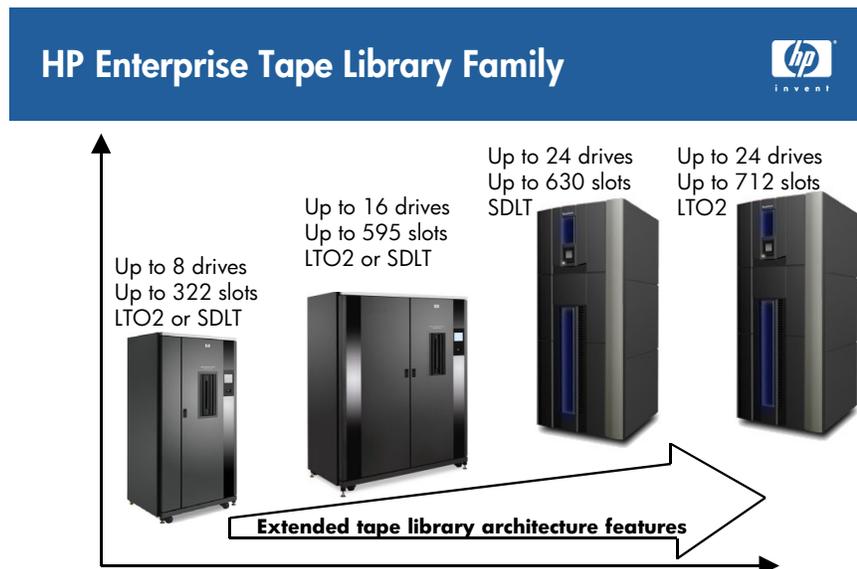
Executive summary

HP listens to customers. When starting to design its new line of enterprise class libraries, HP consulted widely with its customer base, storage analysts, and its technical consultants in the field to establish what features were important and which features could be improved with their current libraries. The result is a library architecture that can be implemented across the whole range of HP libraries both current and future. Moreover, for the first time HP tape libraries will provide self-aware tape storage specifically designed for use in your storage area network (SAN).

With the introduction of the new HP StorageWorks ESL712e and HP StorageWorks ESL630e tape libraries, and enhancements to the existing HP StorageWorks ESL9000 range, HP can better meet the demands of its enterprise customers by providing:

- Tape libraries that are now fully SAN enabled (in the same way that disk arrays are), by utilizing HP StorageWorks Extended Tape Library Architecture to provide much better interoperability, reliability, and advanced features required to use a tape library in today's SAN environments.
- The best gigabyte per square foot density and gigabyte per hour throughput capability of any enterprise library at a competitive price.
- Investment protection. The entire range of the ESL family of libraries will support future SDLT and LTO technologies as they become available. In addition the architecture allows for easy migration to 4-GB Fibre Channel (FC) and other storage networking protocols such as iSCSI, as they become available.

Whether you are an existing HP library customer who now needs better integration into a SAN or a prospective HP library customer evaluating potential suppliers, HP can provide a tape library to meet the most demanding of enterprise environments.

Figure 1. HP enterprise library family

HP Enterprise Tape Library Family

Up to 8 drives
Up to 322 slots
LTO2 or SDLT

Up to 16 drives
Up to 595 slots
LTO2 or SDLT

Up to 24 drives
Up to 630 slots
SDLT

Up to 24 drives
Up to 712 slots
LTO2

Extended tape library architecture features

Target audience for this white paper

This white paper is aimed at the "business continuity" technical decision makers within IT departments. It presents a structured technical case for the adoption of HP enterprise libraries and explains the features and benefits of HP enterprise libraries with extended tape library architecture.

The appendices at the end of this white paper are used as a reference source for customers wanting to design, configure, and order an HP ESL library solution.

Problems with today's enterprise libraries and HP solutions

Problem 1: How can a customer manage an enterprise library (tape drives, robotics, and interface controllers) as a complete entity? More than 37% of those surveyed by HP were using the backup application to manage their library. The backup software is too far removed from the internal workings of the library to report detailed status effectively. Twenty-two percent cited that remote management cards within the library were used to manage the library but complained about the myriad different user interfaces from different manufacturers.

HP Solution: The HP StorageWorks Interface Manager within the HP [Extended Tape Library Architecture](#) acts as a central management point for all the activities within the HP library. The Interface Manager is out of the data path but communicates with the interface controllers by way of a private LAN to report detailed status. The management console interface is the same as with all other HP storage devices and is called HP StorageWorks Command View ESL. This gives all HP storage a common look and feel for management. At a higher level, the Interface Manager is integrated with enterprise-wide management applications such as HP OpenView Storage Area Manager (HP OpenView SAM). By early 2005, HP libraries will also support the Storage Networking Industry Association (SNIA) Storage Management Interface.

Problem 2: "The most difficult part about integrating a large library in a SAN is configuring the FC interface to the library," said 56% of the people surveyed.

HP Solution: The Interface Manager and Command View ESL configuration interface greatly simplify setup in a SAN. Instead of the complexity of configuring each interface controller (and associated tape drives) separately, a simple unified configuration wizard enables the entire library to be configured in four "mouse clicks."

Problem 3: Interoperability and performance optimization. According to the survey, one of the largest reliability problems involving libraries in a SAN is maintaining high performance interoperability in a heterogeneous environment.

HP Solution: With more than four years of development and deployment already behind it, the HP Interface Controller has proved that placing an interface card between the SAN and the back-end tape drives has the following advantages:

- The interface controller buffers the library from events disruptive to backup such as FC loop initialization, spurious test unit ready requests, and reservation conflicts.
- Because much of the HP SAN interoperability has been proven using these interface controllers, it is now quicker, easier, and more reliable for the back-end tape drives or front-end FC infrastructure to

be changed without having to re-qualify the whole interoperability of the library. Upgrading to LTO3 or to 4-GB/sec FC is easy using this approach.

- Interface controllers allow far better aggregation of the available FC bandwidth and reduce the number of FC ports required to connect to the library. The interface controllers allow 2 X 2-Gb/sec FC inputs to be effectively "shared" across 4 x HP StorageWorks Ultrium 460 tape drives or 4 x HP StorageWorks SDLT 320 tape drives. A native FC tape library with direct connections to the SAN (no interface controller) would require four to eight FC ports to accomplish the same functionality and would offer no increase in performance since a 2-Gb/sec (200-MB/sec) connection is only being utilized by a 30-MB/sec tape drive—a waste of bandwidth and expensive FC switch ports. HP StorageWorks Ultrium 460 NFC drive tape libraries using the e2400-FC interface controller utilize 2 X 2-Gb/sec FC inputs and 4 X 2-Gb/sec outputs to the tape drives.

Problem 4: Diagnosing library and drive faults.

HP Solution: The successful HP Library and Tape Tools (L&TT) diagnostics are being ported into the core of the Interface Manager and will be able to recover important log information and SAN activity from the library, drives, and interface controllers. The SAN activity is recorded in Event Logs displayed by Command View ESL management software and can be quickly used to diagnose issues with the library and hosts connected to the library—making tape libraries truly SAN-aware for the first time.

See Appendix 4 for screenshots of this important capability.

These logs can also be incorporated into a comprehensive "support ticket" that HP engineers can then evaluate to find the root cause of the problem. This can only happen because L&TT embedded in the Interface Manager has direct access to all the necessary log files. No other library vendor gives you this amount of diagnostic capability or this quality of information.

Problem 5: It seems impossible to balance space utilization, drive density, load port capacity, and inventory time.

HP Solution: Today's data centers demand maximum space efficiency. The HP StorageWorks ESL E-Series libraries offer up to 28.4 TB/sq ft and the ESL9000 libraries around 19.6TB/sq ft, both ahead of the competition. This assumes 2:1 data compression and is based on the maximum slot counts for each library. The HP ESL extended libraries also offer the most drives in a single frame of any enterprise class library. See Appendix 3.

Some customers in the HP survey complained that an eight media load port (mailbox) was too small for a 595-slot ESL9000 library. In response, the new HP StorageWorks ESL extended libraries have load ports size up to 48 for Linear Tape Open (LTO) and 42 for Super DLT (SDLT). These load ports are fixed at initial launch and will be made removable a short time thereafter.

The bar code reader in the ESL extended series of libraries is faster than in the ESL series, reducing the inventory time from 7 minutes to less than 5 minutes.

For a full description of the HP StorageWorks Extended Tape Library Architecture and Library feature sets follow these links.

HP StorageWorks ESL E-Series Enterprise Tape Libraries—
The latest addition to HP enterprise class tape libraries

Figure 2. HP ESL E-Series library overview

ESL E-Series

- HP StorageWorks E-Series enterprise tape automation coupled with HP's Extended Tape Library Architecture, offer self-aware storage designed for the SAN.
- Working together, HP enables managing more storage with fewer IT resources in less floor space.

  - Best-in-Class Drive Density

  - Best-in-Class Cartridge Density

  - Fully integrated into the Extended Tape Library Architecture

  - Expanded Drive Offering to include native Fibre Channel tape drives

1/29/2004 NSS NDA page 2

The HP ESL E-Series libraries represent a breakthrough in library design and integration into a SAN. The following schematics show the key design points:

- Optimal use of space—Drives, slots, and manageability components
- Four-unit drive clusters for maximum drive density
- Drive clusters also contain drive power monitoring and Interface Manager
- Ergonomic load ports
- Reliable belt-driven robotics
- Built-in interface controller card cage
- Available in four variants
  - 712e—LTO2 drives maximum 712 slots
  - 322e—LTO2 drives with a base configuration of 322 slots (upgradeable with license to 712)
  - 630e—SDLT 320 drives with maximum 712 slots
  - 286e—SDLT 320 drives with a base configuration of 286 slots (upgradeable with license to 630)
- Expandable to five frames using a cross-link mechanism (future offering)

The following figures illustrate some of the key features of the HP StorageWorks ESL E-Series libraries.

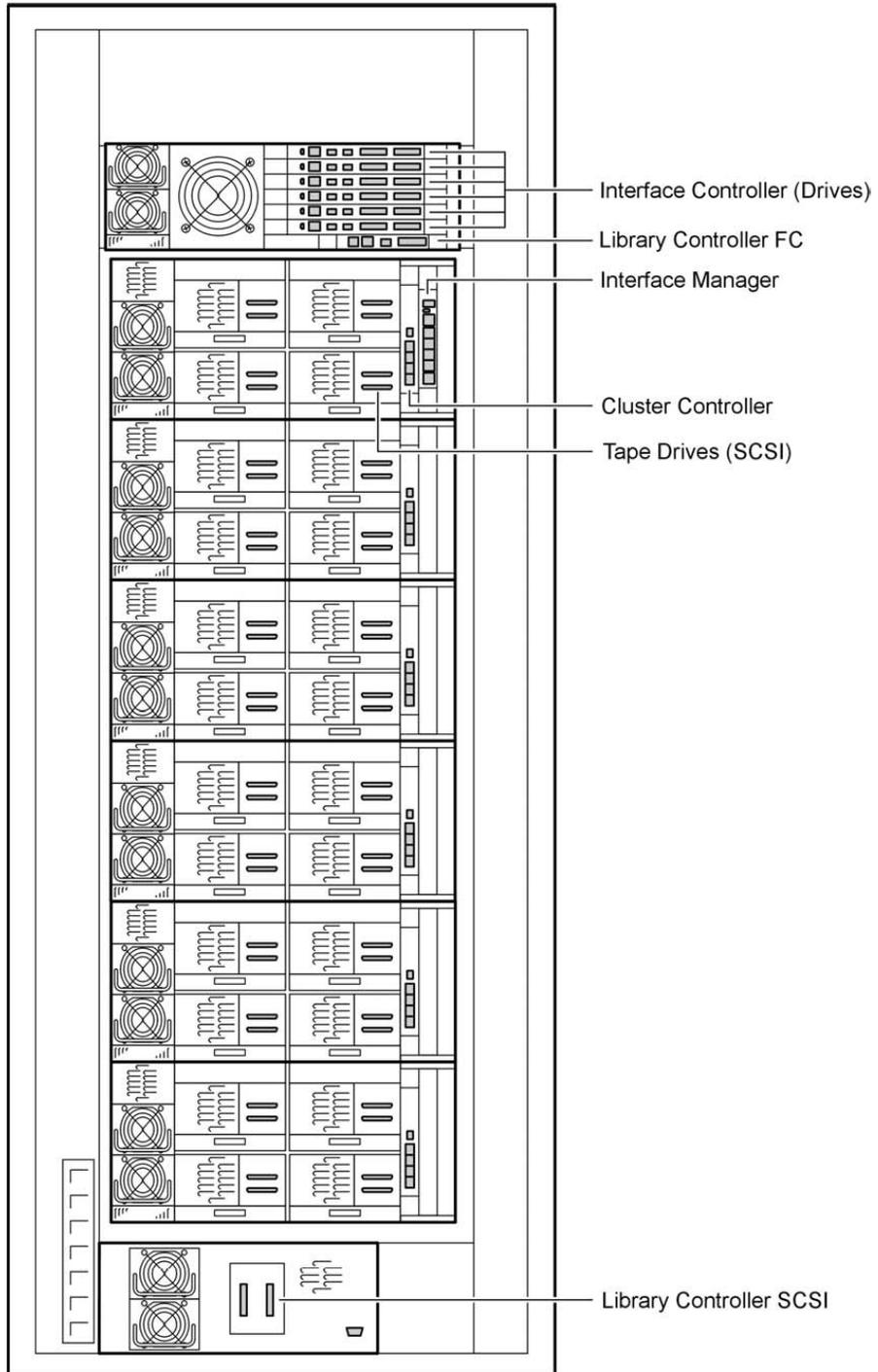**Figure 3.** HP StorageWorks ESL E-Series tape libraries load port locations
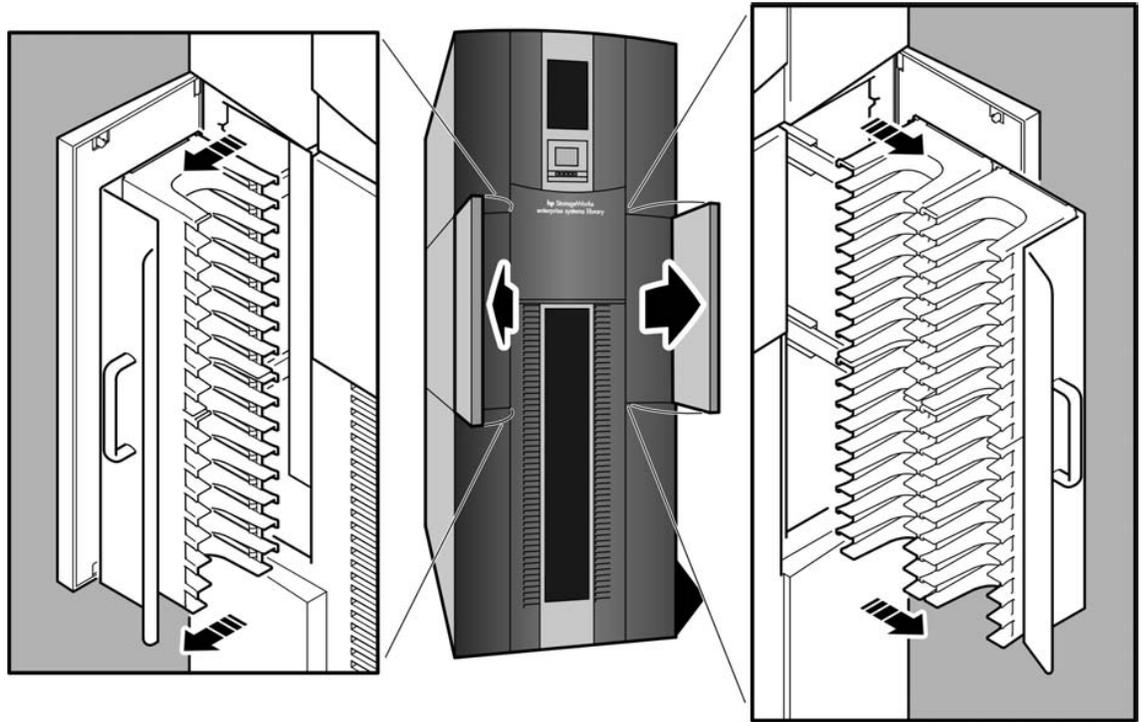
- In the ESL E-Series 712e model shown, the right load port can hold 32 SDLT or 36 Ultrium tapes and the left load port 16 SDLT or 18 Ultrium tapes. The use of these load ports is configurable.
- The monitor and display panel are located in the center of the library.
- The see-through panels are located in the center of the front door.

**Figure 4.** HP StorageWorks ESL E-Series tape libraries internal view
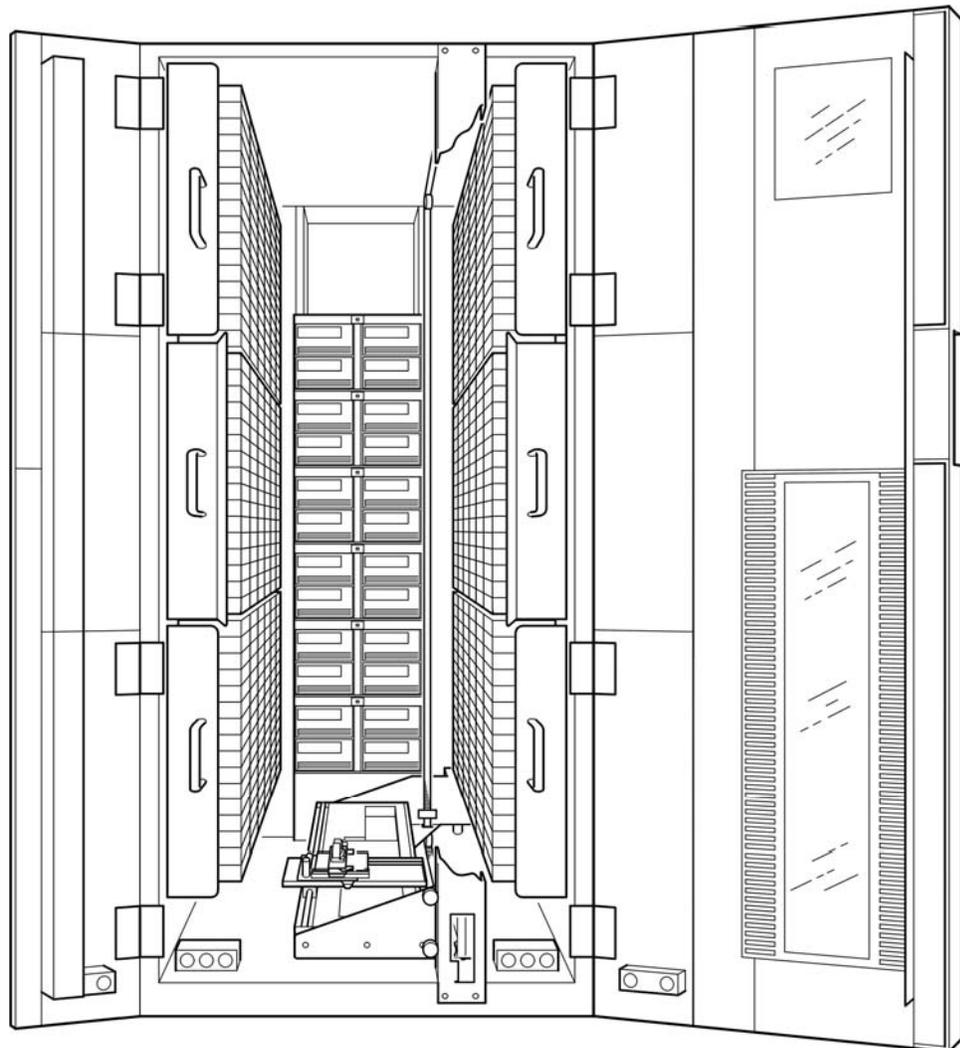
- This illustration shows the maximum configuration of 24 tape drives in six drive clusters at the rear of the library.
- "Wall to wall" slot backs on the right and left walls. Other slots are available if the full complement of drive clusters is not installed. No media slots are on the rear of the front door.
- The media cartridge bins are on runners to facilitate initial bulk loading of media into the library.
- The belt-driven robotics are efficient.
- The overall slot count of the library is dependent on the number of drives installed and load port configuration selected. For a complete matrix of slot count options, see Appendix 2.

Figure 5. HP StorageWorks ESL E-Series tape libraries rear view

Interface Controller (Drives)

Library Controller FC

Interface Manager

Cluster Controller

Tape Drives (SCSI)

Library Controller SCSI

- The interface controllers connect the tape drives to the SAN and are located in the card cage at the top of the library.

- The robotics control for the library is derived from a separate e1200-160 interface controller dedicated to the robotics controller and located in the card cage at the top of the unit. The library robotics are on a separate FC connection. The SCSI output from the e1200-160 controller is cabled to the library SCSI robotics port located at the bottom of the rack.

- The drive SCSI connections are taken from the interface controllers in the card cage at the top of the rack and connected to the individual drives in the drive clusters.

- Each cluster controller has an Inter IC bus (I^2C) interface and four LAN ports. The cluster controller I^2C port is used to coordinate the loading and unloading of tapes for the main robotics controller. The LAN ports connect the Interface Manager, interface controllers, and cluster controllers into an internal LAN used to monitor and configure the whole tape library. One LAN output goes external to the tape library and is used for remote management of the library using a management console and Command View ESL configuration and management software.

- The Interface Manager, located to the right of the cluster controller in the top drive cluster, acts as the focal point of all knowledge within the library.

Figure 6. The ESL E-Series cross-link mechanism enables scaling up to five frames (future offering)
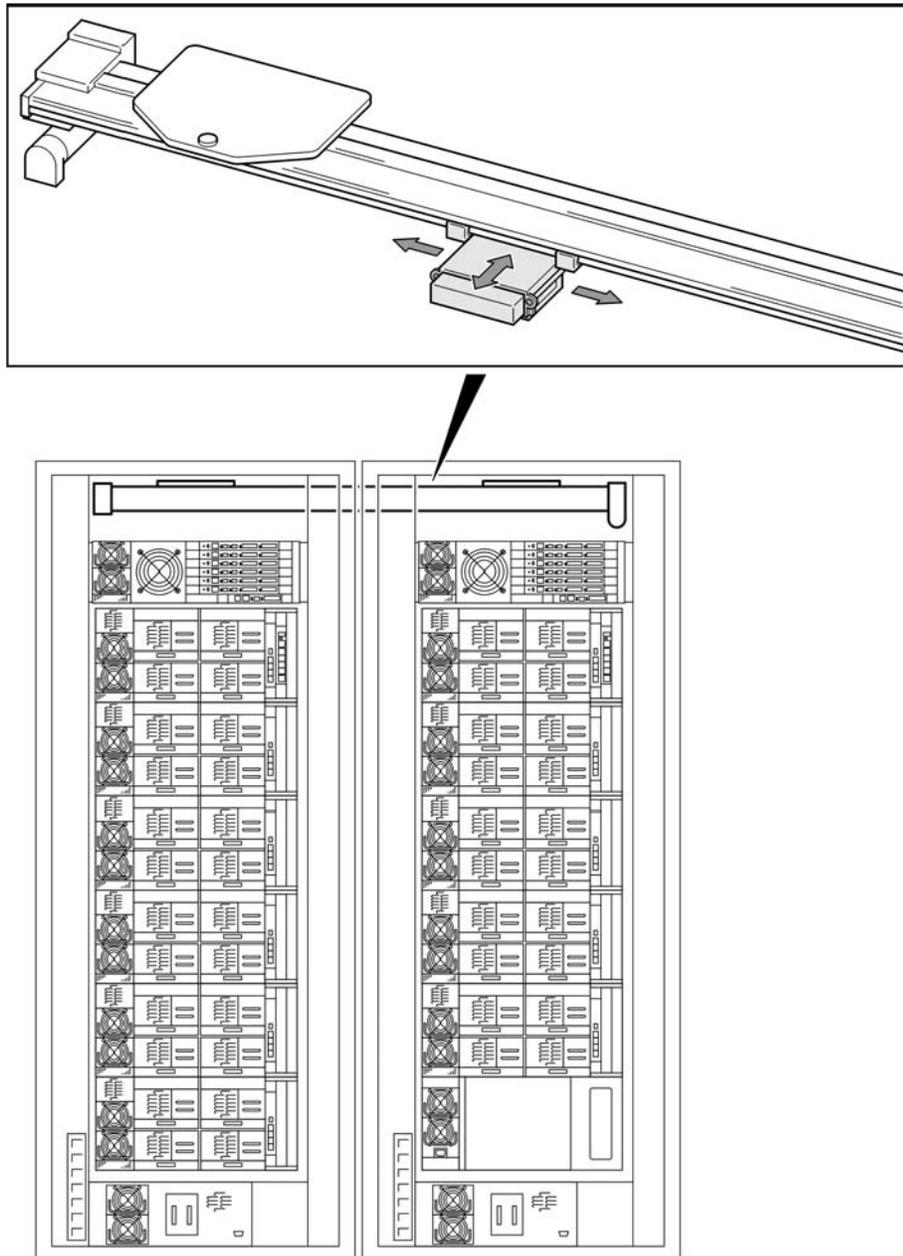
- This illustration shows how multiple ESL E-Series libraries can be connected (future offering) using a cross-link mechanism and a cross-link mechanism controller.
- The cross-link mechanism runs across the top of the racks, passing media between frames.
- The cross-link controller occupies the space of a cluster controller in the rightmost rack of the chain, as shown.

Figure 7. Robotics schematic
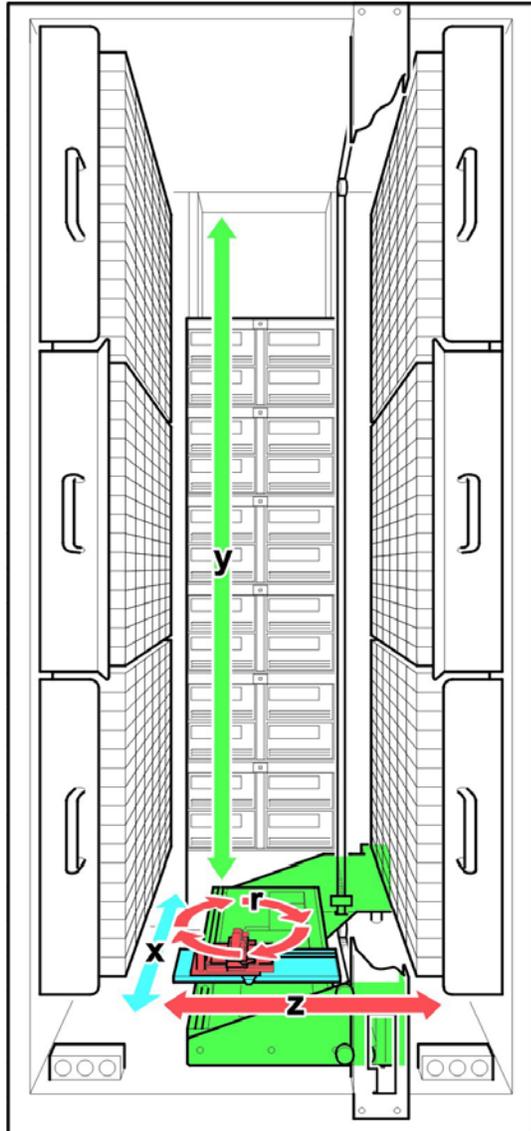
This illustration shows the movement axis for the robot x, y, z, and r (rotational), thus allowing access to all media slots and drive slots within the library.

HP StorageWorks ESL E-Series libraries positioning

The ESL E-Series libraries are the latest addition to the HP StorageWorks ESL series of libraries. Drive upgrades and ongoing interoperability testing will continue on both ESL9000 and ESL E-Series platforms. The ESL E-Series platform, however, offers some important advantages over the ESL that some customers will value:

- More than 500 cartridge slots
- High storage and drive density
- Native FC tape drives
- Tape technology support beyond HP StorageWorks SDLT 600 and LTO3
- Higher scalability (up to 116 drives and 3,050 slots)
- Higher capacity load ports (up to 54 tapes at a time)
- The full range of advanced features offered through the HP StorageWorks Extended Tape Library Architecture (ETLA)

The ESL9000 series libraries will also have many of the important manageability and advanced features offered through the ETLA. Customers should choose an ESL9000 series library when:

- The customer needs 200 to 500 slots.
- The customer wants to expand an existing ESL9000 series library.
- The customer needs HP StorageWorks Ultrium 230 drive technology and/or mixed drive capability within the same library.
- The manageability and certain advanced features offered by the ETLA. ESL9000 series libraries can be ordered as a complete bundled ETLA solution using a single SKU.

Introducing ETLA

ETLA will save library and SAN administrators time and money by simplifying library setup, configuration, and troubleshooting. HP controller-based architecture increases reliability and robustness of libraries in the SAN and integrates with leading enterprise management applications.

The HP StorageWorks Interface Manager and HP StorageWorks Command View ESL for ESL tape libraries is the next step in the ETLA, which is itself a key component of the HP ENSAextended and HP Adaptive Infrastructure strategy. This architecture delivers tape libraries that are self-aware—self-managed, automatically maintained, continuously available—and network-aware—resilient, secure, and adaptable. HP high-end tape libraries provide the reliability, interoperability, and advanced functionality required for your enterprise SAN environment.

ETLA currently consists of the following integrated components:

- HP StorageWorks ESL9322, HP StorageWorks ESL9595, ESL 712e, and ESL 630e enterprise tape libraries, with a choice of Ultrium 460 or SDLT 320 tape drives
- HP StorageWorks Fibre Channel Interface Controller e2400-160
- HP StorageWorks Fibre Channel Interface Controller e1200-160 (used for library robotics control)
- HP StorageWorks Interface Manager card
- HP StorageWorks Command View ESL software
- HP StorageWorks Direct Backup Engine ESL
- HP StorageWorks Secure Manager ESL

Acting together, these integrated components can:

- Decrease both costs and administrative work through enhanced manageability from any location
- Deliver best-in-class interoperability **without** "special" work-arounds
- Simplify the complex task of setting up library robotics, drives, and interface controllers in a SAN
- Minimize uncertainty in complex SAN environments by allowing only authorized servers to access tape drives and critical data
- Eliminate backup server and LAN bottlenecks by allowing data to move directly from disk to tape under the control of your backup application—without application server overload
- Provide investment protection by enabling an easy upgrade path as interface technologies change

Currently installed ESL9322 and ESL9595 tape libraries can upgrade to the ETLA with Interface Manager and Command View ESL upgrade kits and software licenses. New Extended library solutions that include a library frame, card cage, Interface Manager card, Command View ESL software, and permanent software licenses are also available. The ETLA will grow over time to support a wide range of library platforms and advanced features. See Appendix 2 for a complete list of part numbers and a configuration guide.

 Figure 8. ETLA topology
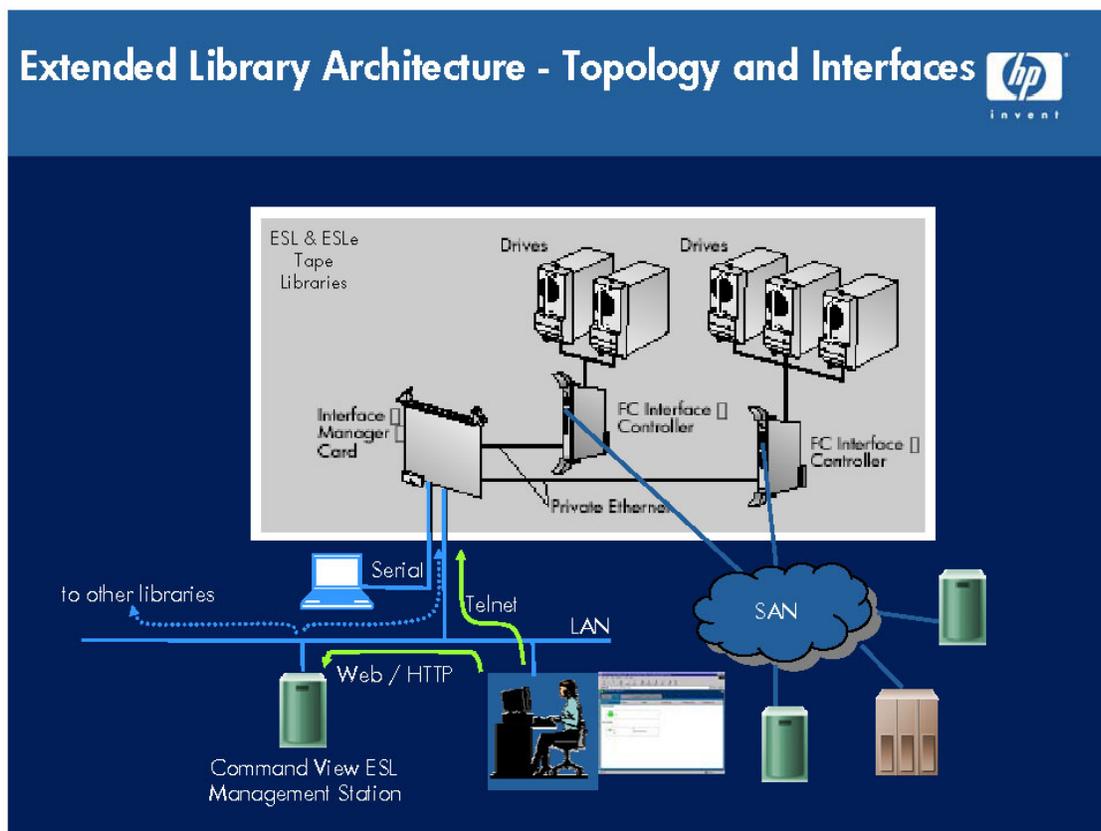
The preceding diagram shows how ETLA works.

- The interface controllers are the interface between the SAN and the tape drives, buffering the tape drives from any disruptive SAN activity that could affect backup and restore reliability. The interface controllers can also track and detect SAN-specific errors (fabric events, conflicts, and so on). One interface controller can support four tape drives (Ultrium 460 or SDLT 320). The interface controllers themselves also support features such as Direct Backup (sometimes known as serverless backup) and implement any advanced SAN access control that HP StorageWorks Secure Manager has configured.

- The Interface Manager communicates through private Ethernet to the interface controllers and can configure the interface controllers, monitor drive and library activity, run diagnostics, accumulate and store (flash Eprom) FC protocol activity from the interface controllers, and (in the future) provide drive performance monitoring. The outside world communicates initially with the Interface Manager through either a telnet or serial interface. The Interface Manger contains six Ethernet ports, four for communication with interface controllers, one for connection to the external management LAN, and one for cascading Interface Manager connections to other libraries. In effect, the Interface Manager provides a central point of knowledge for the entire library subsystem. The Interface Manager therefore also provides the interface to enterprise management applications, such as HP OpenView SAM, CA Unicentre TNG, and so on, through the external LAN connection.

- When the IP address of the Interface Manager is set using a telnet or serial connection, the Command View ESL software can be installed on a nominated Microsoft® Windows® management station. Command View ESL has both a graphical user interface (GUI) and command line interface and provides a host of system monitors, configuration utilities, support ticket generation, Selective Storage Presentations (with Secure Manager option), and inventory reporting and performance analysis (future). See Appendix 4 for more visual information on Command View ESL.

Figure 9. Future features that can be supported with ETLA

ESL E-Series-
Extended Library Roadmap

Jan 2005

Nov 2004

July 2004

Feb 2004

- Multi Unit Scalability

- SDLT600
- Mixed Drive Support
- Library Partioning
- Removable Magazines

- Ultrium 460 NFC
- FC – FC Interface Controller
- Small libraries and Licensed Capacity Upgrades

- 712 LTO , 630 SDLT
- 1-24 drives
- Ultrium 460, SDLT 320
- Interface Manager
- Command View ESL
- Secure Manager ESL
- Direct Backup ESL

Future feature developments within ETLA

The advanced features that can be developed with ETLA are significant. ETLA will become the defining differentiator for HP tape libraries over the competition. Much of the initial current ETLA feature set is based on high-quality manageability, configuration, and diagnostics—being able to see everything happening within the library, together with some specific features such as:

- Secure Manager—The ability to define which SAN hosts are allowed to communicate with the library.
- Direct Backup using the data mover functionality within the interface controller—This can be used in specific environments to offload the processing power required for a backup from the application server to the interface controller (see Appendix 5 for more details).

During 2004, the ETLA feature set will be significantly enhanced to provide:

- **Library partitioning**—The ability to make a large library look like several small libraries (each with its own virtual robotics and dedicated slots). This is necessary when customers want to consolidate their backup into a single library but still use multiple backup software ISVs. Partitioning allows each ISV to see its "own" robot.
- **Data path failover**—The normal dual path configuration for a host is generally accomplished by two host bus adapters (HBA) going to separate (unlinked) FC switches and then to separate FC ports on the interface controller. The host uses one of the paths as a primary to stream data to a tape device behind the controller. When that path fails (link is disconnected or switch is power-cycled), the tape driver in the host automatically fails the I/O to the secondary path. This is done without knowledge from the ISV applications. This capability currently does not exist in the industry today. A further development of this concept would be to enable data paths within the tape library itself to fail over. This is best accomplished using native FC tape drives and FC switches within the library itself.
- **Performance optimization**—The ability to load balance the backup from different servers to optimize the FC bandwidth capability into the library. In addition, this feature can show a graphical illustration of host transfer rates and tape transfer rates dynamically so that bottlenecks could be assessed and investigated.

Physical implementation of HP ETLA in ESL 9000 and ESL E-Series libraries

The physical implementation of ETLA is similar in both ESL and ESL E-Series libraries. In the ESL E-Series libraries, the interface controllers are in a separate card cage at the top of the library, and the Interface Manager cards are installed in the drive cluster (see Figure 5). For the ESL series of libraries, all the components are in a single card cage (see Figure 10).
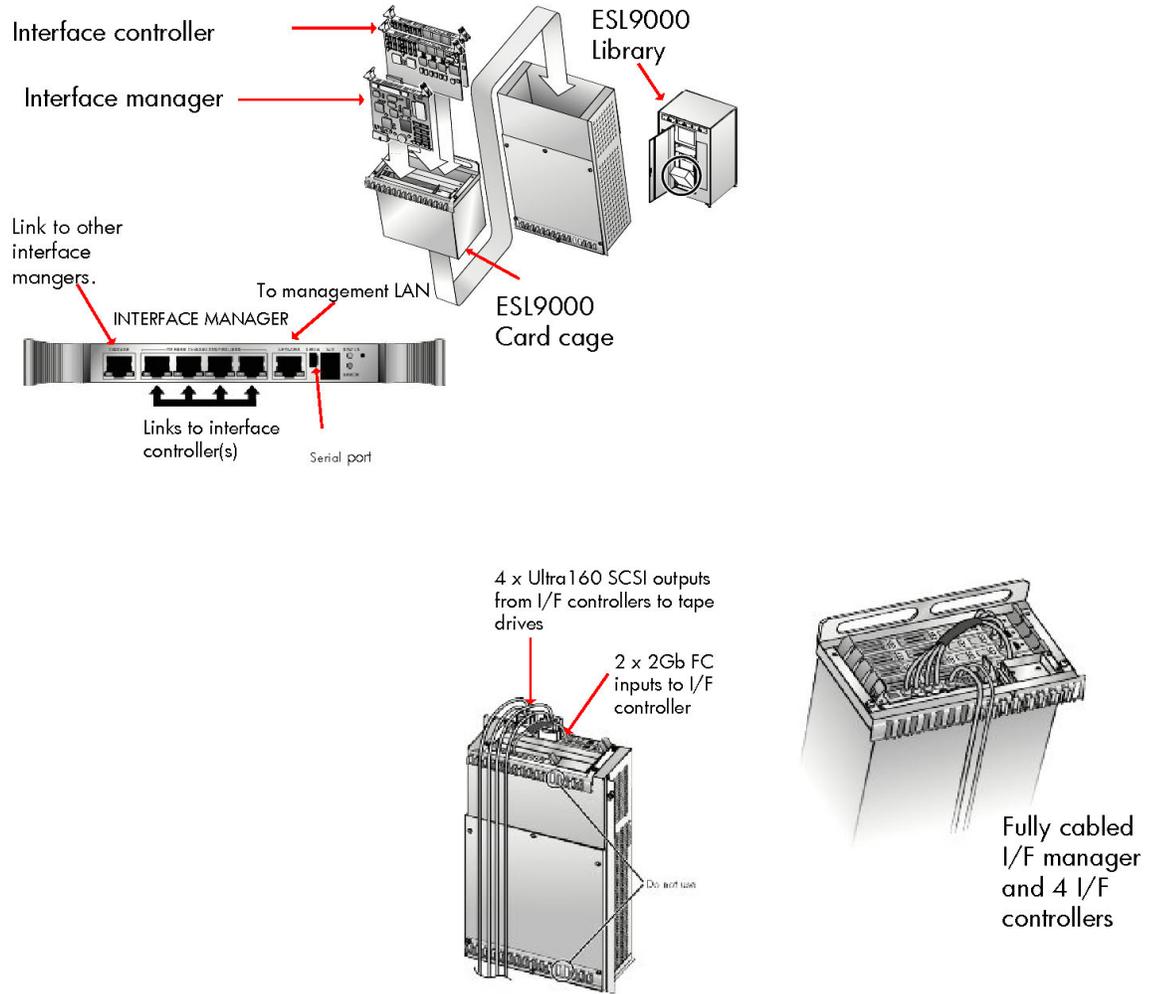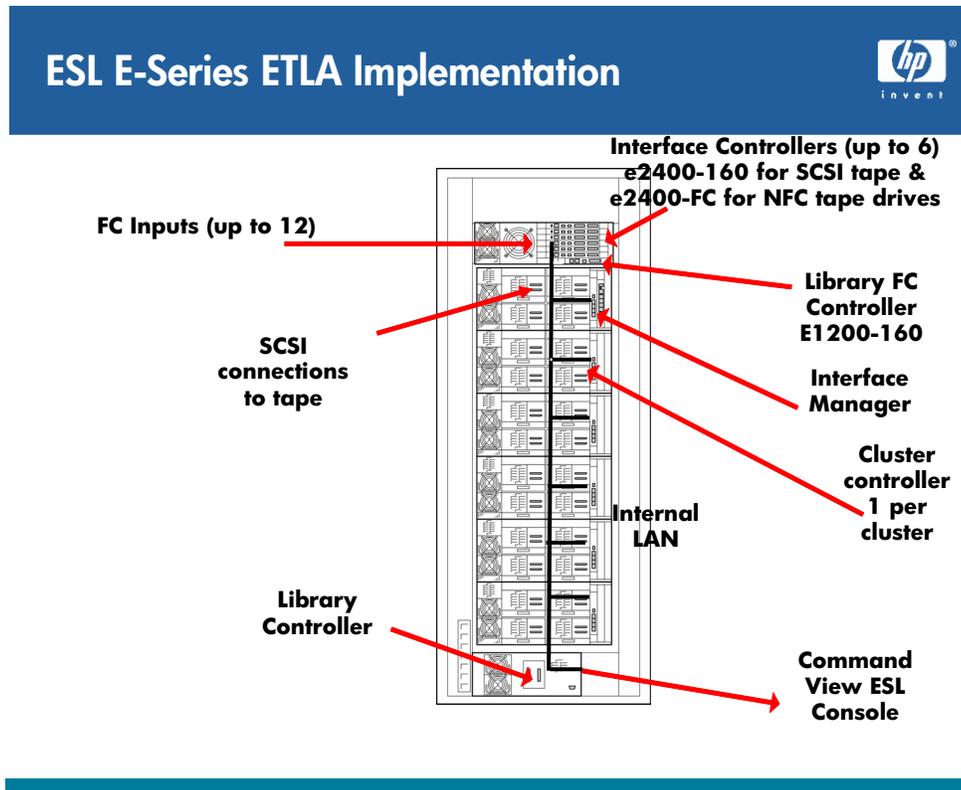
Figure 10. ETLA implementation in ESL libraries

Figure 11. ETLA implementation in ESL E-Series libraries

The implementation in the ESL E-Series libraries is a little more complex because each of the drive clusters must be connected to the overall library internal LAN, as seen in Figure 11. LAN links from the Interface Manger cascade to the drive clusters and interface controllers.

Compatibility/interoperability

Because the compatibility and interoperability for HP tape libraries is continually being enhanced, users should consult http://www.hp.com/go/ebs for the latest information.

However, it is worth pointing out that one of the benefits of ETLA within the ESL and ESL E-Series libraries is that the gating factor for interoperability is the interface controller itself. This means that drive and library firmware revisions are not as critical to interoperability as they are in non-ETLA libraries. ETLA gives more robust interoperability. In addition, the interface controller directly responds to certain "polling" commands that can be issued from the hosts and hence prevent any disruption to the tape drives themselves, which can be in the process of performing a backup. Interface controllers make the interoperability more robust.

Frequently asked questions

1. **Doesn't the interface controller introduce a single point of failure?**

Solution reliability is primarily affected by configuration issues, changes in the SAN, storage network events or collisions, interoperability issues, and storage network failures—**not** hardware failures. ETLA gives the user much more resilience to the real issues that affect solution reliability.

2. **Does the controller reduce performance?**

No. Interface controllers are designed to achieve optimal performance by buffering data and can actually improve performance by blocking third-party traffic. Interface controllers match or exceed tape drive performance in all common implementations.

3. **Is the architecture expensive?**

Aggregating multiple tape drives per FC link can recover much of the cost over a non-controller solution, where every tape drive must have a dedicated FC port.

Reduced administration effort improves the total cost of ownership.

Advanced functionality/monitoring capability is only achievable by having a controller-based architecture, which provides better value and return on investment (ROI).

4. **Will SDLT 600 and LTO3 drives be supported in the existing ESL9322 and ESL9595 libraries?**

Yes, these technologies will be introduced as upgrade options to the ESL9322 and ESL9595 as they become available with drive upgrade kits.

5. **When should I choose an HP native library over a SCSI-based library?**

Choose a native FC tape library when you require a simpler overall cabling interface to your library. The native FC tape drives are also marginally faster than the SCSI tape drives (32 MB/sec vs 30 MB/sec) In addition, if you can foresee the requirement for data path failover within your library (as opposed to on the host system), then choose a native FC HP StorageWorks ESL E-Series extended tape library, since data path failover is a planned development for this library. The use of native FC tape drives in the ESL E-series libraries requires the e2400-FC Interface controller to be used. See Appendix 2

If a customer is considering moving to an IP SAN (iSCSI) in the future, then choosing a SCSI-based library is preferential. ETLA is flexible so an iSCSI interface module could be developed as IP SANs grow in popularity. This is currently not on the roadmap.

6. **When should I choose an ESL9000 and when should I choose an ESL E-Series library?**

Choose ESL9000 series libraries with ETLA if you require a reliable library with expansion and upgrade options and the following features:

- Maximum slot count of 500 slots
- Ultrium 230 drive technology support specifically
- LTO2 and SDLT 320 support together with SDLT 600 and LTO3 technology support when available
- Advanced manageability, diagnostics, and SAN event reporting offered through Command View ESL
- Easy configuration through Command View ESL
- Secure Manager option for best-in-class host access control
- Mixed drive technology libraries—LTO and SDLT in the same library
- Multi-unit scalability up to 64 drives and 2,278 slots

Choose ESL E-Series libraries if you require a reliable library with highest possible scalability and the following features:

- Slot count of more than 500 slots
- Drive count (for increased performance) of more than 16 drives
- Specific requirement for native FC tape drives
- SDLT 600, LTO3, tape technologies and beyond
- Advanced manageability, diagnostics, and SAN event reporting offered through Command View ESL
- Easy configuration through Command View ESL
- Secure Manager option for best-in-class host access control
- Multi-unit scalability up to 116 drives and 3,000 slots (future)
- Further advanced ETLA features (see Appendix 1)

7. **When will multi-unit scalability be available for the HP StorageWorks ESL E-Series libraries?**

Probably early in 2005, firmware enhancements will be required for ETLA Interface Manager controller to support multi-unit libraries. Additional cross-link mechanisms must be purchased to enable multi-unit scalability.

8. **The hardest part of integrating a tape library into a SAN is setting up the storage routers (interface controllers) that often need rebooting to accept new settings. Will these issues be fixed with ETLA?**

Yes. The auto-configuration wizard configures the interface controllers automatically and will satisfy the vast majority of customer requirements. The interface controller firmware has been designed to accommodate the communication with the Interface Manager, thus enabling a much more integrated SAN-aware approach. One of the benefits of this has been a reduction in the need for controller reboots. For example, any changes to the selective storage presentation configuration no longer require a reboot to make them active. It is also important to realize that many of the issues associated with routers in the past have been more to do with disruptive hosts on the SAN. Now, with ETLA, these events can be trapped and logged and the real root cause of the problem isolated far more efficiently. Both the event log (viewable through Command View ESL) and the support ticket (generated from within Command View ESL) contain detailed history of SAN events to aid accurate diagnosis.

Glossary of terms

Command View ESL

The "common look and feel" management console for all HP storage devices. See Appendix 4.

Data Path Failover (future feature)

Two areas of development:

a. The ability to maintain access to the library when one access path is inoperative. This involves using dual fabric switches, dual HBAs in the hosts, and modified HBA drivers to detect path failure and automatically switch to the alternative path. Changes to the interface controller will be required to support this.
b. Using native FC drives and switches inside the library, the library itself will be able to perform data path failover.

Direct Backup

Sometimes known as serverless backup, Direct Backup is the ability for the interface controller to transfer data directly from the disk to tape without the data having to pass through the application server. Significantly reduces server loading. See Appendix 5.

Drive Cluster

HP terminology for the mounting unit used to hold up to four tape drives within the ESL E-Series tape libraries.

ESL libraries

Enterprise System Libraries

ESL9000—Extended ESL9322 and ESL9595 with ETLA embedded

ESL E-Series—ESL712e and ESL630e, featuring a new library platform and embedded ETLA

Integrated Tape and Disk backup and restore

Sometimes known as staging, multi-level data protection, or even D2D2T, Integrated Tape and Disk backup and restore is the use of disk as a staging device in the backup process, either to allow the backup to tape to take place over a longer period or act as a means of faster restore.

Interface controller

HP terminology for the controller that links the tape drives to the SAN. More than a storage router, this controller can manage, report to, and be configured by the Interface Manager. It also possesses additional features such as Direct Backup, LUN masking, failover capability, and so on. Interface controllers are available with FC-SCSI (e2400-160) and FC-FC (e2400-FC) interfaces. Further versions can be produced to accommodate new storage networking protocols such as iSCSI.

Interface Manager

The central point of knowledge for all activities within the library. The Interface Manager communicates with the interface controllers and library controller on one side and the management console (through Command View ESL) on the other.

Native Fibre Channel (NFC) tape drives

These tape drives use 2-GB Fibre connections on the rear of the drives instead of the 68-pin SCSI connections.

Inside the NFC drive, the drive firmware unpacks the SCSI command from within the FC protocol and executes them within the tape drive. The cabling is therefore simpler with native FC tape drives, and because FC is a networked protocol, it allows "many to many" connections, unlike SCSI, which tends to be "point to point" connections. NFC drives will allow data path failover within the library itself.

There is no performance advantage of NFC drives compared to SCSI drives as both interfaces are much faster than the tape drives can physically write or read.

Partitioning (future feature)

Partitioning is the ability to make a large library look like several small libraries (each with its own virtual robotics and dedicated slots). Allows separate hosts to see separate independent libraries.

Performance optimization (future feature)

The ability to load balance the backup from different servers to optimize the FC bandwidth capability into the library. In addition, this feature will show a graphical illustration of host transfer rates and tape transfer rates dynamically so that bottlenecks could be assessed and investigated.

Secure Manager

This feature within ETLA allows specific hosts only to access specific tape drives within a library and acts as a means of ensuring certain tape devices are always available to critical applications. Without Secure Manager, the default configuration is all hosts see all tape drives.

HP StorageWorks Secure Path implements the security at the FC protocol level and not the ISV software level.

Virtualization

Virtualization is the ability to hide the complexity of a storage subsystem by presenting it to hosts as LUNs or volumes, instead of a series of discrete devices.

Appendix 1—Features comparison

Feature	ESL9322/9595 L1	ESL9322/9595 S2	ESL9322/9595 L2	ESL712e	ESL630e
Number of tape drives	1–8/1–16	1–8/1–16	1–8/1–16	1–24	1–24
Number of media slots	222 or 322 / 400 or 500 or 595 (Note 1)	222 or 322 / 400 or 500 or 595 (Note 1)	222 or 322 / 400 or 500 or 595 (Note 1)	712 (Note 2)	630 (Note 2)
Maximum native performance (GB/hr) per single library	432/864	461/922	864/1728	2,592	1,382
Maximum native capacity (TB) per single library	32.2/64.4	51.5/95.2	64.4/119	142.4 (Note 9)	100.8 (Note 9)
Number of media in mail slot	8	8	8	Customer chooses either 32 or 48 (Note 3)	Customer chooses either 14, 28, or 42 (Note 3)
Robotics reliability (MSBF)	3 million	3 million	3 million	1 million at launch, 3 million over time	1 million at launch, 3 million over time
Slot to drive time	6 s	6 s	6 s	6 s	6 s
Cartridge swaps/hour	180	180	180	TBC	TBC
Inventory time	<7 min	<7 min	<7 min	<5 min	<5 min
Bulk media loading	YES	YES	YES	YES (Note7)	YES (Note7)
Scalability (number of enclosures)	5 for ESL9322, 4 for ESL9595	5 for ESL9322, 4 for ESL9595	5 for ESL9322, 4 for ESL9595	5 (Note 5)	5 (Note 5)
Embedded IF controllers	YES	YES	YES	YES (Note 8)	YES (Note 8)
Hot swap drives	YES	YES	YES	YES	YES
Redundant power supplies	YES (2N)	YES (2N)	YES (2N)	YES (DUAL) (Note 6)	YES (DUAL) (Note 6)
Dual AC input	YES	YES	YES	YES	YES
Power consumption	1,200 W/ 1,600 W	1,200 W/ 1,600 W	1,200 W/ 1,600 W	Max 1,600 W	Max 1,600 W
Redundant fans	YES	YES	YES	NO (Note 13)	NO (Note 13)
Interface Manager support	YES (Note 10)	YES (Note 10)	YES (Note 10)	YES (Note 10)	YES (Note 10)

Feature	ESL9322/9595 L1	ESL9322/9595 S2	ESL9322/9595 L2	ESL712e	ESL630e
Command View ESL support for configuration, diagnostics, and manageability	YES	YES	YES	YES	YES
Direct Backup support (sever less)	YES (Note 11)	YES (Note 11)	YES (Note 11)	YES (Note 11)	YES (Note 11)
Secure Manager support	YES (Note 12)	YES (Note 12)	YES (Note 12)	YES (Note 12)	YES (Note 12)
Mixed drive and media support	YES	YES	YES	Yes but at future date	Yes but at future date
Diagnostics	HP Library and Tape Tools from a server connected to library (ESL9000 series) Diagnostics integrated into management console through Command View ESL (ESL9000 extended series)	HP Library and Tape Tools from a server connected to library (ESL9000 series) Diagnostics integrated into management console through Command View ESL (ESL9000 extended series)	HP Library and Tape Tools from a server connected to library (ESL9000 series) Diagnostics integrated into management console through Command View ESL (ESL9000 extended series)	Diagnostics integrated into management console through Command View ESL HP Library and Tape Tools can be run externally (from host) if required	Diagnostics integrated into management console through Command View ESL HP Library and Tape Tools can be run externally (from host) if required
Enterprise management software support	HP OpenView SAM HP Insight Manager for ProLiant HP OpenView Network Node Manager CA Unicenter TNG Tivoli Storage Manager	HP OpenView SAM HP Insight Manager for ProLiant HP OpenView Network Node Manager CA Unicenter TNG Tivoli Storage Manager	HP OpenView SAM HP Insight Manager for ProLiant HP OpenView Network Node Manager CA Unicenter TNG Tivoli Storage Manager	HP OpenView SAM HP Insight Manager for ProLiant HP OpenView Network Node Manager CA Unicenter TNG Tivoli Storage Manager	HP OpenView SAM HP Insight Manager for ProLiant HP OpenView Network Node Manager CA Unicenter TNG Tivoli Storage Manager

Notes

1. ESL9322 ships with 322 physical slots, 222 enabled as standard upgradeable to 322 through an upgrade license. ESL9595 ships with 595 physical slots, 395 enabled as standard upgradeable to 495 and 595 through upgrade licenses.
2. All slots enabled by default.
3. Sixteen on the left side of the library and 32 on the right side of the library for LTO. Fourteen on the left side and 28 on the right side for SDLT. At launch, these load ports are functional but not removable (removable load port magazines planned for April 2004).
4. As normal product improvement proceeds.
5. Not initially available at launch.
6. Dual Redundant Power Supply Units (PSUs) and dual AC supply. However, if an AC supply to a cluster is lost, up to four drives are lost.
7. Bulk loading is easier on the ESL712/ESL630e libraries because the slot panels extend out of the library on runners.

8. Interface controller card cage included as standard (optional on ESL9322/ESL9595).
9. Unused drive space is used as slot space, so the maximum number of slots used in this example is with one to four drives. See [Appendix 2](#). Each drive cluster equates to 14 (LTO) or 12 (SDLT) slots.
10. Interface Manager is an optional upgrade for ESL, but it is shipped as default with ESL Extended Libraries.
11. This is an option at extra cost. See [Appendix 2](#) and [Appendix 5](#). Limited system support at this time.
12. Default Secure Manager setting is all hosts see all drives. For more flexible configurations, a Secure Manager license (option) should be purchased.
13. Design is different and does not require "master cooling." Each module has its own self-contained cooling.

Future features	ESL9322/9595 L1	ESL9322/9595 S2	ESL9322/9595 L2	ESL712e	ESL630e
Support of drive technology	Up to SDLT 600 and LTO3 (SCSI only)	Up to SDLT 600 and LTO3 (SCSI only)	Up to SDLT 600 and LTO3 (SCSI only)	SDLT 600 and LTO3 (SCSI and native FC)	SDLT 600 and LTO3 (SCSI and native FC)
Support of library partitioning	YES	YES	YES	YES	YES
Support of performance monitoring	Under review	Under review	Under review	YES	YES
Support of enhanced path failover	Under review	Under review	Under review	YES	YES
Support of native FC tape drives	NO	NO	NO	YES	YES
Support of SNIA SMI-S Management Interface	YES	YES	YES	YES	YES

Appendix 2—Part number, upgrades, and configuration

New components	Part number
ESL712e base library (Note 1)	AA934A
ESL322e base library	AA939A
ESL630e base library (Note 1)	AA935A
ESL286e base library	AA940A
Drive Cluster Assembly (holds 4 drives) (Note 2)	AA938A
Ultrium 460 SCSI tape drive	AA937A*
SDLT 320 SCSI tape drive	AA936A*
Ultrium 460 native Fiber Channel tape drive (Note 8)	AA941A
SCSI Interface controller for ESL Extended Libraries e2400-160	AA960A
Native FC Interface Controller for ESL Extended E-Series Libraries e2400-FC (See Note 8)	AA928A
Interface Manager upgrade kit (without card cage)	343373-B21
Command View ESL—permanent license (60 days shipped as standard) (Note 3)	343374-B21
Direct Backup license option (per drive)	343375-B21
Secure Manager (Note 4)	343376-B21
Slot license upgrade 322 to 712	Not available until Nov 2004
Slot license upgrade 286 to 630	Not available until Nov 2004
Existing libraries	**Part number**
ESL9322—Complete ETLA enabled ESL9322 (including card cage, I/F Mgr, cables, install guides, Command View ESL software with permanent licenses). Interface controllers and drives purchased separately.	343377-B21
ESL9595—Complete ETLA enabled ESL9595 (including card cage, I/F Mgr, cables, install guides, Command View ESL software with permanent licenses). Interface controllers and drives purchased separately.	343378-B21
ESL9322, 322 slot upgrade license	330840-B21
ESL9595, 400–500 slot upgrade license	330842-B21
ESL9595, 500–595 slot upgrade license	330842-B22
ESL9000 card cage option (for Interface Manager and I/F controllers)	330838-B21
ESL 9000 card cage + Interface Manager	343372-B21
Interface Manager controller	343371-B21
Interface controller with ETLA firmware e2400-160	330839-B21
Ultrium 460 drive upgrade kit	330834-B21
SDLT 320 drive upgrade kit	293414-B21

Tape media	Part number
LTO2 media 400 GB	C7972L
LTO universal cleaning cartridge	C7978A
LTO2 bar code labels (100)	Q2002A
SDLT 320 media	C7980L
SDLT cleaning cartridge	C7982A
SDLT bar code labels (100)	Q2003A
Customized bar code labels	http://www.hpplm.com/

Assorted software	Part number
HP OpenView Data Protector 5.1 Cell Manager for HP-UX	B6961AA
HP OpenView Data Protector 5.1 Cell Manager for Windows	
Additional tape drive licenses to use (HP-UX)	B6953AA
Unlimited slot library licensee	B6958BA
HP Direct Backup for HP StorageWorks XP disk arrays	B7027AA

HP services	Part number
Tape library installation, additional add-on drive installation, and Command View installation	HA113A1
Tape library installation and startup (full integration into the SAN)	HA114A1
HW, 3-year, next-day, onsite	HA101A3
HW, 3-year, 4-hour, 13 x 5, onsite	HA103A3
HW, 3-year, 4-hour, 24 x 7, onsite	HA104A3
SW (Command View ESL), 1-year, phone-in, 9 x 5	HA106A1
SW (Command View ESL), 3-year, phone-in, 9 x 5	HA106A3
SW (Command View ESL), 1-year, phone-in, 24 x 7	HA107A1
SW (Command View ESL), 3-year, phone-in, 24 x 7	HA107A3
Support Plus 3-year (Note 5)	HA109A3
Support Plus24 3-year (Note 6)	HA110A3
HP Operational Service Support (OSS) OSS services provide the day-to-day remote operation of customers open storage environment. Combined with P24 and CS services, OSS provides customers with a balance of onsite and remote storage experts assisting them to operate and maintain their storage infrastructure.	HA289AC

Notes

1. Interface Managers are included as standard with the ESL E-Series 712e and 630e libraries. The base library also includes one drive cluster but with zero drives installed. A Command View ESL 60-day usage license is also included.
2. Internal SCSI cabling for the tape drive connections to the interface controller are shipped as part of the interface controller (four off per interface controller). The only additional cables that must be ordered are the FC cables to connect the library to the SAN switch.

    Drive additions, additional drive clusters, and interface controllers must be added as required to scale the unit up to full capacity. As more drive clusters are added, the slot count reduces by 14 slots per drive cluster (see the following slot count table).
3. To make library cabling simpler, four drives are supported on each e2400-160 (either Ultrium 460 or SDLT 320).
4. After 60 days, the user is continually requested to purchase a permanent license.
5. Secure Manager shipped as default allows all servers in the SAN to see all tape drives in the library. If a customer wants a more refined "selective storage presentation," then the Secure Manager license option must be ordered.
6. Support Plus covers hardware, four-hour, 13 x 5 and software phone-in, 13 x 5.
7. Support Plus24 covers hardware, four-hour, 24 x 7 and software phone-in, 24 x 7.
8. An ESL E-series can use both SCSI and NFC tape drives but HP strongly recommends the same type of tape drive be used in the same cluster. One Interface controller E2400-160 supports up to four Ultrium 460 or SDLT 320 SCSI tape drives. One E2400-FC supports up to four Ultrium 460 Native Fibre Channel tape drives.

* Mixed Media ESL E-Series libraries not currently supported.

Configuration notes

1. On current existing ESL libraries that do not have a card cage already installed, it will be necessary to purchase a card cage together with Interface Manager and interface controllers to be able to deploy the ETLA. There is no external (to library chassis) deployment of the architecture. This might mean some existing components (such as the external M2402 storage routers) become redundant in a customer's configuration.
2. ETLA will be supported on multiple connected libraries in late 2004.
3. A fully configured ESL E-Series 712e library with 24 drives will only require one Interface Manager because in the ESL E-Series architecture, all components are linked to the same internal LAN. For more details on configuring the internal LAN, see pages 48 and 49 in the unpacking and installing manual referenced after these notes.
4. The standard ESL E-Series library comes standard with one Interface Manager, one drive cluster installed, full physical slot count (712 or 630) but with NO drives or interface controllers. Drives and interface controllers must be ordered separately. Four SCSI or NFC cables are shipped with each interface controller card (e2400-160 or E2400-FC).
5. ETLA supports two-unit ESL9000 extended scalability today.
6. Note the relationship between drives, slot count, and load ports as shown in the following tables. Use these tables to calculate usable capacity.

For more details on unpacking and installing the ESL E-Series libraries, read the documentation reference: HP Part # 350800-001

For more details on using and configuring the ESL E-Series libraries, read the documentation reference: HP Part # 350799-001

For more details on using Command View ESL, read documentation reference 349589-002.

Slot counts

Ultrium 460 Drives	Slots Lost to Drive Clusters	Load Port Config (removable magazines)	Overall User Slots
1 to 4		0	712
1 to 4	14	16 (LH Only)	696
1 to 4		32 (RH Only)	680
1 to 4		48 (LH & RH)	664
5 to 8		0	698
5 to 8	28	16 (LH Only)	682
5 to 8		32 (RH Only)	666
5 to 8		48 (LH & RH)	650
9 to 12		0	684
9 to 12	42	16 (LH Only)	668
9 to 12		32 (RH Only)	652
9 to 12		48 (LH & RH)	636
13 to 16		0	670
13 to 16	56	16 (LH Only)	654
13 to 16		32 (RH Only)	638
13 to 16		48 (LH & RH)	622
17 to 20		0	656
17 to 20	70	16 (LH Only)	640
17 to 20		32 (RH Only)	624
17 to 20		48 (LH & RH)	608
21 to 24		0	642
21 to 24	84	16 (LH Only)	626
21 to 24		32 (RH Only)	610
21 to 24		48 (LH & RH)	594

Ultrium 460 Drives	Slots Lost to Drive Clusters	Load Port Config (non-removable magazine)	Overall User Slots
1 to 4		0	718
1 to 4	14	18 (LH Only)	700
1 to 4		36 (RH Only)	682
1 to 4		54 (LH & RH)	664
5 to 8		0	704
5 to 8	28	18 (LH Only)	686
5 to 8		36 (RH Only)	668
5 to 8		54 (LH & RH)	650
9 to 12		0	690
9 to 12	42	18 (LH Only)	672
9 to 12		36 (RH Only)	654
9 to 12		54 (LH & RH)	636
13 to 16		0	676
13 to 16	56	18 (LH Only)	658
13 to 16		36 (RH Only)	640
13 to 16		54 (LH & RH)	622
17 to 20		0	662
17 to 20	70	18 (LH Only)	644
17 to 20		36 (RH Only)	626
17 to 20		54 (LH & RH)	608
21 to 24		0	648
21 to 24	84	18 (LH Only)	630
21 to 24		36 (RH Only)	612
21 to 24		54 (LH & RH)	594

SDLT320 Drives	Slots Lost to Drive Clusters	Load Port Config (removable magazines)	Overall User Slots
1 to 4		0	630
1 to 4	12	14 (LH Only)	616
1 to 4		28 (RH Only)	602
1 to 4		42 (LH & RH)	588
5 to 8		0	618
5 to 8	24	14 (LH Only)	604
5 to 8		28 (RH Only)	590
5 to 8		42 (LH & RH)	576
9 to 12		0	606
9 to 12	36	14 (LH Only)	592
9 to 12		28 (RH Only)	578
9 to 12		42 (LH & RH)	564
13 to 16		0	594
13 to 16	48	14 (LH Only)	580
13 to 16		28 (RH Only)	566
13 to 16		42 (LH & RH)	552
17 to 20		0	582
17 to 20	60	14 (LH Only)	568
17 to 20		28 (RH Only)	554
17 to 20		42 (LH & RH)	540
21 to 24		0	570
21 to 24	72	14 (LH Only)	556
21 to 24		28 (RH Only)	542
21 to 24		42 (LH & RH)	528

SDLT320 Drives	Slots Lost to Drive Clusters	Load Port Config (non-removable magazines)	Overall User Slots
1 to 4		0	636
1 to 4	12	16 (LH Only)	620
1 to 4		32 (RH Only)	604
1 to 4		48 (LH & RH)	588
5 to 8		0	624
5 to 8	24	16 (LH Only)	608
5 to 8		32 (RH Only)	592
5 to 8		48 (LH & RH)	576
9 to 12		0	612
9 to 12	36	16 (LH Only)	596
9 to 12		32 (RH Only)	580
9 to 12		48 (LH & RH)	564
13 to 16		0	600
13 to 16	48	16 (LH Only)	584
13 to 16		32 (RH Only)	568
13 to 16		48 (LH & RH)	552
17 to 20		0	588
17 to 20	60	16 (LH Only)	572
17 to 20		32 (RH Only)	556
17 to 20		48 (LH & RH)	540
21 to 24		0	576
21 to 24	72	16 (LH Only)	560
21 to 24		32 (RH Only)	544
21 to 24		48 (LH & RH)	528

Appendix 3—How HP wins in the enterprise library market

With the addition of the ESL E-Series to the HP enterprise library family and the increasingly advanced features offered by the Extended Library Architecture, HP feels it is well placed compared to the competition in offering the most well-integrated and cost-effective tape libraries for use in a SAN with maximum intelligence and network functionality.

HP offers:

* Better cost-effective SAN integration than any other library vendor, especially the expensive virtual tape server vendors (no other library vendor management console can supply the configuration capabilities together with the depth and quality of information that Command View ESL can)
* Maximum flexibility in terms of:

    I.   Drive technologies supported (SDLT, LTO, and native FC)

    II. Load port configurations

    III. Slot count configurations

    IV. Drive count configurations

* Maximum scalability

    I.   Industry-leading density of 28 TB/sq ft (at 2:1 data)

    II. Family scales up to 116 drives and 3,050 slots

* Feature sets

    I.   Advanced manageability through Command View ESL

    II.   Ease of configuration through Command View ESL

    III. SAN event logging through Command View ESL

    IV.   Mixed drive support (ESL9000 currently, ESL E-Series later in 2004)

    V.   Redundant power supplies for high availability

    VI.   Hot swap tape drives for high availability

    VII. Easy serviceability and access

    VIII. Secure Manager

    IX.   Direct Backup

    X.   Ongoing ETLA roadmap for future new feature integration

        a. Native FC tape drive support

        b. Partitioning

        c. Data path failover

        d. Performance optimizer

Appendix 4—Sample screen shots

Figure 12. Interface controller information (after auto-configuration)

Figure 13. Searchable library inventory

Figure 14. Secure Manager access control (default)—all hosts to all drives
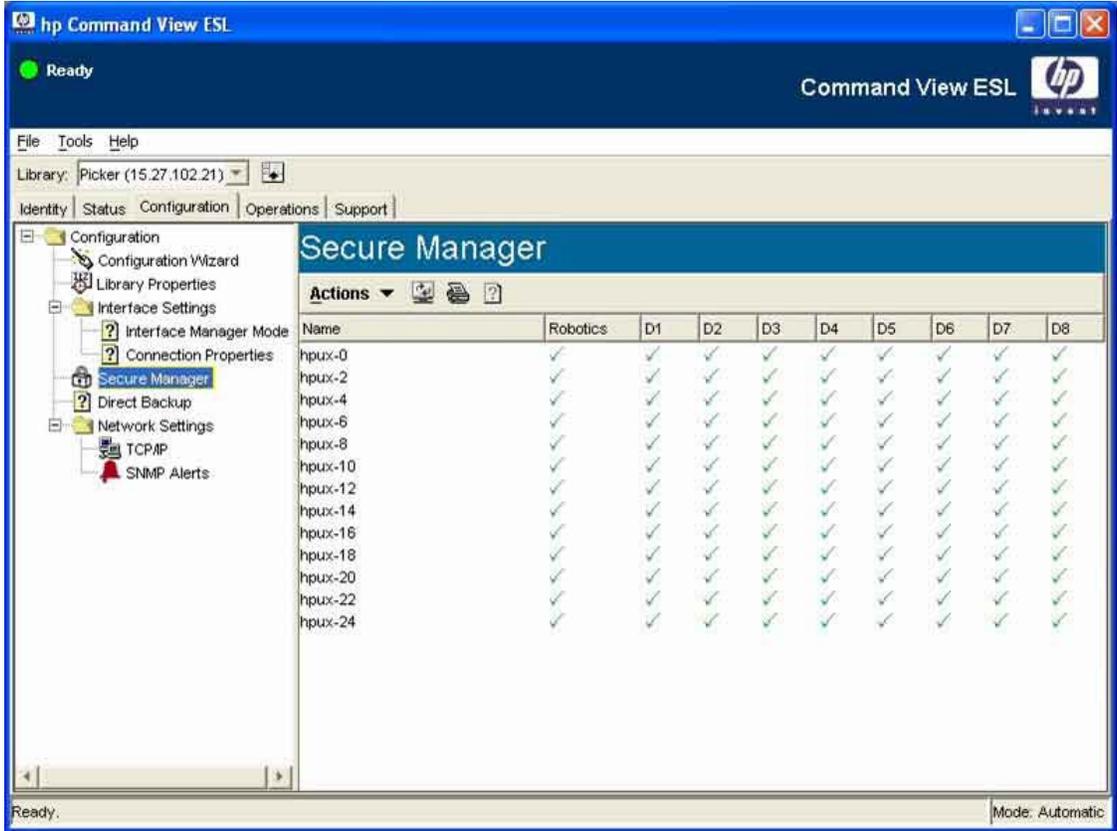
Figure 15. SNMP Alerts

34
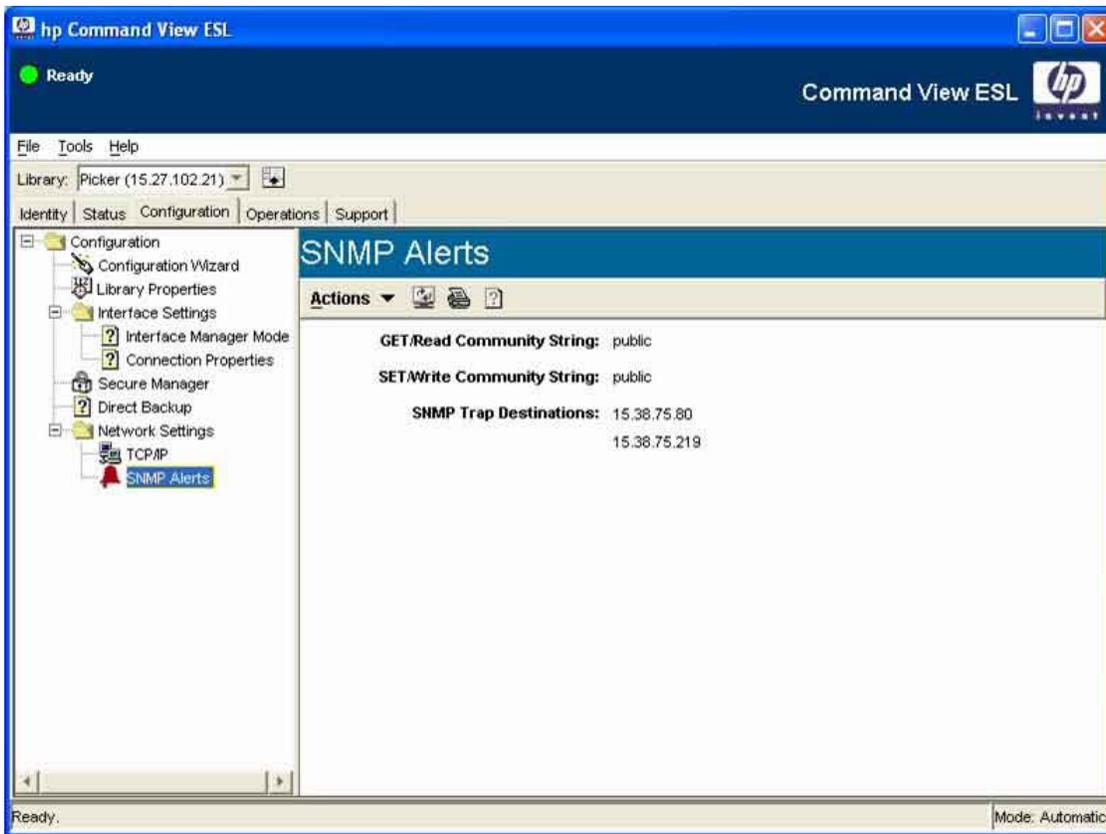
One of the key benefits of the ETLA is the ability to know precisely what is happening in the library at any point in time. The comprehensive event log monitoring capabilities illustrated in the following screenshots show just how useful this feature is, detailing the precise time and SCSI error codes or FC WorldWide Names associated with the issue.

Figure 16. Event logging—drive communication issues

Figure 17. Event logging—library read element status failure

Figure 18. Event Logging—reservation conflict (rogue SAN event: two systems trying to access the same tape drive)
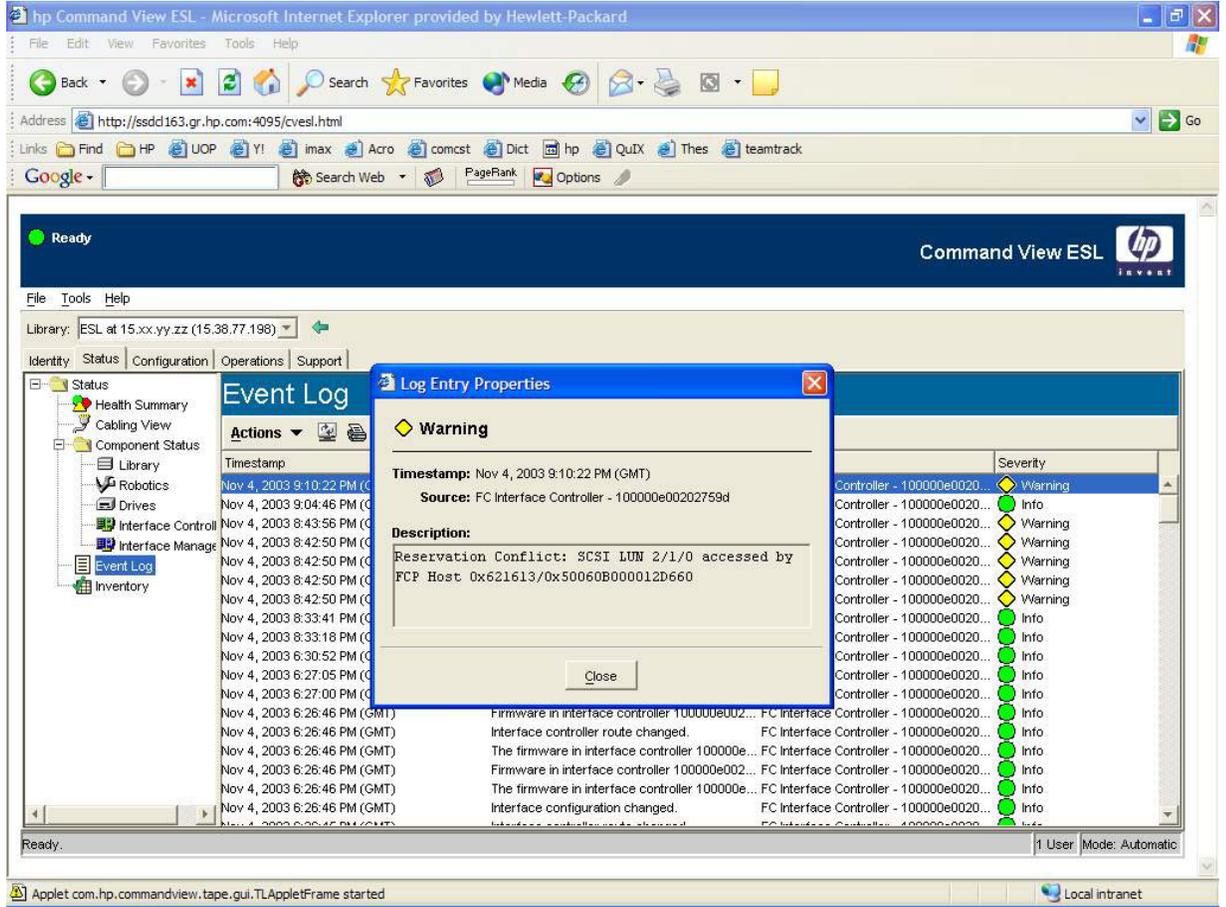
Figure 19. Integration with HP OpenView SAM

Appendix 5—HP Direct Backup solution

Figure 20. HP OpenView Direct Backup solution
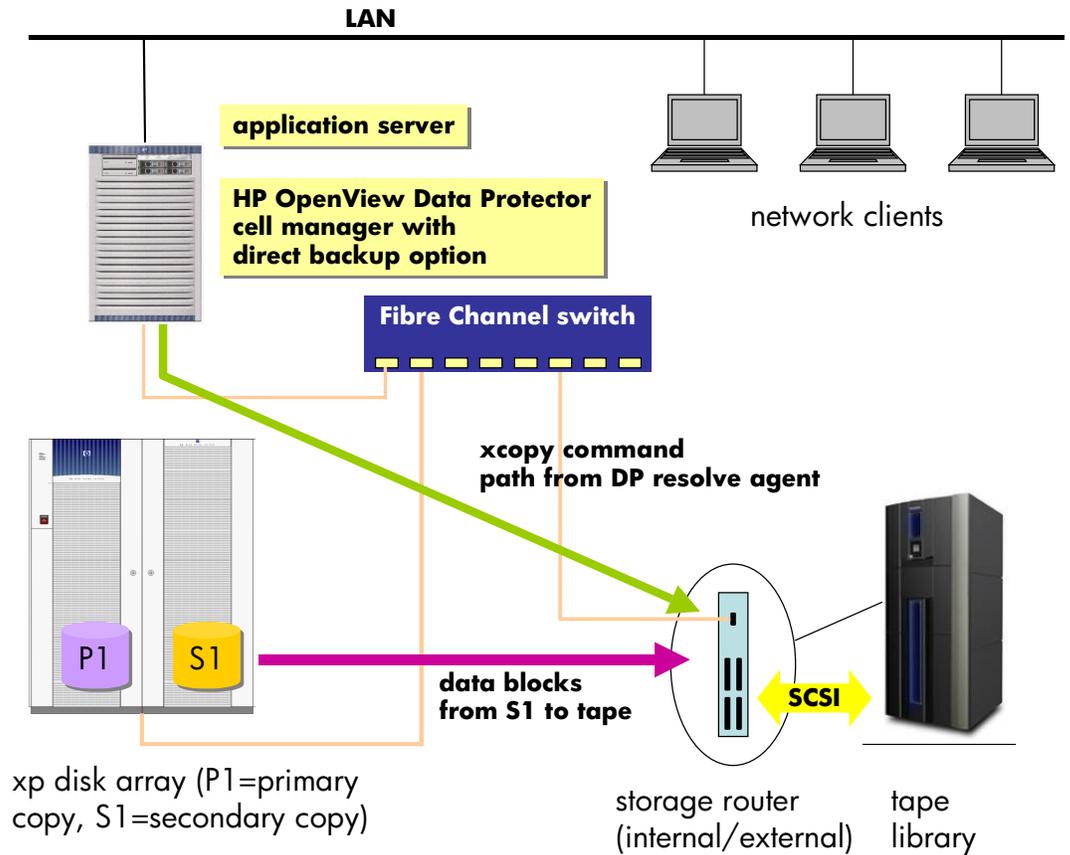
Typical customers for the HP Direct Backup solution require fast online backup of their file system with minimal disruption to the application but do not want the additional expense of running a large backup server.

The data mover functionality within the HP StorageWorks interface controllers is capable of being used in a wide variety of implementations, but because this technology is dependent on ISV software, disk array controllers, and so on, HP is taking a solution-by-solution approach. The first solution in this area to be released is HP Direct Backup XP, a solution designed to back up file system data without the need for a backup server. It is an optional module of HP OpenView Data Protector 5.1 and uses the ability of the HP OpenView Storage Router to move data between a disk array and a tape library. Traditional backup methods use a media agent on the target server or mount split mirror copies on a backup server, which then uses its media agent to back up the copies to the tape library. HP OpenView Direct Backup works in conjunction with HP OpenView Business Copy XP. Direct Backup for file systems then moves this data to tape without passing through a server. The tape is created in standard Data Protector format and can only be restored by running a standard Data Protector restore on the application servers.

Note: There is no concept of a "direct restore" or "serverless restore," which would take data from tape and directly overwrite disk blocks, a procedure that carries a high risk.

The Direct Backup product works by creating a stable image of the user data within the disk array and then moving that data directly to tapes as in Figure 12. The following steps describe the process:

1. A stable image of the data is created within the HP disk array. Data Protector uses its zero downtime backup extension to trigger a copy of the application data. This will normally be a mirror copy. The mirrors are the "split."
2. The HP OpenView Data Protector Direct Backup extension then uses its resolve agent to map logical addresses of file system data to physically block addresses used by the disk array.
3. The extended copy commands are sent from the server to the data mover, which in this case, is the storage router. The location of the physical data blocks is passed to the storage router. The storage router then actually moves the blocks of data from the XP disk array to the tape device. On completion, it will contact the server for more data if necessary.

Direct Backup XP operates with a maximum of four tape drives connected to the interface controller.

Product structure

HP OpenView Data Protector Direct Backup is currently supported on HP-UX 11.i and works in conjunction with HP OpenView Business Copy XP. This can be used on all enterprise PA-RISC servers with HP StorageWorks XP class disk arrays.

HP OpenView Data Protector 5.1 Cell Manager for HP-UX   B6961AA

(This is for a single tape drive and includes media and manuals.)

Additional tape drive license to use (HP-UX)   B6953AA

Unlimited slot library license to use   B6958BA

Split mirror backup for HP XP disk arrays   B7023CA

Direct Backup for ESL libraries   343375-B21

Direct Backup for HP StorageWorks XP disk arrays   B7027AA

For more information

"Choosing the best architecture for data protection in your SAN" and other tape library–related white papers can be found at http://h18006.www1.hp.com/storage/tapewhitepapers.html.

5982-3639EN, Rev. 1, 07/2004

hp invent