IBM TotalStorage UltraScalable Tape Library 3584

SCSI Reference

GA32-0454-00

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GA32-0454-00

Note!
Before using this information and the product it supports, read the information in Appendix E, “Notices”, on page 111.

First Edition (February 2003)

This edition applies to the *IBM TotalStorage UltraScalable Tape Library 3584 SCSI Reference* and to all subsequent releases and modifications until otherwise indicated in new editions.

| This edition replaces WB1108-02.

Contents

Figures

Preface

This guide contains information about how to use and program the IBM TotalStorage UltraScalable Tape Library 3584. It includes the following chapters:

Chapter 1, “Introduction”, on page 1 provides an overview of the UltraScalable Tape Library and describes how it uses the newly introduced IBM TotalStorage LTO Ultrium 2 Tape Drive, as well as the Ultrium 1 Tape Drive, to process LTO Ultrium Tape Cartridges. The chapter indicates the library’s support for DLTtape IV Tape Cartridges. It identifies supported servers and operating systems, lists primary components, outlines performance considerations, and gives methods for cleaning tape drives.

Chapter 2, “Library SCSI Commands”, on page 31 lists the library SCSI commands that the UltraScalable Tape Library supports.

Appendix A, “SCSI Error Sense”, on page 85 describes the sense keys, additional sense codes (ASCs) and additional sense code qualifiers (ASCQs) that the UltraScalable Tape Library reports.

Appendix B, “Implementation Considerations”, on page 87 provides details about SCSI ID, Loop ID, and LUN assignments. It also gives information about cleaning the drives.

Appendix C, “Locations and Addresses of SCSI Elements”, on page 91 shows the physical locations of storage slots and drives in the Model L32 (both with and without the Capacity Expansion Feature), the Model D32, and the Model D42. It gives the rules for mapping the physical locations (and the locations of the I/O slots) to their corresponding SCSI element addresses.

Appendix D, “TapeAlert Flags”, on page 103 lists TapeAlert messages that are supported by the Ultrium Tape Drives, DLT 8000 Tape System, and UltraScalable Tape Library. The messages may aid during problem determination.

Summary of Changes

This guide contains information previously presented in the *IBM 3584 UltraScalable Tape Library SCSI Reference*, WB1108-02. It includes the following changes:

- Support of IBM TotalStorage LTO Ultrium 2 Tape Drive technology, including native capacity of 200 GB, native data rate of 35 MB/s with speed matching, a 2-Gb Fibre Channel interface with fabric attachment, and the Ultra160 Small Computer Systems Interface (SCSI)
- Optional control path failover to a redundant Host Bus Adapter (HBA), a redundant Storage Area Network (SAN), or a redundant library control path when a failure is detected by the IBM device driver

Changes are identified by revision bars in the left margin.

Related Publications

Refer to the following publications for additional information about the IBM TotalStorage UltraScalable Tape Library 3584. To ensure that you have the latest publications, visit the Web at `http://www.ibm.com/storage/lto`.

IBM TotalStorage UltraScalable Tape Library 3584 Publications

- *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*, GA32-0408
- *IBM TotalStorage UltraScalable Tape Library 3584 Maintenance Information*, SA37-0426
- *The IBM LTO Ultrium Tape Libraries Guide*, SG24-5946

IBM @server iSeries and AS/400 Publications

- *Basic System Operation, Administration and Problem Handling*, SC41-5206
- *OS/400 Backup and Recovery*, SC41-5304
- *AS/400 Physical Planning Reference* , SA41-5109
- *System API Reference*, SC41-5801 (in softcopy only)
- *Automated Tape Library Planning & Management*, SC41-5309
- *Backup Recovery and Media Services*, SC41-5345
- *Hierarchical Storage Management*, SC41-5351
- *A Practical Approach to Managing Backup Recovery and Media Services*, SG24-4840 (in softcopy only)
- *The System Administrator's Companion to AS/400 Availability and Recovery*, SG24-2161 (in softcopy only)

IBM @server pSeries and RS/6000 Publications

- *AIX Version 3.2 Getting Started*, GC23-2521
- *AIX Version 4.3 Problem Solving Guide and Reference*, SC23-4123
- *AIX Version 4.3 Messages Guide and Reference*, SC23-4129
- *Site & Hardware Planning Information*, SA38-0508
- *RISC System/6000 Adapters, Devices, and Cable Information for Multiple Bus Systems*, SA38-0516
- *Adapters, Devices, and Cable Information for Micro Channel Bus Systems*, SA23-2764

Other Publications and Sources

- `http://www.storage.ibm.com/storage/`
- `http://www.storage.ibm.com/hardsoft/tape/lto/compatibility.html` (for a list of compatible software, operating systems, and servers)
- *IBM Ultrium Device Drivers Installation and User's Guide*, GA32-0430
- *IBM Ultrium Device Drivers Programming Reference*, GC35-0483
- *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*, GA32-0450
- *Quantum DLT 8000 Tape System Product Manual*

Chapter 1. Introduction

The IBM® TotalStorage™ UltraScalable Tape Library 3584 is a stand-alone device that provides reliable, automated tape handling and storage for unattended mid-range systems and network servers in an Open Systems environment. Formerly known as the 3584 UltraScalable Tape Library, the library combines Ultrium technology with such new benefits as:

- Capacity, performance, and attachment improvements through Ultrium 2 Tape Drive technology, including native capacity of 200 GB, native data rate of 35 MB/s with speed matching, a 2-Gb Fibre Channel interface with fabric attachment, and the Ultra160 Small Computer Systems Interface (SCSI).
- Investment protection through the ability of existing 3584 UltraScalable Tape Libraries to upgrade to any combination of IBM TotalStorage LTO Ultrium 2 Tape Drives and Ultrium 1 Tape Drives in Ultrium frames. The Ultrium 2 Tape Drive is the second-generation tape drive in the Ultrium series of products.
- Enhanced availability through optional control path failover to a redundant Host Bus Adapter (HBA), a redundant Storage Area Network (SAN), or a redundant library control path when a failure is detected by the IBM device driver.
- Flexible support for a universal line voltage of 110 or 220 V ac.
- Improvements to remote administration, including the ability to remotely cycle power to a drive.
- Improvements to remote support, including drive error reporting through the Call Home feature.

Figure 1 shows a IBM TotalStorage UltraScalable Tape Library 3584.

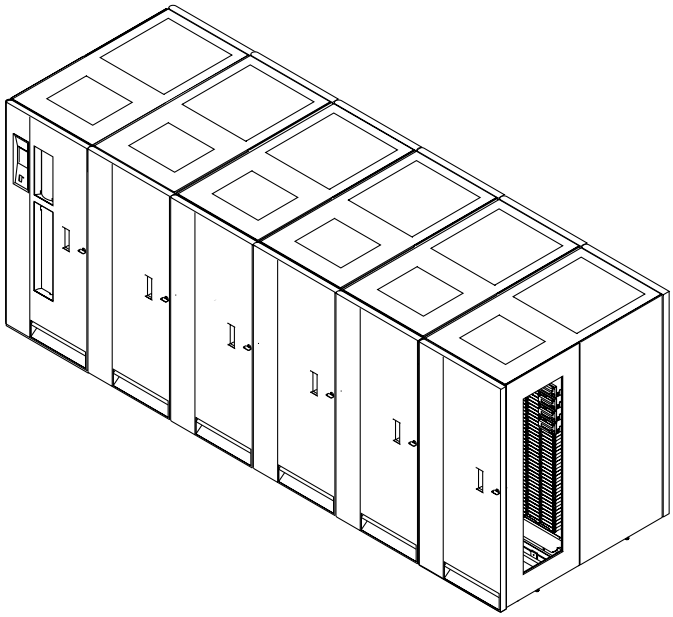

Figure 1. The IBM TotalStorage UltraScalable Tape Library 3584. The library can contain up to 6 frames.

The basic library is a single storage unit known as the base frame. The library's scalability allows you to increase capacity by adding up to five additional storage units, called expansion frames. Each frame in the library may contain up to 12 Ultrium Tape Drives or DLT 8000 Tape Systems, but may not contain a mix of both (for information about drives, see "Tape Drives" on page 6).

A matrix of compatible drives and cartridges is available in "Mixing Media in Drives" on page 8. To view the compatibility of drive types in frames, see "Mixing Drive Types in Frames" on page 9. To view the compatibility of drive types within a logical library, see "Mixing Ultrium Drive Types Within a Logical Library" on page 10.

To suit your system capacity and performance needs, you can tailor the UltraScalable Tape Library to take advantage of the following features:

- Use of up to 72 Ultrium Tape Drives or 60 DLT 8000 Tape Systems
- Use of up to 2481 cartridge storage slots
- Aggregate sustained data transfer rate of up to 18 TB per hour for Ultrium 2 Tape Drives and up to 8 TB per hour for Ultrium 1 Tape Drives (at 2:1 compression)
- Compressed data capacity of 992 TB for Ultrium 2 Tape Cartridges and up to 496 TB for Ultrium 1 Tape Cartridges (at 2:1 compression)
- For the IBM Ultrium 2 Tape Drive, support of any combination of Fibre Channel, Low Voltage Differential (LVD) Ultra160 SCSI, and High Voltage Differential (HVD) Ultra SCSI interfaces
- For the IBM Ultrium 1 Tape Drive, support of any combination of Fibre Channel, LVD Ultra2 SCSI, and HVD Ultra SCSI interfaces
- For the DLT Tape System, support of the Fast/Wide LVD and HVD SCSI interfaces
- Multi-Path Architecture that enables a single library to be shared by multiple homogeneous or heterogeneous applications
- Support of any appropriate combination of frames that use Digital Linear Tape (DLT) or Linear Tape-Open (LTO) Ultrium media

The UltraScalable Tape Library features three models of frames. The models vary, depending on the type of drives that they contain and whether the frame is a base or expansion frame:

Model L32
A base frame that uses Ultrium Tape Drives and IBM LTO Ultrium Tape Cartridges

Model D32
An expansion frame that uses Ultrium Tape Drives and IBM LTO Ultrium Tape Cartridges

Model D42
An expansion frame that uses DLT 8000 Tape Systems and DLTtape IV Tape Cartridges

Figure 2 shows examples of a base and an expansion frame.

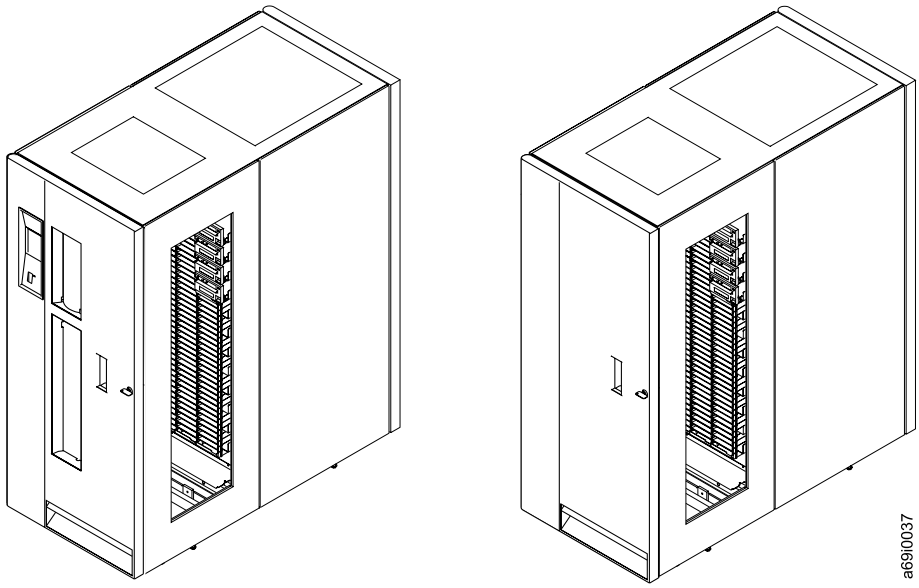

Figure 2. Frames in the IBM TotalStorage UltraScalable Tape Library 3584. Model L32 (the base frame) is on the left. Model D32 (the expansion frame) is on the right and attaches to the base frame. Models L32 and D32 house LTO Ultrium Tape Cartridges; Model D42 (not shown) houses DLTtape IV Tape Cartridges.

Library Components

The UltraScalable Tape Library consists of the major components shown in Figure 3 on page 5 (the figure depicts Model L32). For a more complete description of each component, see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

1 Library frames
The base frame (Model L32 for Ultrium Tape Drives) and the expansion frame (Model D32 for Ultrium Tape Drives or Model D42 for DLT Tape Systems). Each frame contains a rail system, cartridge storage slots, and up to 12 tape drives.

2 Rail system
The assembly on which the cartridge accessor moves through the library. The system includes the top and bottom rails.

3 Cartridge accessor
The assembly that moves tape cartridges between storage slots, tape drives, and the I/O stations.

4 Dual-gripper transport mechanism
A device that gets and puts tape cartridges from and to storage slots, tape drives, and the I/O stations.

5 Accessor controller
A circuit board that facilitates all accessor motion requests (such as calibrations, moves, and inventory updates).

6 Cartridge storage slots
Containers that are mounted in the UltraScalable Tape Library and used to store tape cartridges.

7 IBM LTO Ultrium Tape Drives or DLT Tape System
Mounted in the UltraScalable Tape Library, one or more units that read and write data that is stored on tape cartridges. IBM LTO Ultrium Tape Drives and DLT Tape Systems may not be mixed in the same frame. IBM Ultrium Tape Drives use LTO Ultrium Tape Cartridges; the DLT Tape System uses DLTtape IV Tape Cartridges.

8 Front door
The front door of any frame. When you order the Capacity Expansion Feature for the Model L32, the storage slots inside the front door become enabled and can increase the tape library's capacity.

9 Door safety switch
A device in each frame that shuts down the motion power to the cartridge accessor whenever the front door is opened.

10 I/O stations
Up to two cartridge compartments on the front door of the UltraScalable Tape Library that allow you to insert or remove tape cartridges without the library performing a reinventory of the frame.

11 Operator panel and operator panel controller
Located on the front of the base frame, the operator panel is the set of indicators and controls that lets you perform operations and determine the status of the library. The panel consists of the library power switch, a power-on indicator, a touchscreen liquid crystal display (LCD), and the controller for the I/O stations. The operator panel controller is a circuit board that facilitates communication between the operator panel and the accessor controller.

12 Frame control assembly (FCA)
An assembly of components that facilitates RS-422 communication between the set of drives within the frame and the accessor controller and operator panel controller. The FCA also controls the distribution of AC power to frames and DC power to the library.

13 Patch panel
A panel that houses the cable connections for the drives that use Fibre Channel interfaces.

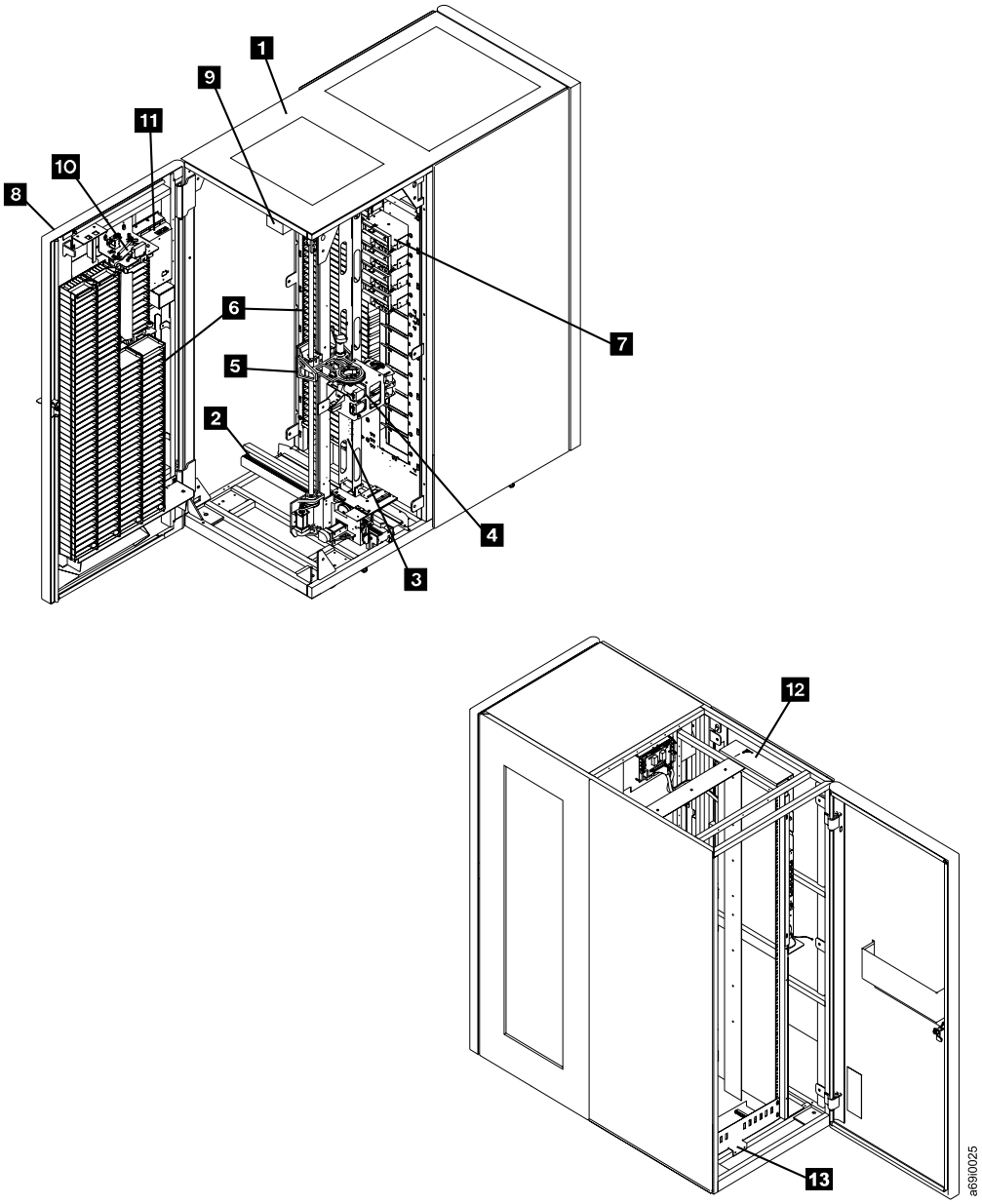

Figure 3. Components of the IBM TotalStorage UltraScalable Tape Library 3584. The front and rear of the Model L32 library are shown.

Tape Drives

The Ultrium Tape Drives and the DLT 8000 Tape System are high-performance, high-capacity data-storage units that can be installed in the UltraScalable Tape Library. Up to 12 Ultrium Tape Drives or DLT 8000 Tape Systems may be installed in each frame of the library.

The Ultrium 2 Tape Drive is compatible with the cartridges of its predecessor, the Ultrium 1 Tape Drive. When labeled according to proper IBM bar code label specifications (see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*), the last character of a cartridge's volume serial number (VOLSER) indicates the generation of the media. For example, a cartridge with a VOLSER of 000764L2 is an Ultrium 2 cartridge; a cartridge with a VOLSER of 003995L1 is an Ultrium 1 cartridge. Cartridge compatibility for the Ultrium 2 Tape Drive is as follows:

- Reads and writes Ultrium 2 format on Ultrium 2 cartridges
- Reads and writes Ultrium 1 format on Ultrium 1 cartridges
- Does not write Ultrium 2 format on Ultrium 1 cartridges
- Does not write Ultrium 1 format on Ultrium 2 cartridges

The Ultrium 2 Tape Drive reads tapes that have been written by other Ultrium drives. It also writes to tapes that can be read by other Ultrium drives.

For a matrix of compatible media and drives, see Table 1 on page 8. For a matrix that shows how to mix drive types in frames or within a logical library, see "Mixing Drive Types in Frames" on page 9 or "Mixing Ultrium Drive Types Within a Logical Library" on page 10.

To enhance library performance, the Ultrium 2 Tape Drive includes the following features:

- Speed matching
- Channel calibration
- Power management

The sections that follow describe each feature.

Speed Matching

The Ultrium 2 Tape Drive performs dynamic speed matching to adjust the drive's native data rate as closely as possible to the net host data rate (after data compressibility has been factored out). This provides the dual benefit of reducing the number of backhitch repositions and improving throughput performance.

Channel Calibration

The Ultrium 2 Tape Drive channel calibration feature allows you to customize each read/write data channel for optimum performance. The customization enables compensation for variations in the recording channel transfer function, media characteristics, and read/write head characteristics.

Power Management

The Ultrium 2 Tape Drive's power management function controls the drive's electronics so that they are completely turned off or in a low-power mode. These power modes occur only when the circuit functions are not needed for drive operation.

Tape Cartridges

Frames that are installed with Ultrium Tape Drives use LTO Ultrium Tape Cartridges and frames that are installed with DLT 8000 Tape Systems use DLTtape IV Tape Cartridges. A frame cannot use both types of cartridges. However, in a library that uses mixed drive types, you may insert DLTtape IV Tape Cartridges into an 18-slot, lower I/O station of a Model L32 frame for transport (by the cartridge accessor) to a Model D42 frame.

The capacity for supported cartridges is:

- IBM TotalStorage LTO Ultrium 200 GB Data Cartridge (native capacity of 200 GB; compressed capacity of 400 GB at 2:1 compression).
- IBM LTO Ultrium Data Cartridge (native capacity of 100 GB; compressed capacity of 200 GB at 2:1 compression)
- DLTtape IV Data Cartridge (native capacity of 40 GB; compressed capacity of 80 GB at 2:1 compression)

Certain restrictions apply to the use of tape cartridges with drives. For an overview of the compatibility between supported cartridges and drives, see Table 1 on page 8.

Cleaning cartridges are identified by a VOLSER that begins with a prefix of `CLN`.

For additional information about the tape cartridges that can be used by the library, see the sections about using Ultrium and DLT media in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Mixing Media in Drives

Not all cartridges that are supported by the UltraScalable Tape Library are compatible with all drives. Table 1 gives a matrix of compatible cartridges and drives.

Note: When labeled according to proper IBM bar code label specifications (see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*), the last character of a cartridge's volume serial number (VOLSER) indicates the generation of the media. For example, a cartridge with a VOLSER of 000764L2 is an Ultrium 2 cartridge; a cartridge with a VOLSER of 003995L1 is an Ultrium 1 cartridge.

Table 1. Compatible cartridges and drives

Cartridges	Drives (see Notes 1 and 2)		
	Ultrium 2 Tape Drive	**Ultrium 1 Tape Drive**	**DLT Tape Drive**
Ultrium 2 Data Cartridge (xxxxxxL2)	Y	N (see Note 3)	N
Ultrium 1 Data Cartridge (xxxxxxL1)	Y	Y	N
IBM TotalStorage LTO Ultrium Cleaning Cartridge (universal, CLNUxxL1)	Y	Y (see Note 4)	N
LTO Ultrium Cleaning Cartridge (IBM only, CLNIxxL1)	Y	Y	N
DLT Data Cartridge	N	N	Y
DLT Cleaning Cartridge	N	N	Y

Notes:

1. Y = supported.
2. N = unsupported.
3. The library rejects any command to move an Ultrium 2 data cartridge to an Ultrium 1 drive, and returns a sense key of 5 and an additional sense code/additional sense code qualifier of 30/00.
4. Requires drive firmware level 25D4 or higher.

Mixing Drive Types in Frames

The UltraScalable Tape Library lets you combine Models L32, D32, and D42. You can order a Model L32 frame (or a feature for an existing frame) such that the device that moves the cartridges (the grippers) can handle both LTO and DLT media.

Not all drives and cartridges are compatible in all frames. Table 2 gives a matrix for mixing drive types and frames.

To learn more, see “Mixing Media in Drives” on page 8 and “Mixing Ultrium Drive Types Within a Logical Library” on page 10.

Table 2. Mixing drives types in frames

Drive Types	Model L32	Model D32	Model D42
Ultrium 2	Y (see Note 1)	Y	N (see Note 2)
Ultrium 1	Y	Y	N
DLT	N	N	Y

Notes:

1. Y = supported.
2. N = unsupported.

Mixing Ultrium Drive Types Within a Logical Library

The UltraScalable Tape Library supports mixed Ultrium drive types in the same logical library. Some ISVs support mixed drive types within logical libraries; others do not. Some ISVs that support mixed drive types do so with restrictions. For details, contact your ISV.

For situations where the ISV support does not exist or does not meet customer requirements, the UltraScalable Tape Library provides another option to protect the customer's investment by partitioning the tape drives into separate logical libraries. The customer can customize the partition to any number of slots by using menus or special bar code labels.

Figure 4 shows examples of methods for mixing Ultrium drive types.

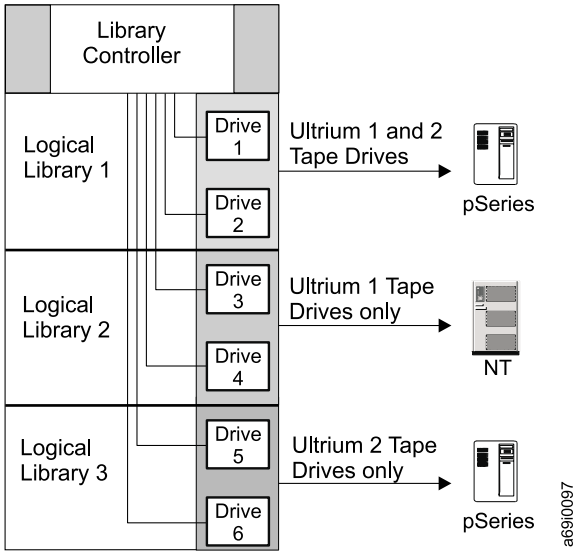

Figure 4. Examples of methods for mixing Ultrium drive types

Multi-Path Architecture

The UltraScalable Tape Library features the Storage Area Network (SAN)-ready Multi-Path Architecture, which allows homogeneous or heterogeneous open systems applications to share the library's robotics without middleware or a dedicated server (host) acting as a library manager. The SAN-ready Multi-Path Architecture makes sharing possible by letting you partition the library's storage slots and tape drives into logical libraries. Servers can then run separate applications for each logical library. This partitioning capability extends the potential centralization of storage that the SAN enables. Partitioning also provides investment protection for Ultrium 1 Tape Drives if your application does not support the mixing of Ultrium 1 and Ultrium 2 Tape Drives and media in the same logical library. The Multi-Path Architecture is compliant with the following attachment interfaces:

- Small Computer Systems Interface (SCSI)
- Fibre Channel

Whether partitioned or not, the UltraScalable Tape Library is certified for SAN solutions (such as LAN-free backup).

The Multi-Path Architecture also lets you configure additional control paths for any one logical library. A control path is a logical path into the library through which a server sends standard SCSI Medium Changer commands to control the logical library. Additional control paths allow the cartridge inventory of the library to be shared by multiple iSeries™ and AS/400® servers, or by other open systems hosts that run the same applications. Additional control paths reduce the possibility that failure in one control path will cause the entire library to be unavailable. Use of the control path failover feature further reduces that possibility (see "Using Multiple Control Paths for Control Path Failover" on page 17).

For details about configuring the library to share robotics, see "Library Sharing" on page 12.

Library Sharing

The UltraScalable Tape Library's default configuration allows a single application to operate the library through a single control path. Often, however, it is advantageous to be able to share a single library between heterogeneous (dissimilar) or homogeneous (similar) applications. Some applications (and some servers) do not allow for sharing a library between systems. With the UltraScalable Tape Library, however, you can create configurations that enable the library to process commands from multiple heterogeneous applications (such as an IBM @server pSeries™ application and a Windows NT® application) and multiple homogeneous applications (for example, the same application run by several pSeries servers).

From the library's web interface or operator panel, you can perform the following actions:

- Configure the library so that is partitioned into separate logical libraries that independently communicate with separate applications through separate control paths. This configuration (see example **1** in Figure 5 on page 13 or Figure 6 on page 14) requires no special capabilities from the server or application. (For more information, see "Using Multiple Logical Libraries" on page 15.)
- Configure any single logical library (including the entire physical library) so that it is shared by two or more servers that are running the same application. Depending on the capabilities of the server and application, there are several ways to set up this type of configuration. Three typical ways include:
  - Configuring one server (host) to communicate with the library through a single control path; all other servers send requests to that server through a network (see example **2** in Figure 5 on page 13 or Figure 6 on page 14). This configuration is used by Tivoli® Storage Manager (TSM).
  - Configuring all of the servers to communicate with the library through a single, common control path (see example **3** in Figure 5 on page 13 or Figure 6 on page 14). This configuration is used in high-availability environments such as IBM's High Availability Clustered Microprocessing (HACMP) and Microsoft®'s Systems Management Server (SMS) and Clustered Server Environments. Multi-initiator configurations are only supported by certain adapters and ISVs. Check with your ISV.
  - Configuring a single logical library to communicate with multiple servers through multiple control paths. This configuration (see example **4** in Figure 5 on page 13) requires that you add control paths (see "Using Multiple Control Paths" on page 16). It is used by Backup Recovery and Media Services (BRMS).

    Note: The iSeries or AS/400 servers do not support DLT 8000 Tape Systems.

Your library configuration is not limited to the examples shown in Figure 5 on page 13 or Figure 6 on page 14. Many configurations are possible, and you can design them according to your business needs.

Example Configurations for a Library with Ultrium Tape Drives

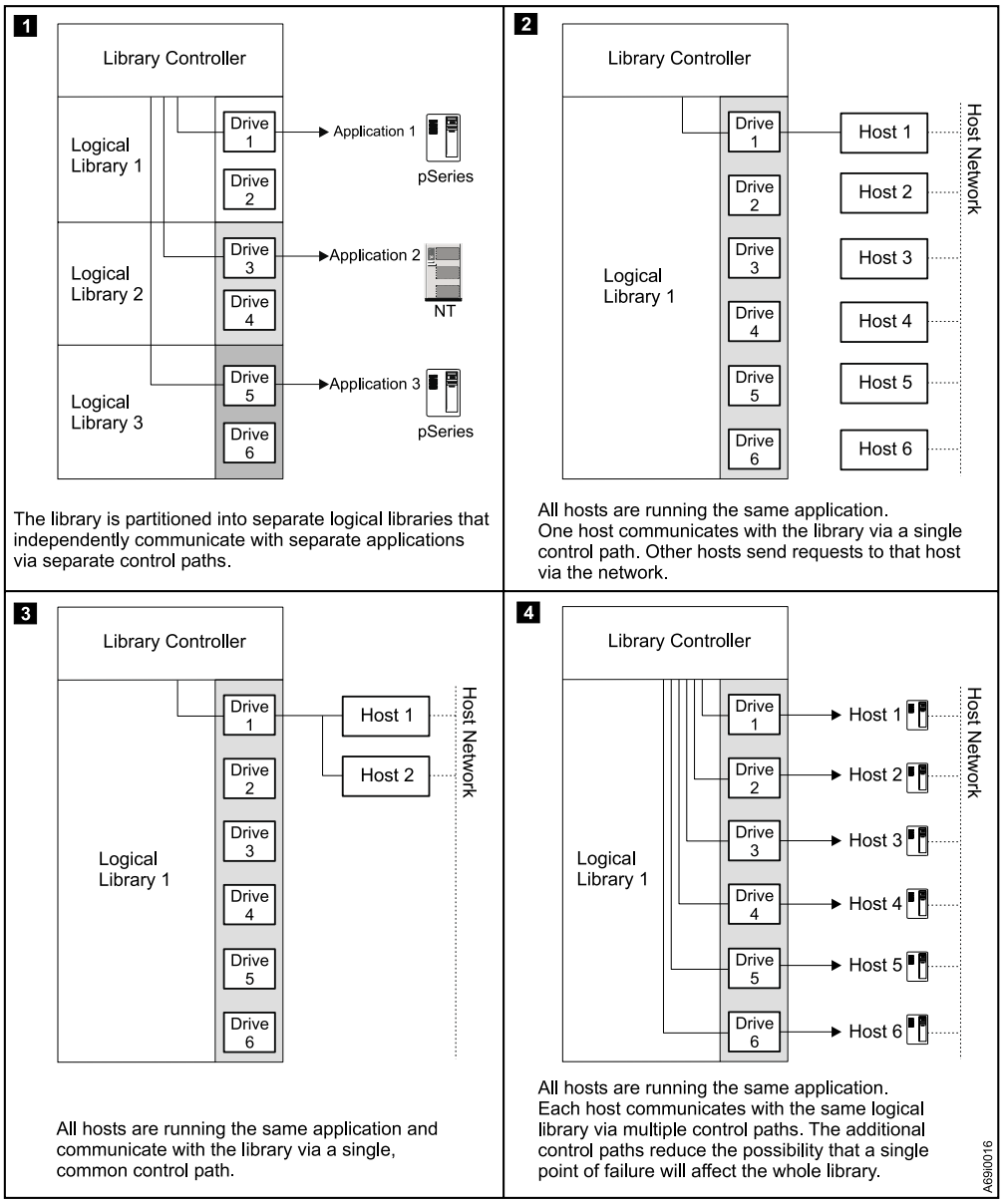

Figure 5. Examples of configurations for a IBM TotalStorage UltraScalable Tape Library 3584 that uses Ultrium Tape Drives. Lines from one or more drives to the library controller represent control paths.

Example Configurations for a Library with DLT 8000 Tape Systems

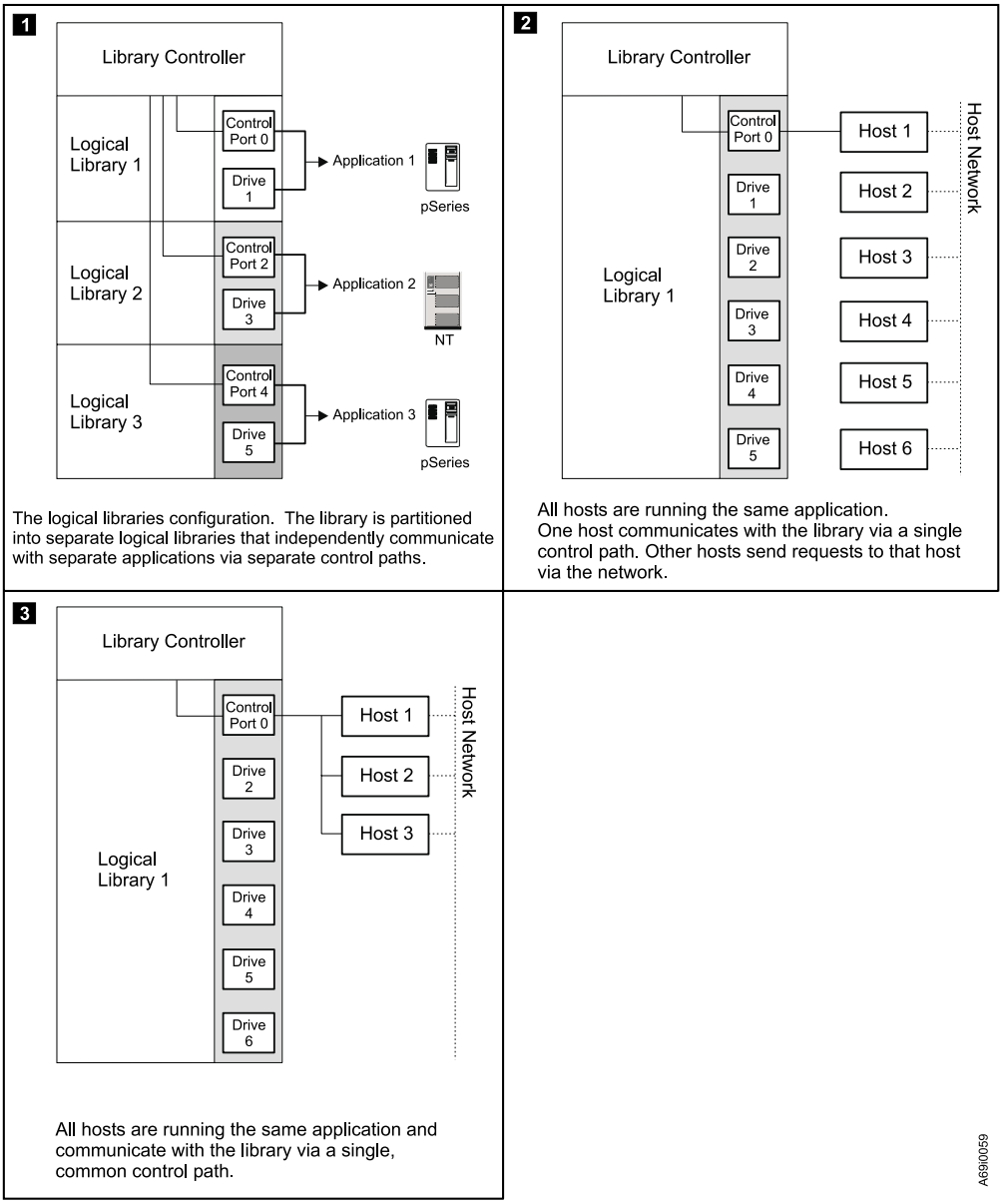

Figure 6. Examples of configurations for a IBM TotalStorage UltraScalable Tape Library 3584 that uses DLT 8000 Tape Systems. Lines from one or more drives to the library controller represent control paths.

Using Multiple Logical Libraries

To maximize your investment, you can use multiple logical libraries to share the physical library between applications or to support mixed drive types for any application. The sections that follow give guidelines for both processes.

You can create multiple logical libraries by partitioning the physical library's storage slots and tape drives into two or more logical libraries. Each logical library consists of:

- Tape drives
- Storage slots
- Input/output (I/O) slots
- Cartridge accessor

Each logical library has its own control path (a logical path into the library through which a server sends standard SCSI Medium Changer commands to control the logical library). For Ultrium frames, each logical library control path is available to servers through logical unit number 1 (LUN 1) of the first drive that is defined within that logical library. A logical unit number is a number used by a server to identify a drive. For DLT frames, each logical library control path is available to servers through LUN 0 of a dedicated control port.

A logical library cannot share another logical library's tape drives and storage slots. However, it does share the I/O slots and the cartridge accessor on a first-come, first-served basis. In addition, a logical library cannot include both LTO and DLT elements. That is, you must configure LTO and DLT elements (drives, storage slots, I/O slots, and grippers) into separate logical libraries.

Frames that use Ultrium Tape Drives can be partitioned into twelve logical libraries, and frames that use DLT 8000 Tape Systems can be partitioned into six logical libraries. You can partition multiple logical libraries by using one of two methods:

- Opening the door of the library and manually labeling the elements (storage slot columns and drives) that you want to include in each logical library (see the section about configuring the library by using labels in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*). This method enables you to view your partition at a glance whenever you open the front doors.
- Identifying the quantity of elements that you want to include in each logical library, then using the UltraScalable Specialist configuration wizard or the operator panel menus to create the logical libraries (see the section about configuring the library by using menus in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*). This method makes it unnecessary for you to manually label the elements, but you cannot view your partition whenever you open the front doors.

To create or change the configurations for your UltraScalable Tape Library, see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

When automatic cleaning is enabled, any appropriate cleaning cartridge may be used to clean a drive in any configured logical library, even if the cartridge resides in a different logical library. For additional details, see "Drive Cleaning" on page 23.

The following sections describe two uses for multiple logical libraries.

Using Multiple Logical Libraries for Library Sharing

Multiple logical libraries are an effective way for the UltraScalable Tape Library to simultaneously back up and restore data from heterogeneous applications. For example, you can partition the library so that it processes commands from Application 1 (about Department A) in Logical Library 1, commands from Application 2 (about Department B) in Logical Library 2, and commands from Application 3 (about Department C) in Logical Library 3. In this configuration, the storage slots and drives in each logical library are dedicated to that library and are not shared among other libraries. Commands issued by the applications travel to the library through three unique control paths. Thus, the data processing for Department A is confined to the storage slots and drives in Logical Library 1, processing for Department B is confined to the storage slots and drives in Logical Library 2, and so forth.

Using Multiple Logical Libraries for Mixed Drive Types

For applications that cannot support Ultrium 1 and Ultrium 2 drives and media in the same logical library, you can use multiple logical libraries to keep them separate.

By using partitioning and logical libraries, you provide investment protection for any Ultrium 1 Tape Drive if your application does not support the mixing of Ultrium 1 and Ultrium 2 Tape Drives and media in the same logical library.

Using Multiple Control Paths

In addition to creating multiple logical libraries, you can also configure any logical library to have more than one control path. When you configure additional control paths, additional library sharing configurations and availability options are made possible. Access to the logical library is on a first-come, first-served basis and each control path for a logical library can accept commands while the library is in use by another control path.

Note: Microsoft Windows® 2000 Removable Storage Manager (RSM) does not support multiple control paths within a logical library. IBM recommends that you disable RSM to use this feature.

To add or remove additional control paths, see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

The sections that follow describe two potential uses for multiple control paths.

Using Multiple Control Paths for iSeries and AS/400 Attachment

The use of control paths for the iSeries and AS/400 servers is unique. In general, every iSeries adapter must “see” the control path that is associated with the drives to which it is connected. Different scenarios exist:

- For an HVD SCSI Ultrium 1 Tape Drive, IBM supports single drive configurations so that every HVD Ultrium Tape Drive must have a control path when connected to the iSeries server.
- For HVD and LVD SCSI Ultrium 2 Tape Drives, the iSeries server supports multiple drives that are connected per adapter, and one of the drives must have a control path.
- For the Fibre-Channel-attached drives (both Ultrium 1 and Ultrium 2 Tape Drives), OS/400® V5R1 supports only one drive per adapter and every drive requires a control path.
- For an OS/400 V5R2 Fibre Channel connection, the adapter supports multiple drives per adapter, so that only one control path for the group of drives is required.

Using Multiple Control Paths for Control Path Failover

Command failures and timeouts are costly. You want your library to run smoothly and efficiently. To ensure continued processing, the UltraScalable Tape Library offers an optional control path failover feature that enables the host device driver to resend the command to an alternate control path for the same logical library. With control path failover installed, the alternate control path can include another HBA, SAN, or library control path drive. The device driver initiates error recovery and continues the operation on the alternate control path without interrupting the application. Only AIX® hosts that run the IBM Atape device driver are currently supported for this feature; DLT control ports are not supported.

The control path failover feature can be enabled at the factory, or you may order it later and have your IBM Service Representative enable it. To order the feature, contact your IBM Sales Representative.

Notes:

1. The control path failover feature is activated by a license key.
2. To get a comprehensive list of ISVs that support control path failover, visit the web at `http://www.storage.ibm.com/hardsoft/tape/lto/compatibility.html` or contact your IBM Sales Representative.

For more information about using the control path failover feature, see the *IBM Ultrium Device Drivers Installation and User's Guide*.

Supported Servers and Software

The UltraScalable Tape Library is supported by a wide variety of servers (hosts), operating systems, and adapters. These attachments can change throughout the product's life cycle. To determine the latest attachments, visit the web at `http://www.storage.ibm.com/hardsoft/tape/lto/compatibility.html` or contact your IBM Sales Representative.

Attachments to the UltraScalable Tape Library include (but are not limited to) those shown in Table 3.

Table 3. Supported servers and operating systems for SCSI and Fibre Channel attachment

Supported Servers	Supported Operating Systems
IBM AS/400 or iSeries	OS/400
IBM RS/6000®, RS/6000 SP™, or pSeries	AIX
Hewlett-Packard	HP-UX
Sun Microsystems	Solaris
32-bit, Intel-compatible servers	Microsoft Windows 2000 or Windows NT
	Red Hat Linux
64-bit, Intel Itanium servers	Red Hat Linux
Note: The iSeries and AS/400 servers do not support the Model D42 frame.	

To get a comprehensive list of compatible software, visit the web at `http://www.storage.ibm.com/hardsoft/tape/lto/compatibility.html` or contact your IBM representative.

Notes:

1. IBM does not provide application software with the UltraScalable Tape Library. To order software, contact your IBM Sales Representative, IBM Business Partner, or an independent software provider.
2. If you attach your library to a non-IBM platform with non-IBM software, IBM recommends that you contact your software vendor to obtain a matrix of compatible hardware, software, firmware revisions, and adapter cards.

Supported Device Drivers

IBM provides device driver support for the Ultrium Tape Drives and the robotics in the UltraScalable Tape Library (including the Model D42 frame). It maintains the latest levels of device drivers and driver documentation on the Internet. Use one of the following procedures to access this material. **(Note: If you do not have Internet access and you need information about device drivers, contact your Marketing Representative.)**

- Using a browser, type one of the following:

  `http://www.ibm.com/storage`

  `ftp://ftp.software.ibm.com/storage/devdrvr`

  `ftp://207.25.253.26/storage/devdrvr`

- Using FTP, enter the following specifications:

  FTP site: `ftp.software.ibm.com`

  IP Addr: `207.25.253.26`

  Userid: `anonymous`

  Password: (use your current e-mail address)

  Directory: `/storage/devdrvr`

The DLT 8000 Tape System is supported by native operating system device drivers. For instructions about installing, configuring, and operating device drivers for the DLT 8000 Tape Systems, refer to the documentation for your operating system or application software.

IBM provides PDF- and PostScript-formatted versions of its documentation in the /storage/devdrvr/Doc directory:

- IBM_ultrium_tape_IUG.ps and IBM_ultrium_tape_IUG.pdf contain the current version of the *IBM Ultrium Device Drivers Installation and User's Guide*
- IBM_ultrium_tape_PROGREF.ps and IBM_ultrium_tape_PROGREF.pdf contain the current version of the *IBM Ultrium Device Drivers Programming Reference*

Device drivers and utilities for each supported server are beneath /storage/devdrvr/ in the following directories (the device driver for the iSeries or AS/400 server is included in the OS/400 operating system).

- AIX
- HPUX
- Linux
- Solaris
- Windows

For more information about device drivers, refer to any of the preceding directories.

Attachment Interfaces

The UltraScalable Tape Library supports three types of attachment interfaces: Fibre Channel, LVD SCSI, and HVD SCSI. In an Ultrium frame, any combination of interfaces for the Ultrium Tape Drive is supported (including Fibre Channel); in a DLT frame, only LVD or HVD SCSI interfaces can be used.

The sections that follow describe the Fibre Channel and SCSI interfaces.

Fibre Channel Interface

Attention: This product contains an assembly that complies with the performance standards set by the U.S. Food and Drug Administration for a Class I Laser Product. This laser assembly is registered with the Department of Health and Human Services and is in compliance with IEC825.

For drives that use a Fibre Channel interface, the following conditions apply:

- The Ultrium 2 Tape Drive can attach to the following:
  - A SAN by using SCSI over 2-Gb Fibre Channel in a point-to-point or Arbitrated Loop topology.
  - A server by using SCSI over 2-Gb Fibre Channel in an Arbitrated Loop topology.
- The Ultrium 1 Tape Drive can attach to a server or a SAN by using SCSI over 1-Gb Fibre Channel Arbitrated Loop topology.

The 2-Gb interface is a 200-MB-per-second, full-duplex, serial-communications technology capable of interconnecting Ultrium Tape Drives that are separated by as much as 10 kilometers (7 miles).

Fibre Channel technology combines the best features of traditional input/output (I/O) interfaces (such as the throughput and reliability of SCSI and Programmed Control Interrupt) with the best features of networking interfaces (such as the connectivity and scalability of Ethernet and Token Ring). The technology offers a transport mechanism for delivering commands, and provides high performance by allowing processing to be done in the hardware.

You can establish Fibre Channel connections between Fibre Channel ports that reside in the UltraScalable Tape Library, one or more servers, and the network interconnecting them. The network can consist of such elements as switches, hubs, bridges, and repeaters used in the interconnection.

For more information about the Fibre Channel interface, see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

SCSI Interface

The UltraScalable Tape Library operates as a set of SCSI-3 devices. For drives that use a SCSI interface, the following conditions apply:

- The Ultrium 2 Tape Drive can attach to a server through a Low Voltage Differential (LVD) Ultra160 SCSI interface or a High Voltage Differential (HVD) Ultra SCSI interface
- The Ultrium 1 Tape Drive can attach to a server through an LVD Ultra2 SCSI interface or an HVD Ultra SCSI interface
- The DLT 8000 Tape System can attach to a server through a Fast/Wide LVD or HVD SCSI interface

Each SCSI drive canister uses shielded, VHDCI, 68-pin connectors and can attach directly to a 2-byte-wide SCSI cable.

Note: The earlier version of the SCSI drive used HD68 connectors and was packaged on a tray (sled). While drive trays are still supported, they can no longer be ordered. For information about the replacement design, contact your IBM representative.

Any combination of up to two initiators (servers) and up to four targets (devices) is allowed on a single SCSI bus if the following conditions are met:

- The SCSI bus is terminated properly at each end
- Cable restrictions are followed according to SCSI-3 standards

Under the SCSI-3 protocol, this type of attachment allows cable lengths of up to 25 m (81 ft) with the appropriate cable and terminator.

For more information about the SCSI interface, see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Expanded I/O Capacity

To insert cartridges into and remove them from the library (without requiring a reinventory), the library offers an input/output (I/O) station located on the front door of the base frame (Model L32). You can also order an additional I/O station to be installed on the door (if you are using both Ultrium and DLT drives, you automatically receive the additional I/O station).

The upper I/O station contains 10 slots for LTO Ultrium Tape Cartridges. The quantity of storage slots in the lower I/O station varies, depending on whether you use both Ultrium and DLT drives. For LTO Ultrium Tape Cartridges, the lower I/O station contains 20 slots; for DLTtape IV Tape Cartridges, the lower I/O station contains 18 slots.

A frame cannot combine both Ultrium and DLT cartridges. However, in a library that uses DLT drives, you may insert DLTtape IV Tape Cartridges into the lower I/O station of a Model L32 frame for transport (by the cartridge accessor) to a Model D42 frame.

Capacity Expansion Feature

The Capacity Expansion Feature is a license key that lets you enable the use of storage slots inside the front door of the UltraScalable Tape Library. With the Capacity Expansion Feature installed, the library offers 140 additional slots for Ultrium Tape Cartridges in the Model L32 if the second I/O station is not present and 88 additional slots if the second I/O station is present. The Capacity Expansion Feature is required when you add one or more expansion frames (Models D32 or D42) to the base frame.

When you purchase your library, you may specify that the Capacity Expansion Feature be installed at the factory, or you may order the feature later and have your IBM Service Representative install it. To order the Capacity Expansion Feature, contact your IBM Sales Representative.

To determine the quantity of LTO Ultrium Tape Cartridges and DLTtape IV Tape Cartridges that the library supports, see the section about library capacity in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Web Interface

The library's web interface, known as the IBM TotalStorage UltraScalable Tape Library Specialist, enables operators and administrators to manage storage devices from any location in an enterprise. The UltraScalable Specialist allows you to communicate directly with your UltraScalable Tape Library and perform a full range of end user, operator, and administrator tasks without being at the operator panel.

The UltraScalable Specialist requires a Category 5 Ethernet cable (not supplied with the tape library). It may be installed by you or your IBM Service Representative.

For information about using the UltraScalable Specialist web interface, see the section about operating the library from the web in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Remote Support

Optional remote support is available for the UltraScalable Tape Library through its Call Home capability. This feature minimizes the time it takes to correct both drive and library problems. It uses a modem connection to report failures that are detected by the drive or the library. Whenever a failure is detected, the Call Home feature sends detailed error information to IBM. The IBM Service Representative can then prepare an action plan to handle the problem before traveling to the library.

Hardware requirements for the remote support function vary, depending on whether you already have one or more IBM tape products that have the remote support capability. Table 4 indicates the requirements.

Table 4. Requirements for remote support (the Call Home feature)

Quantity of IBM Tape Products with Remote Support Capability	Requirement
1	Remote Support Facility (modem and cable; feature code #2710)
2	Remote Support Switch (feature code #2711). This feature applies only if you are attaching multiple libraries to one modem.
3 or more	Remote Support Attachment (cable; feature code #2712)

Drive Cleaning

The head of every tape drive in the UltraScalable Tape Library must be kept clean to prevent errors caused by contamination. To help you keep the drives clean, IBM provides a cleaning cartridge with the library. Whenever a drive determines that it needs to be cleaned, it alerts you with a message on the library's display or host console. The library uses the cleaning cartridge to clean the drive with whatever cleaning method that you choose. In all methods, cleaning is performed after the data cartridge has been unloaded from the drive and before the next load.

Three methods of cleaning are available:

Automatic cleaning (preferred)

Automatic cleaning enables the library to automatically respond to any tape drive's request for cleaning and to begin the cleaning process. The cleaning process is transparent to any host application that uses the library. You can enable or disable automatic cleaning by using the library's operator panel or by using the UltraScalable Specialist web interface. The setting is stored in non-volatile memory and becomes the default during subsequent power-on cycles. It applies to all logical libraries that are configured for the UltraScalable Tape Library. For more information, see the section about enabling or disabling automatic cleaning in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Host cleaning

Host cleaning enables the server (host) to detect the need to clean an Ultrium Tape Drive or a DLT 8000 Tape System, and to control the cleaning process. Host cleaning with a cleaning cartridge is only supported when you disable automatic cleaning and only for the logical library in which each cleaning cartridge is stored. When you enable automatic cleaning, or when the cleaning cartridge is stored in a different logical library, the host application does not have access to the cleaning cartridge. For more information, see the section about cleaning in your application software's documentation.

Manual cleaning

Manual cleaning requires that you select a menu option from the library's operator panel or UltraScalable Specialist web interface to perform cleaning on one or more of the tape drives. Manual cleaning is always supported, regardless of whether automatic cleaning is enabled or disabled. For more information, see the section about performing a manual cleaning operation in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

IBM recommends that you make sure that the automatic cleaning method is always enabled. By continually keeping itself clean, a drive does not shut itself down because of improper maintenance or contaminants that cause the drive to fail.

TapeAlert Support

The UltraScalable Tape Library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the host application. The library provides this information as TapeAlert *flags* that are reported to the application by the SCSI LOG SENSE command.

Appendix D, "TapeAlert Flags", on page 103 defines the TapeAlert flags for the drives and the library.

SNMP Messaging

Occasionally, the library may encounter a situation that you want to know about, such as an open door that causes the library to stop. Because many servers can attach to the UltraScalable Tape Library by differing attachment methods, the library provides a standard TCP/IP protocol called Simple Network Management Protocol (SNMP) to send alerts about conditions (such as an opened door) over a TCP/IP LAN network to an SNMP monitoring server. These alerts are called SNMP traps. Using the information supplied in each SNMP trap, the monitoring server (together with customer-supplied software) can alert operations staff of possible problems or operator interventions that occur. Many monitoring servers (like Tivoli Netview) can be used to send e-mail or pager notifications when they receive an SNMP alert (for more information, see your Tivoli Netview documentation or the manuals for your network management application).

The monitoring server must be loaded with systems management software that can receive and process the trap, or the trap is discarded. SNMP trap support does not provide a mechanism for the operator to gather more information about a problem or to query the library about its current status.

Figure 7 shows the flow of SNMP traps from the library over the Ethernet local area network (LAN) to an SNMP monitoring server.

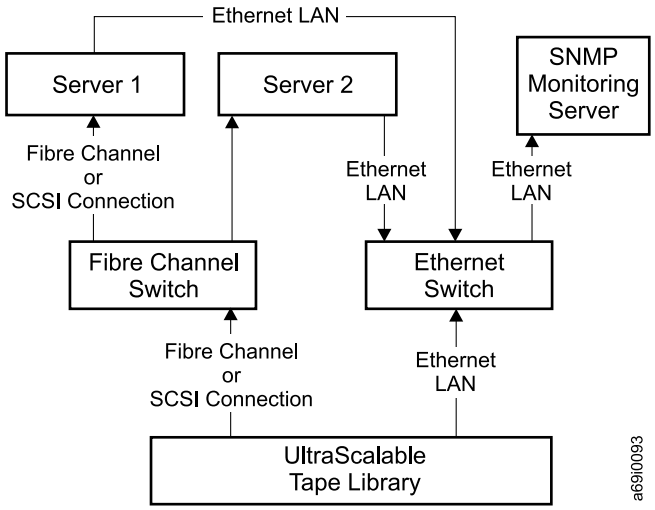

Figure 7. The SNMP messaging system. The UltraScalable Tape Library issues SNMP traps to an SNMP monitoring server.

For information about interpreting an SNMP trap, see the section about interpreting an SNMP trap in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Drive Performance

If you run applications that are highly dependent on tape-processing speed, you can take advantage of the significant performance improvements provided by the Ultrium Tape Drives and the DLT Tape System. Table 5 lists the performance characteristics of each.

Table 5. Performance characteristics of the Ultrium Tape Drives and the DLT Tape System

Performance Characteristic	Tape Drive		
	Ultrium 2 Tape Drive	**Ultrium 1 Tape Drive**	**DLT Tape System**
Native sustained data rate	35 MB/s (with Ultrium 2 media)	15 MB/s	6 MB/s
	20 MB/s (with Ultrium 1 media)		
Compressed data rate (at 2:1 compression)	70 MB/s (with Ultrium 2 media)	30 MB/s	12 MB/s
	40 MB/s (with Ultrium 1 media)		
Maximum sustained data rate (at maximum compression)	110 MB/s	60 MB/s	12 MB/s
Burst data rate for Fibre Channel drives	200 MB/s	100 MB/s	Not applicable
Burst data rate for Low Voltage Differential (LVD) SCSI drives	160 MB/s (Ultra160)	80 MB/s (Ultra2)	20 MB/s (Fast/Wide)
Burst data rate for High Voltage Differential (HVD) SCSI drives	40 MB/s (Ultra)	40 MB/s (Ultra)	20 MB/s (Fast/Wide)
Nominal load-to-ready time	15 seconds	20 seconds	130 seconds (formatted)
			133 seconds (unformatted)
Nominal unload time	15 seconds	18 seconds	21 seconds
Average search time to first byte of data	49 seconds	73 seconds	60 seconds
Note: All sustained data rates are dependent on the capabilities of the interconnect (for example, an Ultra SCSI bus is limited to less than 40 MB/s).			

By using the built-in data-compression capability of the tape drives, you can achieve greater data rates than the native data transfer rate. However, the actual throughput is a function of many components, such as the host system processor, disk data rate, block size, data compression ratio, SCSI bus capabilities, and system or application software. Although the UltraScalable Tape Library is capable of a 18-TB/hour rate with Ultrium 2 Tape Drives (at 2:1 compression), other components of the system may limit the actual effective data rate.

For maximum performance with SCSI drives, multiple SCSI buses may be required and the UltraScalable Tape Library devices must be the only target devices that are active on each SCSI bus. For more information, see the section about the SCSI interface in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Library Performance

The following performance values, whether measured on test systems or modeled through simulations, are based on a fixed set of workload assumptions to ensure accurate comparisons; however, the results were not evaluated in all production environments. Thus, the performance values show the relative performance of the systems and may not be absolute indicators of performance in your specific environment.

Some of the specific assumptions may not pertain to a given operating environment. Actual performance may vary. Accordingly, the performance information in this section does not constitute a performance guarantee or warranty. Verify that the performance of the library is acceptable in your specific environment.

Cartridge Inventory Times

The typical time required for the library to inventory cartridges is less than 60 seconds per frame.

A cartridge inventory operation includes a check to determine whether each cartridge storage slot in the library is empty or full, and a scan of the bar code labels. An inventory occurs whenever you:

- Power-on the UltraScalable Tape Library
- Issue the SCSI Initialize Element Status with Range command
- Select the appropriate menus from the UltraScalable Specialist web interface (see the section about performing an inventory of the library in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*)
- Go to the library's operator panel and select Inventory from the Manual Operations menu
- Close the front door after manually accessing the inventory

Note: The UltraScalable Tape Library tracks the logical location of all elements in the library by performing an automatic inventory as required (if you issue the SCSI Initialize Element Status command, it is allowed but ignored). The automatic inventory improves application audit performance.

When the library performs an automatic inventory because the front door was closed, the inventory occurs only for those frames whose doors have been opened.

Cartridge Move Times

Move time is the time required for the cartridge accessor to pick a cartridge from a random slot, move the cartridge to a drive, pivot (if required), and insert the cartridge into the drive.

Table 6 lists the average move times for the UltraScalable Tape Library.

Table 6. Average move times

Library Configuration	Tape Drive	
	Ultrium Tape Drives	**DLT Tape System (see Note)**
1 frame	2.5 seconds	6.2 seconds
2 frames	3 seconds	6.7 seconds
4 frames	3.7 seconds	7.4 seconds
6 frames	4.5 seconds	8.2 seconds
Note: The results for DLT Tape Systems were produced from models, but are consistent with expectations.		

Mount Throughput

Mount throughput is a measure of the overall capability of the cartridge accessor and tape drives. It is defined as the number of cartridges that the tape library can mount in one hour. A mount, often called the mount/demount cycle, involves removing the cartridge from a drive, returning it to its storage slot, collecting another cartridge from a random storage slot, moving it to the drive, and loading the cartridge into the drive.

Table 7 shows the mount throughput performance for frames that contain LTO Ultrium Tape Cartridges and DLT Tape Cartridges.

Table 7. Mount throughput rate

Library Configuration	Mounts Per Hour	
	Ultrium Tape Drives	**DLT Tape System**
1 frame	550	220
2 frames	500	210
4 frames	390	190
6 frames	320	170
Note: The results for DLT Tape Systems were produced from models, but are consistent with expectations.		

Fetch Rate

Fetch rate is a measure of the overall capability of the cartridge accessor without tape drive involvement. It is defined as the number of cartridges that the tape library can fetch in one hour. A fetch involves moving the cartridge from an I/O slot to a random storage slot or returning it from that storage slot to the I/O slot. Each move is a fetch.

Table 8 shows the fetch rate for LTO Ultrium Tape Cartridges and DLT Tape Cartridges.

Table 8. Fetch rate

Library Configuration	Fetches/Hour	
	Ultrium Tape Drives	**DLT Tape System (see Note)**
1 frame	1400	800
2 frames	1200	730
4 frames	970	640
6 frames	800	560
Note: The results for DLT Tape Systems were produced from models, but are consistent with expectations.		

Chapter 2. Library SCSI Commands

Table 9 lists all of the commands that are defined by the referenced SCSI-3 standard for medium changer devices and that are supported by the IBM TotalStorage UltraScalable Tape Library 3584 Models L32, D32, and D42. For each command, the operation code, page number of the command's description, applicable SCSI-3 standard, and applicable conditions are shown.

For the SCSI commands supported by the IBM Ultrium 2 Tape Drive, see the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*.

For the SCSI commands supported by the DLT 8000 Tape System, see the *Quantum DLT 8000 Tape System Product Manual*.

Table 9. Supported SCSI Commands for the UltraScalable Tape Library

Command Name	Operation Code	See page	SCSI Document	Applicable Conditions:		
				RVC[1]	UAT	NRD
Exchange Medium	X'A6'	33	SMC	Y	Y	Y
Initialize Element Status	X'07'	34	SMC	Y	Y	Y
Initialize Element Status with Range	X'E7'	35	VU	Y	Y	Y
Inquiry	X'12'	36	SPC	-	-	-
Log Select	X'4C'	NS	SPC	Y	Y	Y
Log Sense	X'4D'	43	SPC	Y	-	Y
Mode Select (6)	X'15'	45	SPC	Y	Y	-
Mode Select (10)	X'55'	47	SPC	Y	Y	-
Mode Sense (6)	X'1A'	49	SPC	-	Y	Y[2]
Mode Sense (10)	X'5A'	51	SPC	-	Y	Y[2]
Move Medium	X'A5'	59	SMC	Y	Y	Y
Position to Element	X'2B'	60	SMC	Y	Y	Y
Prevent Allow Medium Removal	X'1E'	61	SPC	Y	Y	Y
Read Buffer	X'3C'	62	SPC	Y	-	-
Read Element Status	X'B8'	64	SMC	-	Y	Y[3]
Receive Diagnostic Results	X'1C'	NS	SPC	Y	Y	-
Release Element (6)	X'17'	75	SMC	-[4]	Y	-
Request Sense	X'03'	76	SPC	-	-	-
Request Volume Element Address	X'B5'	79	SMC	Y	Y	-
Reserve Element (6)	X'16'	80	SMC	Y[5]	Y	-
Rezero Unit	X'01'	NS	SPC	Y	Y	-
Send Diagnostic	X'1D'	81	SPC	Y	Y	Y
Send Volume Tag	X'B6'	82	SMC	Y	Y	Y
Test Unit Ready	X'00'	83	SPC	Y	Y	Y
Write Buffer	X'3B'	84	SPC	Y	Y	Y

Table 9. Supported SCSI Commands for the UltraScalable Tape Library (continued)

Command Name	Operation Code	See page	SCSI Document	Applicable Conditions:		
				RVC[1]	UAT	NRD

Legend:

```
-    Not Applicable
NRD  CHECK CONDITION status for Not Ready
NS   Not Supported
RVC  Reservation Conflict status
SMC  SCSI-3 Medium Changer specification
SPC  SCSI Primary Commands-2 (SPC-2) specification
UAT  CHECK CONDITION status for Unit Attention
Y    Yes (condition applies)
Yn   Yes (condition applies per note n below)
```

Notes:

1. When multiple logical libraries or control paths are configured (see "Library Sharing" on page 12), the library has multiple Medium Changer device ports (via LUN 1 of the drives for LTO Ultrium frames and via dedicated control ports for DLT frames). Medium changer device reservations only prevent access for those initiators using the same device port as the initiator that has sent the Reserve command. Initiators using another device port (for example, for a different logical library or different control path) are not affected.
2. Reporting of Not Ready conditions for Mode Sense (6) and Mode Sense (10) is limited to reset conditions with associated sense data of 2/0401.
3. Reporting of Not Ready conditions for Read Element Status with DVCID=B'1' is limited to reset conditions with associated sense data of 2/0401.
4. Performs no operation if logical unit is reserved to another initiator.
5. Condition applies if logical unit is reserved to another initiator.

The tables in the following descriptions of each SCSI command indicate the fields in each Command Descriptor Block (CDB). The table is similar to the style used in the applicable SCSI-3 standard. The descriptions specify the supported options, values, and ranges for each field. For a description of a CDB and its fields, see the applicable SCSI-3 standard.

Exchange Medium - X'A6'

Table 10 shows the command format.

Table 10. Exchange Medium Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'A6')							
1	Logical Unit Number			Reserved				
2	Transport Element Address							
3								
4	Source Address							
5								
6	First Destination Address							
7								
8	Second Destination Address							
9								
10	Reserved						Inv2 (B'0')	Inv1 (B'0')
11	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

This command is not supported in libraries with mixed cartridge types (for example, LTO and DLT media).

The medium in the source element is moved to the first destination element and the medium which previously occupied the first destination element is moved to the second destination element. The second destination element may be the same as the source element.

The following UltraScalable Tape Library-specific parameters apply:

- **Transport Element Address:** If the cartridges are not a mix of Ultrium and DLT types, a value of X'0000', X'0001', or X'0002' is allowed for this field. For any of these values, the library will select an MTE based on optimal availability and performance.
- **Source/Destination Addresses:** The valid element addresses for this field are dependent upon library model and library configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.

  Notes:

  1. The Medium Transport Elements are not capable of an exchange. If this element address is specified as a Destination Address in an Exchange Medium command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).
  2. If a destination element is an Ultrium 1 tape drive and the source element address contains an Ultrium 2 cartridge (VolTag of `xxxxxxL2`), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).

For additional information on element addresses and descriptions, see "Mode Page X'1D': Element Address Assignment" on page 55, "Mode Page X'1F': Device Capabilities" on page 57, and "Read Element Status - X'B8'" on page 64.

Initialize Element Status - X'07'

Table 11. Initialize Element Status Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'07')							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The UltraScalable Tape Library keeps all element status current and valid by performing an automatic inventory operation as required (see "Cartridge Inventory Times" on page 27). Therefore, the Initialize Element Status command is allowed and ignored (the library returns GOOD status without performing another inventory). To re-inventory specific elements as part of application error handling, see "Initialize Element Status with Range - X'E7'" on page 35.

Initialize Element Status with Range - X'E7'

Table 12. Initialize Element Status with Range Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'E7')							
1	Logical Unit Number			Reserved				Range
2	Starting Element Address							
3								
4	Reserved							
5	Reserved							
6	Number of Elements							
7								
8	Reserved							
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The Initialize Element Status with Range command causes the library to check a range of elements for media present and any other status relevant to that element including the bar code label. The UltraScalable Tape Library keeps all element status current and valid by automatically performing an inventory operation as required (see "Cartridge Inventory Times" on page 27). The intent of this command is to retry the library inventory operation for a specific element address when an unexpected condition is detected by the host application software.

The following UltraScalable Tape Library-specific parameters apply:

- **Range:** The following values apply:

  B'0' Requests the library to check all elements. This value is allowed but no action is taken by the library (it returns GOOD status).

  B'1' Requests the library to check any valid elements within the range specified by the Starting Element Address and Number of Elements fields.

- **Starting Element Address:** Specifies the minimum element address that is to be checked.
- **Number of Elements:** Specifies the range of elements that are to be checked, beginning with the Starting Element Address. Any valid elements in the range are checked by the library. If there are no valid elements in the range, no action is taken and GOOD status is returned. The valid element addresses are dependent upon library model and library configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.

For further information on element addresses and descriptions refer to "Mode Page X'1D': Element Address Assignment" on page 55, "Mode Page X'1F': Device Capabilities" on page 57, and "Read Element Status - X'B8'" on page 64.

Inquiry - X’12’

Table 13. Inquiry Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'12')							
1	Logical Unit Number			Reserved			CmdDt (B'0')	EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

There are several forms of Inquiry data. The following are supported and described in more detail as follows:

- “Inquiry Standard Data: Valid LUN (Logical Unit Number)” on page 37
- “Inquiry Standard Data: Invalid LUN (DLT Control Port Only)” on page 39
- “Inquiry Page X’00’” on page 40
- “Inquiry Page X’80’: Unit Serial Number” on page 41
- “Inquiry Page X’83’: Device Identification” on page 42
- “Inquiry Page X'D0'” (the contents of this page are not specified in this document)

Refer to Table 13 for a description of the Inquiry command.

Inquiry Standard Data: Valid LUN (Logical Unit Number)

The following UltraScalable Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'0'
- Page Code: X'00'
- Allocation Length: X'38' (56) bytes available

Table 14 shows the standard inquiry data that is returned (character fields are in ASCII) for a logical unit number (LUN) that is configured as a SCSI Medium Changer (see “Default SCSI ID and Loop ID (AL_PA) Assignments” on page 87).

Table 14. Standard Inquiry Data Returned for a SCSI Medium Changer

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	RMB (B'1')	Reserved						
2	ISO/IEC Version (B'00')		ECMA Version (B'000')			ANSI Approved Version (B'011')		
3	AERC (B'0')	Obsolete (B'0')	NormACA (B'0')	HiSupport (B'0')	Response Data Format (B'0010')			
4	Additional Length (n-4) (X'33' or X'35')							
5	SCCS (B'0')	Reserved						
6	BQue	EncServ (B'0')	BarC (B'1')	MultiP (B'0')	MChngr (B'0')	AckReqQ (B'0')	Addr32 (B'0')	Addr16
7	RelAdr (B'0')	WBus32 (B'0')	WBus16	Sync	Linked (B'0')	TranDis (B'0')	CmdQue (B'0')	SftRe (B'0')
8-15	Manufacturer (‘IBM ’) (in ASCII)							
16-31	Device Type and Model Number (‘03584L32’ or ‘03584L42’)							
32-35	Product Revision Level							
36-37	IBM Plant of Manufacture Code							
38-49	Serial Number of Device							
50-51	‘0’ (in ASCII)							
52-55	Reserved							
56	Reserved				Clocking		QAS (B'0')	IUS (B'0')
57	Reserved							

For Ultrium 1 control path tape drives and DLT control ports, bytes 56 and 57 are not returned.

For SCSI control path drives and control ports, the following values apply:

- **BQue:** set to 0, which indicates that the drive does not support tagged queueing.
- **Adr16:** set to 1, which indicates that the drive supports 16 SCSI IDs.
- **WBus16:** set to 1, which indicates that the drive supports a 16-bit wide data path on a single cable.
- **Sync:** set to 1, which indicates that the drive supports synchronous data transfers.
- **Clocking:** is supported on Ultrium 2 devices only and is set to 11b because the drive supports both ST and DT modes.

For Fibre Channel control path drives, the following values apply:

- **BQue:** set to 1, which indicates that the drive supports tagged (simple command) queueing.
- **Adr16:** set to 0.
- **WBus16:** set to 0.
- **Sync:** set to 0.
- **Clocking:** set to 00b (the Clocking field is not used in Fibre Channel devices).

For all control paths, the following values apply:

- **Device Type and Model Number:**

For LTO logical libraries	‘03584L32	’ (in ASCII)
For DLT logical libraries	‘03584L42	’ (in ASCII)

- **Product Revision Level:** UltraScalable Tape Library Firmware Revision Level (in ASCII).
- **Serial Number of Device:** right justified with leading zeroes (in ASCII).

Inquiry Standard Data: Invalid LUN (DLT Control Port Only)

The following UltraScalable Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'0'
- Page Code: X'00'
- Allocation Length: X'24' (36) bytes available

Table 15 shows the standard inquiry data that is returned (character fields are in ASCII) for a LUN that is not associated with an installed device (see “Default SCSI ID and Loop ID (AL_PA) Assignments” on page 87).

Table 15. Standard Inquiry Data Returned for a LUN Not Associated with an Installed Device

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'011')			Peripheral Device Type (X'1F')				
1	RMB (B'0')	Reserved						
2	ISO/IEC Version (B'00')		ECMA Version (B'000')			ANSI Approved Version (B'011')		
3	AERC (B'0')	Obsolete (B'0')	NormACA (B'0')	HiSupport (B'0')	Response Data Format (B'0010')			
4	Additional Length (n-4) (X'1F' or 31 bytes)							
5	SCCS (B'0')	Reserved						
6	BQue (B'0')	EncServ (B'0')	BarC (B'1')	MultiP (B'0')	MChngr (B'0')	AckReqQ (B'0')	Addr32 (B'0')	Addr16
7	RelAdr (B'0')	WBus32 (B'0')	WBus16	Sync	Linked (B'0')	TranDis (B'0')	ComQue (B'0')	SftRe (B'0')
8-15	Manufacturer (‘IBM ’) (in ASCII)							
16-31	Device Type and Model Number							
32-35	Product Revision Level							

- **Device Type and Model Number:** ASCII blanks are returned.
- **Product Revision Level:** ASCII blanks are returned.

Inquiry Page X'00'

The following UltraScalable Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'00'
- Allocation Length: X'08' bytes available

Table 16 shows the data that is returned.

Table 16. Data Returned for Inquiry Page X'00'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'00')							
2	Reserved							
3	Page Length (n-3) (X'04')							
4	Supported page (X'00')							
5	Supported page (X'80')							
6	Supported page (X'83')							
7	Supported page (X'D0')							

Inquiry Page X'80': Unit Serial Number

The following library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'80'
- Allocation Length: X'14' (20) bytes available

Table 17 shows the data that is returned.

Table 17. Data Returned for Inquiry Page X'80'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'80')							
2	Reserved							
3	Page Length (X'10')							
4-15	Serial Number of Device							
16-19	First Storage Element Address							

- **Serial Number of Device:** Right justified with leading zeroes, in ASCII (same as Inquiry Standard Data bytes 38-49).
- **First Storage Element Address:** ASCII representation of four hexadecimal digits from Mode Page X'1D', bytes 6-7.

Inquiry Page X'83': Device Identification

The following UltraScalable Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'83'
- Allocation Length: X'30' (48) bytes available

Table 18 shows the data that is returned.

Table 18. Data Returned for Inquiry Page X'83'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'83')							
2	Reserved							
3	Page Length (X'2C')							
4	Reserved				Code Set (X'2')			
5	Reserved		Association (B'00')		Identifier Type (X'1')			
6	Reserved							
7	Identifier Length (X'28')							
8-15	Vendor ID							
16-31	Device Type and Model Number							
32-43	Serial Number of Device							
44-47	First Storage Element Address							

- **Code Set:** Identifier is all ASCII.
- **Vendor ID:** Same as Inquiry Standard Data bytes 8-15.
- **Device Type and Model Number:** Same as Inquiry Standard Data bytes 16-31.
- **Serial Number of Device:** Right justified with leading zeroes, in ASCII (same as Inquiry Standard Data bytes 38-49).
- **First Storage Element Address:** ASCII representation of four hexadecimal digits from Mode Page X'1D', bytes 6-7.

Log Sense - X’4D’

The Log Sense command is supported by the UltraScalable Tape Library. Table 19 shows the command format.

Table 19. Data Returned for Log Sense Page X'00'

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'4D')							
1	Logical Unit Number			Reserved			PPC (B'0')	SP (B'0')
2	PC		Page Code					
3	Reserved							
4	Reserved							
5-6	Parameter Pointer (X'0000')							
7-8	Allocation Length							
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **PPC:** Parameter pointer control.
- **SP:** Save parameters.
- **PC:** Page control. The following values apply:

  B'00' Threshold Values. Supported for all log pages with log counters (the LP field is set to B'0' in the Log Parameter Control Byte).
  B'01' Cumulative Values. Supported for all log pages.
  B'10' Default Threshold Values. Supported for all log pages with log counters. The default threshold value for all 2-byte log counter fields is X'FFFF'. The default threshold value for all 4-byte log counter fields is X'FFFF FFFF'.
  B'11' Default Cumulative Values. Not supported. The default cumulative value for all 2-byte log counter fields is X'0000'. The default cumulative value for all 4-byte log counter fields is X'0000 0000'.

- **Page Code**: Indicates the log page to be returned.

The log pages supported for the Log Sense command are:

- “Log Page X’00’: Supported Log Pages” on page 44
- “Log Page X’2E’: TapeAlert” on page 44

Log Page X’00’: Supported Log Pages

The Supported Log Page returns the list of log pages that are supported by the UltraScalable Tape Library. Table 20 shows the data that is returned.

Table 20. Data Returned for Log Sense Page X'00'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code (B'000000')					
1	Reserved							
2-3	Page Length (X'0002')							
4	Supported Log Pages (X'00')							
5	TapeAlert Page (X'2E')							

Log Page X’2E’: TapeAlert

Table 21 shows the data that is returned for the TapeAlert Page.

Table 21. Data Returned for Log Sense Page X'2E'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code (X'2E')					
1	Reserved							
2-3	Page Length (X'0140')							
5n-1 to 5n	Parameter Code (n)							
5n+1	DU (B'0')	DS (B'1')	TSD (B'0')	ETC (B'0')	TMC (B'00')		Reserved	LP (B'0')
5n+2	Parameter Length (X'01')							
5n+3	Reserved							Value of Flag

- **Parameter Code:** n equals 1 to 64.
- **Value of Flag:** The following values apply:

  B'0' Indicates that the flag is not set.
  B'1' Indicates that the flag is set.

Mode Select (6) - X’15’

The Mode Select (6) command is supported by the UltraScalable Tape Library. Table 22 shows the command format.

Note: In the future, the length of the mode parameter list for Mode Sense Page Code X'3F' (return all pages) may exceed 255 bytes. At that time, use of the Mode Select (10) and Mode Sense (10) commands will be required in order to transfer all mode pages with one command. For this reason, use of the Mode Select (6) and Mode Sense (6) commands is not recommended.

Table 22. Mode Select (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'15')							
1	Logical Unit Number			PF (B'1')	Reserved			SP (B'0')
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **PF:** Page format. The PF bit is explicitly **not** checked.
- **Parameter List Length:** Specifies the length (in bytes) of the mode parameter list that is transferred from the initiator to the target. A parameter list length of 0 indicates that no data is transferred. This condition is not considered an error. The target terminates the command with CHECK CONDITION status with associated sense data of 5/1A00 (Illegal Request, Parameter List Length Error) if the parameter list length results in the truncation of the mode parameter header, the mode parameter block descriptor, or any mode page.

Note: Issuing a Mode Sense for current values before a Mode Select is generally recommended to avoid accidentally attempting to set fields that cannot be changed by the initiator.

The mode pages supported by the UltraScalable Tape Library are:

- “Mode Page X’18’: Fibre Channel Logical Unit Control Page” on page 53 (Fibre Channel control paths only)
- “Mode Page X’1C’: Informational Exceptions Control” on page 54
- “Mode Page X’1D’: Element Address Assignment” on page 55
- “Mode Page X’1E’: Transport Geometry Parameters” on page 56
- “Mode Page X’1F’: Device Capabilities” on page 57
- “Mode Page X’20’: VU Mode Parameters Page” on page 58

Mode Parameter Header for Mode Select (6)

The Mode Pages for the Mode Select (6) command are preceded by a 4-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 23. Mode Parameter Header for Mode Select (6)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Mode Data Length (X'00')							
1	Medium Type (X'00')							
2	Device-Specific Parameter (X'00')							
3	Block Descriptor Length (X'00')							

- **Mode Data Length:** Reserved when used with the Mode Select (6) command. (When used with the Mode Sense commands, this field specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the UltraScalable Tape Library.

Mode Select (10) - X’55’

The Mode Select (10) command is supported by the UltraScalable Tape Library. Table 24 shows the command format.

Table 24. Mode Select (10) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'55')							
1	Logical Unit Number			PF (B'1')	Reserved			SP (B'0')
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Parameter List Length							
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following library-specific parameters apply:

- **PF:** Page format. The PF bit is explicitly **not** checked.
- **Parameter List Length:** Specifies the length (in bytes) of the mode parameter list that is transferred from the initiator to the target. A parameter list length of 0 indicates that no data is transferred. This condition is not considered an error. The target terminates the command with CHECK CONDITION status with associated sense data of 5/1A00 (Illegal Request, Parameter List Length Error) if the parameter list length results in the truncation of the mode parameter header, the mode parameter block descriptor, or any mode page.

Note: Issuing a Mode Sense for current values before a Mode Select is generally recommended to avoid accidentally attempting to set fields that cannot be changed by the initiator.

The mode pages supported by the UltraScalable Tape Library are:

- “Mode Page X’18’: Fibre Channel Logical Unit Control Page” on page 53 (Fibre Channel control paths only)
- “Mode Page X’1C’: Informational Exceptions Control” on page 54
- “Mode Page X’1D’: Element Address Assignment” on page 55
- “Mode Page X’1E’: Transport Geometry Parameters” on page 56
- “Mode Page X’1F’: Device Capabilities” on page 57
- “Mode Page X’20’: VU Mode Parameters Page” on page 58

Mode Parameter Header for Mode Select (10)

The Mode Pages for the Mode Select (10) command are preceded by an 8-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 25. Mode Parameter Header for Mode Select (10)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Mode Data Length (X'0000')							
2	Medium Type (X'00')							
3	Device-Specific Parameter (X'00')							
4-5	Reserved							
6-7	Block Descriptor Length (X'0000')							

- **Mode Data Length:** Reserved when used with the Mode Select (10) command. (When used with the Mode Sense commands, this field specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the UltraScalable Tape Library.

Mode Sense (6) - X'1A'

The Mode Sense (6) command is supported by the UltraScalable Tape Library. Table 26 shows the command format.

Note: In the future, the length of the mode parameter list for Mode Sense Page Code X'3F' (return all pages) may exceed 255 bytes. At that time, use of the Mode Select (10) and Mode Sense (10) commands will be required in order to transfer all mode pages with one command. For this reason, use of the Mode Select (6) and Mode Sense (6) commands is not recommended.

Table 26. Mode Sense (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1A')							
1	Logical Unit Number			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **DBD:** Disable block descriptors. Supported values are B'0' or B'1'.
- **PC:** Page control. Supported values are B'00', B'01', or B'10'.
- **Page Code:** Supported values are X'18', X'1C', X'1D', X'1E', X'1F', X'20', and X'3F' (return all pages).
- **Allocation Length:** The maximum number of bytes to be transferred. If the allocation length specified is less than the amount available, then the allocated amount is transferred and no error is reported.

The mode pages supported by the UltraScalable Tape Library are:

- "Mode Page X'18': Fibre Channel Logical Unit Control Page" on page 53 (Fibre Channel control paths only)
- "Mode Page X'1C': Informational Exceptions Control" on page 54
- "Mode Page X'1D': Element Address Assignment" on page 55
- "Mode Page X'1E': Transport Geometry Parameters" on page 56
- "Mode Page X'1F': Device Capabilities" on page 57
- "Mode Page X'20': VU Mode Parameters Page" on page 58

Mode Parameter Header for Mode Sense (6)

The Mode Pages for the Mode Sense (6) command are preceded by a 4-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 27. Mode Parameter Header for Mode Select (6)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Mode Data Length							
1	Medium Type (X'00')							
2	Device-Specific Parameter (X'00')							
3	Block Descriptor Length (X'00')							

- **Mode Data Length:** Specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself. (This field is reserved when used with the Mode Select (6) command.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the UltraScalable Tape Library.

Mode Sense (10) - X’5A’

The Mode Sense (10) command is supported by the UltraScalable Tape Library. Table 28 shows the command format.

Table 28. Mode Sense (10) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'5A')							
1	Logical Unit Number			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Allocation Length							
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **DBD:** Disable block descriptors. Supported values are B'0' or B'1'.
- **PC:** Page control. Supported values are B'00', B'01', or B'10'.
- **Page Code:** Supported values are X'18', X'1C', X'1D', X'1E', X'1F', X'20', and X'3F' (return all pages).
- **Allocation Length:** The maximum number of bytes to be transferred. If the allocation length specified is less than the amount available, then the allocated amount is transferred and no error is reported.

The mode pages supported by the UltraScalable Tape Library are:

- “Mode Page X’18’: Fibre Channel Logical Unit Control Page” on page 53 (Fibre Channel control paths only)
- “Mode Page X’1C’: Informational Exceptions Control” on page 54
- “Mode Page X’1D’: Element Address Assignment” on page 55
- “Mode Page X’1E’: Transport Geometry Parameters” on page 56
- “Mode Page X’1F’: Device Capabilities” on page 57
- “Mode Page X’20’: VU Mode Parameters Page” on page 58

Mode Parameter Header for Mode Sense (10)

The Mode Pages for the Mode Sense (10) command are preceded by an 8-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 29. Mode Parameter Header for Mode Select (10)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Mode Data Length							
2	Medium Type (X'00')							
3	Device-Specific Parameter (X'00')							
4-5	Reserved							
6-7	Block Descriptor Length (X'0000')							

- **Mode Data Length:** Specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself. (This field is reserved when used with the Mode Select (10) command.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the UltraScalable Tape Library.

Mode Page Format

Table 30 shows the format of the mode parameter list. The individual mode page descriptions that follow this table include the field descriptions. Each field is non-changeable unless specifically identified otherwise.

Table 30. Mode Page Format

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	PS	Reserved	Page code					
1	Page Length (n-1)							
2-n	Mode Parameters							

Mode Page X’18’: Fibre Channel Logical Unit Control Page

This page is defined for Fibre Channel-attached devices only. There is only one copy of this page for each initiator.

Table 31. Data Returned for Mode Page X'18'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'18')					
1	Page Length (X'06')							
2	Reserved							
3	Reserved							EPDC (B'0')
4-7	Reserved							

- **EPDC:** Enable precise delivery control.

Mode Page X'1C': Informational Exceptions Control

See the SCSI-3 standard.

This page is defined as common for all initiators. This page is a static page. There are no changeable parameters in this mode page.

Table 32. Data Returned for Mode Page X'1C'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1C')					
1	Page Length (X'0A')							
2	Perf (B'0')	Reserved			DExcept (B'1')	Test (B'0')	Reserved	LogErr (B'0')
3	Reserved				MRIE (X'3')			
4-7	Interval Time (X'00000000')							
8-11	Report Count/Test Flag Number (X'00000000')							

Mode Page X'1D': Element Address Assignment

See the SCSI-3 standard. This page is defined as common for all initiators. This page is a static page. Addresses defined here are those which should be used by the Move Medium command.

The fields in Mode Page X'1D' depend on the model of the library and the library's configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.

Note: The fields in Mode Page X'1D' are not changeable. If a Mode Select command is issued with values other than those returned by a Mode Sense command, the device returns CHECK CONDITION status with associated sense data of 5/2600 (Illegal Request, Invalid Field in Parameter List).

Table 33. Data Returned for Mode Page X'1D'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1D')					
1	Parameter Length (X'12')							
2-3	Medium Transport Element Address (X'0001')							
4-5	Number of Medium Transport Elements: (X'0001' or X'0002')							
6-7	First Storage Element Address							
8-9	Number of Storage Elements							
10-11	First Import/Export Element Address							
12-13	Number of Import/Export Elements							
14-15	First Data Transfer Element Address							
16-17	Number of Data Transfer Elements							
18-19	Reserved							

Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (for the example, the Number of Data Transfer Elements is 3). However, a command to move a cartridge to a non-existent drive will be terminated with CHECK CONDITION status and associated sense data of 5/3B82 (Illegal Request; Element Not Accessible, Drive is Not Present).

Mode Page X'1E': Transport Geometry Parameters

The transport geometry parameters page defines whether each medium transport element is a member of a set of elements that share a common robotics subsystem and whether the element is capable of medium rotation. One transport geometry descriptor is returned for each medium transport element. Because the UltraScalable Tape Library has one or two medium transport elements, one or two descriptors are returned.

This page is defined as common to all initiators. This page is a static page.

There are no changeable parameters in this mode page.

Note: Bytes 4 and 5 are not returned if the library is configured with mixed cartridge types (for example, Ultrium and DLT).

Table 34. Data Returned for Mode Page X'1E'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1E')					
1	Page Length (X'02' or X'04')							
2	Reserved							Rotate (B'0')
3	Member Number in Transport Element Set (X'00')							
4	Reserved							Rotate (B'0')
5	Member Number in Transport Element Set (X'01')							

- **Rotate:** the UltraScalable Tape Library does not support media rotation.

Mode Page X’1F’: Device Capabilities

See the SCSI-3 standard.

This page is defined as common for all initiators. This page is a static page.

Note: The fields in Mode Page X'1F' are not changeable. If a Mode Select command is issued with values other than those returned by a Mode Sense command, the device returns CHECK CONDITION status with associated sense data of 5/2600 (Illegal Request, Invalid Field in Parameter List).

Table 35. Data Returned for Mode Page X'1F'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1F')					
1	Parameter Length (X'0E')							
2	**Store XX Field**							
	Reserved				StorDT (B'1')	StorI/E (B'1')	StorST (B'1')	StorMT (B'0')
3	Reserved							
4	**Medium Transport Capabilities**							
	Reserved				MT->DT (B'1')	MT->I/E (B'1')	MT->ST (B'1')	MT->MT (B'0')
5	**Storage Element Capabilities**							
	Reserved				ST->DT (B'1')	ST->I/E (B'1')	ST->ST (B'1')	ST->MT (B'0')
6	**Import/Export Element Capabilities**							
	Reserved				I/E->DT (B'1')	I/E->I/E (B'1')	I/E->ST (B'1')	I/E->MT (B'0')
7	**Data Transfer Element Capabilities**							
	Reserved				DT->DT (B'1')	DT->I/E (B'1')	DT->ST (B'1')	DT->MT (B'0')
8-11	Reserved							
12	**Medium Transport Element Exchange Capabilities**							
	Reserved				MT<>DT (B'0')	MT<>I/E (B'0')	MT<>ST (B'0')	MT<>MT (B'0')
13	**Storage Element Exchange Capabilities**							
	Reserved				ST<>DT (B'1')	ST<>I/E (B'1')	ST<>ST (B'1')	ST<>MT (B'0')
14	**Import/Export Element Exchange Capabilities**							
	Reserved				I/E<>DT (B'1')	I/E<>I/E (B'1')	I/E<>ST (B'1')	I/E<>MT (B'0')
15	**Data Transport Element Exchange Capabilities**							
	Reserved				DT<>DT (B'1')	DT<>I/E (B'1')	DT<>ST (B'1')	DT<>MT (B'0')

Mode Page X’20’: VU Mode Parameters Page

This page is defined as common to all initiators.

Table 36. Data Returned for Mode Page X'20'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'20')					
1	Page Length (X'08')							
2	Reserved (Vendor Unique)					AutoClean	Reserved (Vendor Unique)	
3-9	Reserved (Vendor Unique)							

- **AutoClean:** This field is not changeable. Automatic drive cleaning may only be enabled or disabled at the library’s operator panel. The following values apply:

  B'0' Automatic drive cleaning is disabled.
  B'1' Automatic drive cleaning is enabled.

Move Medium - X'A5'

Table 37. Move Medium Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'A5')							
1	Logical Unit Number			Reserved				
2	Transport Element Address							
3								
4	Source Address							
5								
6	Destination Address							
7								
8	Reserved							
9	Reserved							
10	Reserved							Invert (B'0')
11	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

- **Transport Element Address:** For any of these values, the library will select an MTE based on optimal availability and performance. The following values apply:

  X'0000'
  X'0001'
  X'0002' (if the cartridges are not a mix of Ultrium and DLT types)

- **Source/Destination Addresses:** The valid element addresses for these fields depend on the library's configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.

  Notes:

  1. The Medium Transport Element is not capable of storing a media element. If this element address is specified as a Destination Address in a Move Medium command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).
  2. If a destination element is an Ultrium 1 tape drive and the source element address contains an Ultrium 2 cartridge (VolTag of xxxxxxL2), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).

For additional information on element addresses and descriptions, see "Mode Page X'1D': Element Address Assignment" on page 55, "Mode Page X'1F': Device Capabilities" on page 57, and "Read Element Status - X'B8'" on page 64.

Position to Element - X’2B’

Table 38. Position to Element Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'2B')							
1	Logical Unit Number			Reserved				
2	Transport Element Address							
3								
4	Destination Element Address							
5								
6	Reserved							
7	Reserved							
8	Reserved							Invert (B'0')
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

This command will position the transport element (the picker) in front of the destination element specified.

The following UltraScalable Tape Library-specific parameters apply:

- **Transport Element Address:** The following values apply. For any of these values, the library will select an MTE based on optimal availability and performance.

  X'0000'
  X'0001'
  X'0002' (if the cartridges are not a mix of Ultrium and DLT types)

- **Destination Address:** The valid element address for this field depends on the library’s configuration. See Appendix C, “Locations and Addresses of SCSI Elements”, on page 91 for additional details.

  Note: The Medium Transport Element is not capable of storing a media element. If this element address is specified as a Destination Address in a Position to Element command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).

For further information on element addresses and descriptions refer to “Mode Page X’1D’: Element Address Assignment” on page 55 and to “Read Element Status - X’B8’” on page 64.

Prevent Allow Medium Removal - X'1E'

The Prevent Allow Medium Removal command is supported by the UltraScalable Tape Library. Table 39 shows the command format.

Table 39. Prevent Allow Medium Removal Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1E')							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved						Prevent	
5	Lock Shared	Vendor Specific (B'00')	Reserved (B'0000')				Flag (B'0')	Link (B'0')

- **Prevent:** The following values apply:

  B'00' Allow Cartridge Removal
  B'01' Prevent Cartridge Removal
  B'10' Not Supported
  B'11' Not Supported

- **LockShared:** This field should not be set by device drivers or commercial applications. It is intended for use by user-developed applications in specific environments where sharing and locking of the I/O station are both required.

If the I/O station is not shared by multiple logical libraries, the UltraScalable Tape Library supports Prevent Cartridge Removal by locking the I/O station. The Prevent Cartridge Removal option will only cause a shared I/O station to be locked if the LockShared bit is set to B'1'. If the I/O station is shared and the LockShared bit is set to B'0', the Prevent Cartridge Removal option is allowed and ignored (returns GOOD status without action). Cartridge removal is enabled again when any initiator issues the Prevent Allow Medium Removal command, with the Prevent field set to B'00' (Allow Cartridge Removal). A power-on reset also restores the UltraScalable Tape Library to the allow removal state.

For physical security in an unattended environment, the UltraScalable Tape Library supports a manual lock on the library door. The locked door prevents access to the cartridges in the library.

Read Buffer - X'3C'

The Read Buffer command is supported by the UltraScalable Tape Library. Table 40 shows the command format.

Table 40. Read Buffer Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'3C')							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID							
3	Buffer Offset							
4								
5								
6	Allocation Length							
7								
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag B'0'	Link B'0'

The following UltraScalable Tape Library-specific parameters apply:

- **Mode:** The following values apply.

  B'001' Vendor Specific mode. Returns data contained in the buffer specified by the Buffer ID.
  B'011' Descriptor mode. Returns the offset boundary and buffer size (in bytes) for the buffer specified in the Buffer ID.

- **Buffer ID:** The buffers supported in the UltraScalable Tape Library are described in Table 41 on page 63.
- **Buffer Offset:** In mode B'001', the starting address in the buffer to be read. For mode B'011', this field must be X'000000'.
- **Allocation Length:** The maximum number of bytes to be transferred. The device transfers the number of bytes specified in the Allocation Length field or the number of bytes in the header and buffer being read, whichever is less. This is not an error.

Each buffer image has its own unique format, describing where certain key data may be found. Certain buffers contain embedded data in the buffer image describing the length of the total buffer image, and a CRC field that checks the total buffer image. Uploading the microcode buffer is one such example.

Table 41 lists the accessible buffers.

Table 41. Read Buffer ID's

Buffer ID	Description
X'01'	Error Log
X'03'	Motion Log
X'04'	Servo Log
X'05'	Statistics
X'11'	XYC Event Log
X'21'	OPC Event Log
X'31'	ACC Event Log
X'41'-X'46'	MCC Event Log (Frames 1-6, Buffer Size of 0 is returned if not installed)

Read Element Status - X'B8'

Table 42 shows the command format.

Table 42. Read Element Status Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'B8')							
1	Logical Unit Number			VolTag	Element Type Code			
2	Starting Element Address							
3								
4	Number of Elements							
5								
6	Reserved						CURDATA	DVCID
7	Allocation Length							
8								
9								
10	Reserved							
11	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **VolTag (Volume Tags):** The following values apply:

  B'0' Requests the device to not report volume tag information.
  B'1' Requests the device to report volume tag information.

- **Element Type Code:** The following values apply:

  X'0' Reports all element types.
  X'1' Reports Medium Transport Elements only.
  X'2' Reports Storage Elements only.
  X'3' Reports Import/Export Elements only.
  X'4' Reports Data Transfer Elements only.

- **Starting Element Address:** The minimum element address to report.
- **Number of Elements:** The maximum number of elements to be included in this report.
- **DVCID (Device ID):** The following values apply:

  B'0' Requests the library to report status for the element indicated in the Element Type Code field.
  B'1' Requests the library to report device identifiers, if available, for the Data Transfer Elements. If this bit is set to B'1', the VolTag field must be set to B'0' and the Element Type Code field must be set to X'4'. Only the device identifier data is valid in the response. All other data will be returned as invalid with an ASC/ASCQ in each element descriptor set to 81/00 or 82/00 (Status is Questionable).

- **CURDATA:** The following values apply:

  B'0' Motion is allowed as needed to return a maximum set of valid element status data.

  B'1' Motion is not allowed; a minimum set of valid data may be returned. This field is supported for SCSI-3 compliance, but it is not required to be set to B'1' in order to obtain the Device IDs for the Data Transfer Elements.

- **Allocation Length:** The maximum number of bytes of data to be returned for this report.

Element Status Data

This data is a header that precedes the specific element type information, if any. Following this data are zero or more Element Status Pages, up to one for each of the four Element Types supported, if the command permits. Following each Element Status Page are zero or more Element Descriptors, up to one Element Descriptor for each element cell of that element type in the library, again if the data in the CDB permits.

Table 43. Header for Element Type Information

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements							
4	Reserved							
5-7	Byte Count of Report Available							

- **First Element Address Reported:** The smallest element address found to meet the CDB request.
- **Number of Elements:** The number of elements meeting the request in the CDB.

Element Status Page

There is one status page for each of the element types to be reported.

Table 44. Element Status Page

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Element Type Code							
1	PVolTag	AVolTag (X'0')	Reserved					
2-3	Element Descriptor Length							
4	Reserved							
5-7	Byte Count of Descriptor Data Available							

- **Element Type Code:** Indicates the element type reported by this page.
- **PVolTag (Primary volume tag):** The following values apply:

  B'0' Indicates that the primary volume tag information is omitted from the element descriptors that follow.
  B'1' Indicates that the primary volume tag information field is present in each of the element descriptors that follow.

- **AVolTag (Alternate volume tag):** The UltraScalable Tape Library does not support AVolTag.
- **Element Descriptor Length:** The following values apply:

  X'0010' If DVCID=B'0' and VolTag=B'0'
  X'0032' If DVCID=B'1' and VolTag=B'0'
  X'0034' If DVCID=B'0' and VolTag=B'1'

- **Byte Count of Descriptor Data Available:** The number of bytes of element descriptor data available for elements of this element type that meet the request in the CDB.

Element Descriptors

For each Element Type, there is a set of Element Descriptors, one descriptor for each element in the library of that Element Type, up to the limit imposed by the CDB. These pages are described below.

Element Type 1: Medium Transport Element Descriptor. This is the element associated with the transport mechanism. Cartridges are never stored in the transport mechanism. However, this element descriptor can indicate the transport contains a cartridge in certain error conditions.

Table 45. Element Type 1: Medium Transport Element Descriptor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved					Except	Reserved	Full
3	Reserved							
4-5	ASC/ASCQ							
6-8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** There are one or two medium transport elements in the library. The following values apply:

  X'0001'
  X'0002'

- **Except:** The following values apply:

  B'0' The transport is in a normal state.
  B'1' The transport is in an abnormal state.

- **Full:** The following values apply:

  B'0' The transport does not contain a cartridge.
  B'1' The transport contains a cartridge. A value of B'1' indicates an error has occurred and recovery is required. Recovery of the cartridge from the transport can be performed by the host using the Move Medium command or by the operator using operator panel menus.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The UltraScalable Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (see "Element Status Page" on page 66). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks. Normally, there is no cartridge present in the picker when this command is processed; however, if a cartridge is present and label information is available, it will be returned.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 2: Storage Element Descriptor. This is the element used for cartridge storage.

Table 46. Element Type 2: Storage Element Descriptor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved				Access	Except	Reserved	Full
3	Reserved							
4-5	ASC/ASCQ							
6-8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.
- **Access:** The following values apply:

  B'0' Indicates that access to the storage element by a medium transport element is denied.
  B'1' Indicates that access to the storage element by a medium transport element is allowed.

  Note: An example of when access would be denied is when the storage element contains a cleaner cartridge and the auto-clean option is enabled.

- **Except:** The following values apply:

  B'0' The element is in a normal state.

B'1' The element is in an abnormal state.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element cell contains a cartridge.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  30/03 Cleaning Cartridge Installed
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The UltraScalable Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (see "Element Status Page" on page 66). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 3: Import/Export Element Descriptor. This is the element used for moving volumes into and out of the medium changer. In the UltraScalable Tape Library, this element is also known as the I/O Station and Bulk I/O slots.

Table 47. Element Type 3: Import/Export Element Descriptor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved		InEnab (B'1')	ExEnab (B'1')	Access	Except	ImpExp	Full
3	Reserved							
4-5	ASC/ASCQ							
6-8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** The range of element addresses reported in this field depends on the library configuration. For additional details, see Appendix C, “Locations and Addresses of SCSI Elements”, on page 91.
- **InEnab:** Import Enable. InEnab indicates that this element supports movement of media into the scope of the library.
- **ExEnab:** Import Enable. Indicates that this element supports movement of media out of the scope of the library.
- **Access:** The following values apply:

  B'0' Indicates that access to the Import/Export element by a Medium Transport Element is denied.
  B'1' Indicates that access to the Import/Export element by a Medium Transport Element is allowed.

  Note: Examples of when access would be denied include (1) when the I/O Station door is open and (2) when a cartridge has been moved to the I/O slot from a storage slot or drive that is part of a logical library different from the logical library reporting the status.
- **Except:** The following values apply:

  B'0' The element is in a normal state.
  B'1' The element is in an abnormal state.

- **ImpExp:** Import/Export. The following values apply:

  B'0' Indicates the unit of media in the Import/Export Element was placed there by the Medium Transport Element.
  B'1' Indicates the unit of media in the Import/Export Element was placed there by an operator.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element cell contains a cartridge.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The UltraScalable Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (see

"Element Status Page" on page 66). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.

- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 4: Data Transfer Element Descriptor (DVCID=B'0'). This is the element descriptor block used to report the status of the drive.

Table 48. Element Type 4: Data Transfer Element Descriptor (DVCID=B'0'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved				Access	Except	Reserved	Full
3	Reserved							
4-5	ASC/ASCQ							
6	Not Bus	Reserved	ID Valid	LU Valid	Reserved	Logical Unit Number (B'000')		
7	SCSI Bus Address							
8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details.

  Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (in the example above, the range of Data Transfer Element addresses will include X'0101' , X'0102', and X'0103'). The ASC/ASCQ field of the Data Transfer Element Descriptor indicates if the associated drive is not present.

- **Access:**

  B'0' Indicates that access to the Data Transfer element by a Medium Transport Element is denied.
  B'1' Indicates that access to the Data Transfer element by a Medium Transport Element is allowed.

- **Except:** The following values apply:

  B'0' The element is in a normal state.
  B'1' The element is in an abnormal state.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element contains a cartridge in a loaded or ejected position.

Note: A cartridge in the loaded position is indicated by the Full bit set to B'1' and the Access bit set to B'0'. A cartridge in the ejected position is indicated by the Full bit set to B'1' and the Access bit set to B'1'.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  81/00 Status is Questionable (for example, the door is open)
  82/00 Drive is Not Present or is Unable to Communicate
  83/00 Medium in Drive (Unable to Access Bar Code Label)

- **Not Bus:** Not this bus. This bit is not supported.
- **ID Valid:** The following values apply:

  B'0' Indicates the SCSI Bus Address field is not valid.
  B'1' Indicates that the SCSI Bus Address field contains valid information.

- **LU Valid:** The following values apply:

  B'0' Indicates the Logical Unit Number field is not valid.
  B'1' Indicates that the Logical Unit Number field contains valid information.

- **Logical Unit Number:** The LUN is always 0.
- **SCSI Bus Address:** Set to the SCSI ID of the drive.
- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The UltraScalable Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (see “Element Status Page” on page 66). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 4: Data Transfer Element Descriptor (DVCID=B'1')

This is the element descriptor block used to report the device identifiers for the drive.

Table 49. Element Type 4: Data Transfer Element Descriptor (DVCID=B'1')

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved				Access (B'0')	Except (B'1')	Reserved	Full (B'0')
3	Reserved							
4-5	ASC/ASCQ							
6	Not Bus (B'0')	Reserved	ID Valid (B'0')	LU Valid (B'0')	Reserved	Logical Unit Number (B'000')		
7	SCSI Bus Address (X'00')							
8	Reserved							
9	SValid (B'0')	Invert (B'0')	Reserved					
10-11	Source Storage Element Address (X'0000')							
12-49	Identification Descriptor							

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. See Appendix C, "Locations and Addresses of SCSI Elements", on page 91 for additional details. The range is X'0101–0148'.

  Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (in the example above, the range of Data Transfer Element addresses will include X'0101' , X'0102', and X'0103'). The ASC/ASCQ field of the Data Transfer Element Descriptor indicates if the associated drive is not present.
- **Access:** Not supported when DVCID = B'1'.
- **Except:** Always set when DVCID = B'1'.
- **Full:** Not supported when DVCID = B'1'.
- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  8100 Status is Questionable, Drive is Present
  8200 Status is Questionable, Drive is Not Present

- **Not Bus:** Not this bus.
- **ID Valid:** Not supported when DVCID = B'1'.
- **LU Valid:** Not supported when DVCID = B'1'.
- **Logical Unit Number:** The LUN is always 0.
- **SCSI Bus Address:** Not supported when DVCID = B'1'.
- **SValid:** Not supported when DVCID = B'1'.

- **Identification Descriptor:** Indicates the following:
  - If no drive is present, all bytes are set to X'00'.
  - For LTO devices, these bytes are the same as reported by the drive in Inquiry Page X'83', specifically the Identification Descriptor with Identifier Type of X'1'.
  - For DLT devices, these bytes are defined as follows:

Table 50. Identification Descriptor for DLT Devices

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
12	Reserved				Code Set (X'2') (Identifier is all ASCII)			
13	Reserved		Association (B'00')		Identifier Type (X'0')			
14	Reserved							
15	Identifier Length (X'0A')							
16-25	Identifier (serial number from drive Inquiry Page X'80', in ASCII)							
26-49	Reserved							

Release Element (6) - X’17’

Table 51. Release Element (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'17')							
1	Logical Unit Number			3rdPty (B'0')	Third Party Device ID (B'000')			Element (B'0')
2	Reservation Identification (X'00')							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **3rdPty:** Third Party. This release is not supported by the UltraScalable Tape Library.
- **Third Party Device ID:** Not supported by the UltraScalable Tape Library.
- **Element:** Element reservation. Not supported by the UltraScalable Tape Library.
- **Reservation Identification:** Not supported by the UltraScalable Tape Library.

Request Sense - X'03'

The Request Sense command is supported by the UltraScalable Tape Library. Table 52 shows the command format.

Table 52. Request Sense Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'03')							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameter applies:

Allocation Length: The maximum number of bytes to be transferred. This device has up to 78 bytes of sense data. If the allocation length specified is less, then the allocated amount is transferred, the remaining sense data is lost, and no error is reported. If the allocated length specified is greater, then only up to 78 bytes of sense data are transferred and no error is reported.

Library Sense Data

The format of the sense data follows:

Table 53. Format of Library Sense Data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Valid (B'0')	Error Code (X'70')						
1	Segment Number (X'00')							
2	Filemark (B'0')	EOM (B'0')	ILI (B'0')	Reserved	Sense Key			
3-6	Information (X'0000 0000')							
7	Additional Sense Length (n-7)							
8-11	Command-Specific Information (X'0000 0000')							
12	ASC							
13	ASCQ							
14	Field Replaceable Unit Code (X'00')							
15-17	Sense Key Specific (see explanation that follows)							
18	Hardware Error Code							
19	Hardware Error Code Qualifier							
20-22	Reserved							
23	Mechanism Status Bit Map							
24	Control Path Frame/Device							
25	Failing Frame/Device							
26	TapeAlert Flag Number							
27	Retry Count							
28-29	Object Error Code							
30-34	Reserved							
35	Source Element Bit Map							
36-37	Source Element Address							
38	Destination Element Bit Map							
39-40	Destination Element Address							
41	Secondary Source Element Bit Map							
42-43	Secondary Source Element Address							
44	Second Destination Element Bit Map							
45-46	Second Destination Element Address							
47	Reserved							

- **Sense Key:** See Appendix A, “SCSI Error Sense”, on page 85.

- **Additional Sense Length:** When the Sense Key field is Recovered Error (1) or Hardware Error (4), the library reports a total of 78 bytes of sense data. For any other Sense Key, the library reports a total of 18 bytes of sense data. Supported values for this field are:

  X'0A' (10)
  X'46' (70)

- **Command-Specific Information:** The UltraScalable Tape Library does not support the commands associated with this field.
- **Additional Sense Code (ASC):** See Appendix A, “SCSI Error Sense”, on page 85.
- **Additional Sense Code Qualifier (ASCQ):** See Appendix A, “SCSI Error Sense” , on page 85.
- **Sense Key Specific:** Values vary, depending on the following conditions.
  – When the sense key field value is not Illegal Request, the SKSV bit is B'0' and bytes 15-17 are all set to X'00'.
  – When the sense key field value is Illegal Request and the SKSV bit is B'1', bytes 15-17 are interpreted as follows:

Table 54. Sense Key Specific Values

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
15	SKSV (B'1')	C/D	Reserved		BPV	Bit Pointer		
16-17	Field Pointer							

- **SKSV:** Sense key specific valid.
- **C/D:** Control/data

  B'0' Specifies that the error is in a data field of the parameter list.
  B'1' Specifies that the error is in a CDB field.

- **BPV:** Bit Pointer Valid.

  B'0' Specifies that the Bit Pointer Field is not valid.
  B'1' Specifies that the Bit Pointer Field is valid.

- **Bit Pointer:** When BPV is set to B'1', this field points to the bit in error of the field specified by the Field Pointer.
- **Field Pointer:** Points to the CDB byte or parameter byte in error.

When the Sense Key field value is Recovered Error (1) or Hardware Error (4), the library reports additional sense bytes 18 through 77. For additional information, see the *IBM TotalStorage UltraScalable Tape Library 3584 Maintenance Information* manual.

Request Volume Element Address - X'B5'

The Request Volume Element Address command transfers the results of a Send Volume Tag command. Multiple Request Volume Element Address commands may be used to retrieve the results of a single Send Volume Tag command with the translate option. Table 55 shows the command format.

Table 55. Request Volume Element Address Command

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation Code (X'B5')							
1	Reserved			Voltag	Element Type Code			
2-3	Element Address							
4-5	Number of Elements to Report							
6	Reserved							
7-9	Allocation Length							
10	Reserved							
11	Control							

The following UltraScalable Tape Library-specific behaviors apply:

Element Type Code shall act as a filter similar to (Minimum) Element Address, which, if the criteria are met, shall advance the most recent element address reported. Once information for a given element address has been reported, only higher element addresses will be reported by subsequent Request Volume Element Address commands (even if this means some Send Volume Tag element list matches are skipped and never reported). If the criteria are not met based on the Element Type Code or Element Address (and there are still element addresses to be reported), this command will respond with an empty volume element address header but the most recent element address reported will not be advanced and the element list will not be considered completely reported.

Table 56 shows the volume element address header format. For the format of the Element Status Pages, see "Read Element Status - X'B8'" on page 64.

Table 56. Volume Element Address Header

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements Reported							
4	Reserved			Send Action Code				
5-7	Byte Count of Report Available (all pages, x - 7)							
8-x	Element status page(s)							

If a Request Volume Element Address command is received and no prior Send Volume Tag command has been executed or the element list has been completely reported for the most recently successful Send Volume Tag command, the library will return command response data consisting of only the volume element address header with First Element Address Reported set to X'0000', Number of Elements Reported set to X'0000', and Byte Count of Report Available set to X'000000'.

Reserve Element (6) - X’16’

Table 57. Reserve Element (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'16')							
1	Logical Unit Number			3rdPty (B'0')	Third Party Device ID (B'000')			Element (B'0')
2	Reservation Identification (X'00')							
3-4	Element List Length (X'0000')							
5	Vendor Specific (B'00')		Reserved (B'0000'				Flag (B'0')	Link (B'0')

Note: When multiple logical libraries or control paths are configured (see “Library Sharing” on page 12), the library has multiple medium changer device ports (via LUN 1 of the drives for LTO Ultrium frames and via dedicated control ports for DLT frames). Medium changer device reservations only prevent access for those initiators using the same device port as the initiator that has sent the Reserve command. Initiators that use another device port (for example, for a different logical library or different control path) are not affected.

The following UltraScalable Tape Library-specific parameters apply:

- **3rdPty:** Third Party. Not supported by the UltraScalable Tape Library.
- **Third Party Device ID:** Not supported by the UltraScalable Tape Library.
- **Element:** Element reservation. Not supported by the UltraScalable Tape Library.
- **Reservation Identification:** Not supported by the UltraScalable Tape Library.
- **Element List Length:** Not supported by the UltraScalable Tape Library.

Send Diagnostic - X'1D'

The Send Diagnostic command is supported by the UltraScalable Tape Library. Send Diagnostic is used to execute the library's self-test diagnostics. Table 58 shows the command format.

Table 58. Send Diagnostic Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1D')							
1	Logical Unit Number			PF (B'0')	Reserved	SlfTst (B'1')	DevOfl (B'0')	UnitOfl (B'0')
2	Reserved							
3	Parameter List Length (X'0000')							
4								
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

Send Volume Tag - X'B6'

The Send Volume Tag command transfers a volume tag template to be used for a search of existing volume tag information. The Request Volume Element Address command may be used to transfer the results of a translate search operation. Table 59 shows the command format.

Table 59. Send Volume Tag Command

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation Code (X'B6')							
1	Reserved				Element Type Code			
2-3	Element Address							
4	Reserved							
5	Reserved			Send Action Code				
6-7	Reserved							
8-9	Parameter List Length							
10	Reserved							
11	Control							

The following UltraScalable Tape Library-specific behaviors apply:

- **Send Action Code**: The following values are the only supported values:

  X'4' Translate - search all defined tags - ignore sequence numbers

  X'5' Translate - search primary tags - ignore sequence numbers
- **Parameter List Length**: Must be X'20' or X'28', otherwise the command is presented CHECK CONDITION status with associated sense data of 5/2400 (Illegal Request, Invalid CDB).

Table 60 shows the Send Volume Tag Parameters Format.

Table 60. Send Volume Tag Parameters Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-31	Volume Identification Template							
32-33	Reserved							
34-35	Minimum Volume Sequence Number (ignored)							
36-37	Reserved							
38-39	Maximum Volume Sequence Number (ignored)							

The only UltraScalable Tape Library-specific behavior to apply is the **Volume Identification Template**, with the following special characters:

- '*' (X'2A') will match any string of characters. When it appears in a template, the remainder of the template at higher offsets is not used.
- '?' (X'3F'), blank character (X'20'), or null character (X'00') in a template will each be treated the same as an '*'.

Test Unit Ready - X’00’

The Test Unit Ready command is supported by the UltraScalable Tape Library. Table 61 shows the command format.

Table 61. Test Unit Ready Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'00')							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

Write Buffer - X'3B'

Table 62. Write Buffer Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'3B')							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID (X'00')							
3	Buffer Offset							
4								
5								
6	Parameter List Length							
7								
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following UltraScalable Tape Library-specific parameters apply:

- **Mode:** Supported modes are:

Mode 4	Download Microcode
Mode 5	Download Microcode and Save
Mode 6	Download Microcode With Offsets
Mode 7	Download Microcode With Offsets and Save

- **Buffer ID:** For microcode.
- **Buffer Offset:** The UltraScalable Tape Library defines the buffer offset field to be the address of the first location to be written by the current Write Buffer command.
- **Parameter List Length:** The number of bytes to be transferred.

Appendix A. SCSI Error Sense

This appendix lists all possible combinations of Sense Keys, Additional Sense Codes (ASC), and Additional Sense Code Qualifiers (ASCQ) that are reported by the UltraScalable Tape Library.

Sense Key 2 (Not Ready)

Table 63. ASC, and ASCQ Summary for Sense Key 2 (Not Ready)

ASC ASCQ	Description
04 00	Logical Unit Not Ready, Cause Not Reportable
04 01	Logical Unit Is in Process of Becoming Ready
04 03	Logical Unit Not Ready, Manual Intervention Required
04 83	Library has not been set up
04 84	I/O Station is open
04 85	Logical Unit Not Ready, Door is Open

Sense Key 4 (Hardware Error)

Table 64. ASC, and ASCQ Summary for Sense Key 4 (Hardware Error)

ASC ASCQ	Description
44 00	Internal Target Failure

Sense Key 5 (Illegal Request)

Table 65. ASC, and ASCQ Summary for Sense Key 5 (Illegal Request)

ASC ASCQ	Description
1A 00	Parameter List Length Error
20 00	Invalid Command Operation Code
21 01	Invalid Element Address
24 00	Invalid Field in CDB
25 00	Logical Unit Not Supported
26 00	Invalid Field in Parameter List
2C 00	Command Sequence Error
30 00	Incompatible Medium Installed
39 00	Saving Parameters Not Supported
3B 0D	Medium Destination Element Full
3B 0E	Medium Source Element Empty
3B 80	Medium Transport Element Full
3B 81	Element Not Accessible, Cartridge Present was Exported by Another Logical Library
3B 82	Element Not Accessible, Drive is Not Present
3D 00	Invalid Bits in Identify Message
53 02	Medium Removal Prevented

Sense Key 6 (Unit Attention)

Table 66. ASC, and ASCQ Summary for Sense Key 6 (Unit Attention)

ASC ASCQ	Description
28 00	Not Ready to Ready Transition, Medium May Have Changed
28 01	Import or Export Element Accessed
29 00	Power On, Reset, or Bus Device Reset Occurred
2A 01	Mode Parameters Changed
3F 01	Microcode Has Been Changed

Sense Key B (Aborted Command)

Table 67. ASC, and ASCQ Summary for Sense Key B (Aborted Command)

ASC ASCQ	Description
1B 00	Synchronous Data Transfer Error
43 00	Message Error
44 00	Internal Target Failure
45 00	Select or Reselect Failure
47 00	SCSI Parity Error
48 00	Initiator Detected Error Message Received
49 00	Invalid Message Error
4A 00	Command Phase Error
4B 00	Data Phase Error
4E 00	Overlapped Commands Attempted

Appendix B. Implementation Considerations

Default SCSI ID and Loop ID (AL_PA) Assignments

Based on its physical position in the frame, each tape drive and control port is assigned a default SCSI ID (from 0 to 13) or a default Loop ID (AL_PA). Table 68 lists the default SCSI IDs.

Table 68. Default SCSI ID for Each Drive or Control Port in the IBM TotalStorage UltraScalable Tape Library 3584

Device Position	SCSI ID
Row 0 (control port only)	13
Row 1	0
Row 2	1
Row 3	2
Row 4	3
Row 5	4
Row 6	5
Row 7	6
Row 8	8
Row 9	9
Row 10	10
Row 11	11
Row 12	12

Note: You can change the SCSI IDs or Loop IDs for the drives and control ports by using the SETTINGS menu option on the operator panel, or by using the UltraScalable Specialist web interface. To change the IDs, refer to the appropriate procedure in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.

Table 69 on page 88 lists the default Loop IDs (AL_PAs).

Table 69. Loop IDs and Their Associated AL_PAs for Ultrium 2 Tape Drives in the IBM TotalStorage UltraScalable Tape Library 3584

Drive	Frame 1		Frame 2		Frame 3		Frame 4		Frame 5		Frame 6	
	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA
Row 1	17	X'CC'	33	X'B1'	49	X'97'	65	X'71'	81	X'54'	97	X'39'
Row 2	18	X'CB'	34	X'AE'	50	X'90'	66	X'6E'	82	X'53'	98	X'36'
Row 3	19	X'CA'	35	X'AD'	51	X'8F'	67	X'6D'	83	X'52'	99	X'35'
Row 4	20	X'C9'	36	X'AC'	52	X'88'	68	X'6C'	84	X'51'	100	X'34'
Row 5	21	X'C7'	37	X'AB'	53	X'84'	69	X'6B'	85	X'4E'	101	X'33'
Row 6	22	X'C6'	38	X'AA'	54	X'82'	70	X'6A'	86	X'4D'	102	X'32'
Row 7	23	X'C5'	39	X'A9'	55	X'81'	71	X'69'	87	X'4C'	103	X'31'
Row 8	24	X'C3'	40	X'A7'	56	X'80'	72	X'67'	88	X'4B'	104	X'2E'
Row 9	25	X'BC'	41	X'A6'	57	X'7C'	73	X'66'	89	X'4A'	105	X'2D'
Row 10	26	X'BA'	42	X'A5'	58	X'7A'	74	X'65'	90	X'49'	106	X'2C'
Row 11	27	X'B9'	43	X'A3'	59	X'79'	75	X'63'	91	X'47'	107	X'2B'
Row 12	28	X'B6'	44	X'9F'	60	X'76'	76	X'5C'	92	X'46'	108	X'2A'
Note: Loop IDs are given in decimal format and AL_PA values are given in hexadecimal format.												

LUN Assignments for Ultrium Tape Drives

The logical unit number (LUN) for the Sequential Access device is always LUN 0 of the drive, and the LUN for the Medium Changer device is always LUN 1 (all other LUNs are invalid addresses). These devices are compatible with the SCSI-2 or SCSI-3 standard. For information about the SCSI commands for the tape drive and the library, see Chapter 2, “Library SCSI Commands”, on page 31 or the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*.

LUN Assignments for DLT 8000 Tape Systems and Control Ports

The logical unit number (LUN) for the Sequential Access device is always LUN 0 of the drive, and the LUN for the Medium Changer device is always LUN 0 of each control port (all other LUNs are invalid addresses). These devices are compatible with the SCSI-2 or SCSI-3 standard. For information about the SCSI commands for the tape drive and the library, see the *Quantum DLT 8000 Tape System Product Manual* or this manual.

Library Status During Automatic Cleaning

See “Drive Cleaning” on page 23 for an overview of the methods supported for cleaning a drive in the UltraScalable Tape Library.

The design of automatic cleaning is intended to make the cleaning process as transparent as possible to any host application using the library. The library performs the following steps during an automatic cleaning process:

1. Detect the need and opportunity to clean a drive
2. Move the cleaning cartridge from the storage cell to the drive
3. Wait for drive cleaning to complete (approximately 90 seconds for Ultrium 2 Tape Drives and up to 5 minutes for DLT 8000 Tape Systems)

While waiting for the drive cleaning to complete, the UltraScalable Tape Library (medium changer) will accept and process all SCSI commands except for a move to a drive that is cleaning. Any command to move a data cartridge to a drive that is being cleaned will be queued.

While an automatic cleaning is in progress, movement of the cleaning cartridge is not reflected in the element descriptors reported in response to a Read Element Status command. The Storage Element descriptor reported for the cleaning cartridge slot does not change while the cleaning cartridge is in a drive (indicates the FULL bit set to 1). Similarly, the Data Transfer Element descriptor reported for the drive that is cleaning does not change (indicates the FULL bit set to 0).

4. Move the cleaning cartridge from the drive to the storage cell
5. Increment the cleaning cartridge usage counter

   This counter is used by the library to determine when the cleaning cartridge should be replaced. When the usage counter has exceeded the recommended threshold, the library will display a warning message on the operator panel indicating the need to replace the cleaning cartridge.

Cleaning Cartridge Presence Indicators

The UltraScalable Tape Library can monitor up to 100 cleaning cartridges in the physical library for any supported method of cleaning (see “Drive Cleaning” on page 23). The presence of a library-monitored cleaning cartridge is indicated in the Storage Element descriptor of Read Element Status data as follows:

- EXCEPT bit is set to `1`
- FULL bit is set to `1`
- ASC/ASCQ field is set to `30/03`
- The first, second, and third characters of the Primary Volume Tag field, if available, are set to `CLN` in ASCII

In addition, when automatic cleaning is enabled, the ACCESS bit is set to `0`; when automatic cleaning is disabled, the ACCESS bit is set to `1`.

While an automatic cleaning is in progress, movement of the cleaning cartridge is not reflected in the element descriptors. The Storage Element descriptor reported for the cleaning cartridge slot does not change while the cleaning cartridge is in a drive. Similarly, the Data Transfer Element descriptor reported for the drive that is cleaning does not change (indicates the FULL bit set to `0`).

While a host cleaning is in progress, movement of the cleaning cartridge is reflected in the element descriptors in the same manner as for a data cartridge.

Automatic Cleaning Enabled Indicator

Automatic cleaning can only be enabled and disabled from the operator panel. The current setting may be detected by sending a SCSI Mode Sense command to the library (Medium Changer). Bit 2 of byte 2 in Mode Page 20 is set to `1` when automatic cleaning is enabled. This field may not be changed using Mode Select.

Note: The tape drive has no knowledge of the automatic cleaning setting and therefore, the drive does not suppress drive cleaning indicators when automatic cleaning is enabled (see “Drive Cleaning Indicators” on page 90). It is recommended that the host application log these notifications rather than present them to the operator when automatic cleaning is enabled.

Drive Cleaning Indicators

For stand-alone drive models, automatic cleaning of the drive is not possible. For library models, automatic cleaning of the drives by the library may be disabled (although it is not recommended). For either case, cleaning of the drives must be managed either by the host application, or manually by the operator.

Note: Failure to clean a drive may result in data loss.

For a description of how cleaning indicators are presented from the drive, see the applicable drive's SCSI command reference. The cleaning indicators may be presented even with automatic cleaning enabled in a library environment.

Appendix C. Locations and Addresses of SCSI Elements

In the IBM TotalStorage UltraScalable Tape Library 3584, each storage slot, I/O slot, and drive is assigned a logical SCSI element address by the library's firmware. When moving a tape cartridge within the library, you can specify its source and destination by SCSI element address (although many operators prefer to specify a VOLSER, or a frame, column, and row address).

For the following frames, this appendix shows the physical locations of storage slots and drives, and provides the rules for determining their SCSI element addresses (as well as the element addresses of the I/O slots).

- Model L32 (base frame) without the Capacity Expansion Feature
- Model L32 (base frame) with the Capacity Expansion Feature
- Model D32 (expansion frame)
- Model D42 (expansion frame)

Note: Element addresses vary, depending on the quantity of storage slots in the library. In turn, the quantity of storage slots depends on the quantity of drives in the library, whether the Capacity Expansion Feature is installed, and whether the Expanded I/O Station is included. As an aid in determining element addresses for each of the above frames, this appendix also includes tables that list the quantity of available storage slots, based on the preceding factors.

Location and Quantity of Addressable Storage Elements in Model L32 without Capacity Expansion Feature

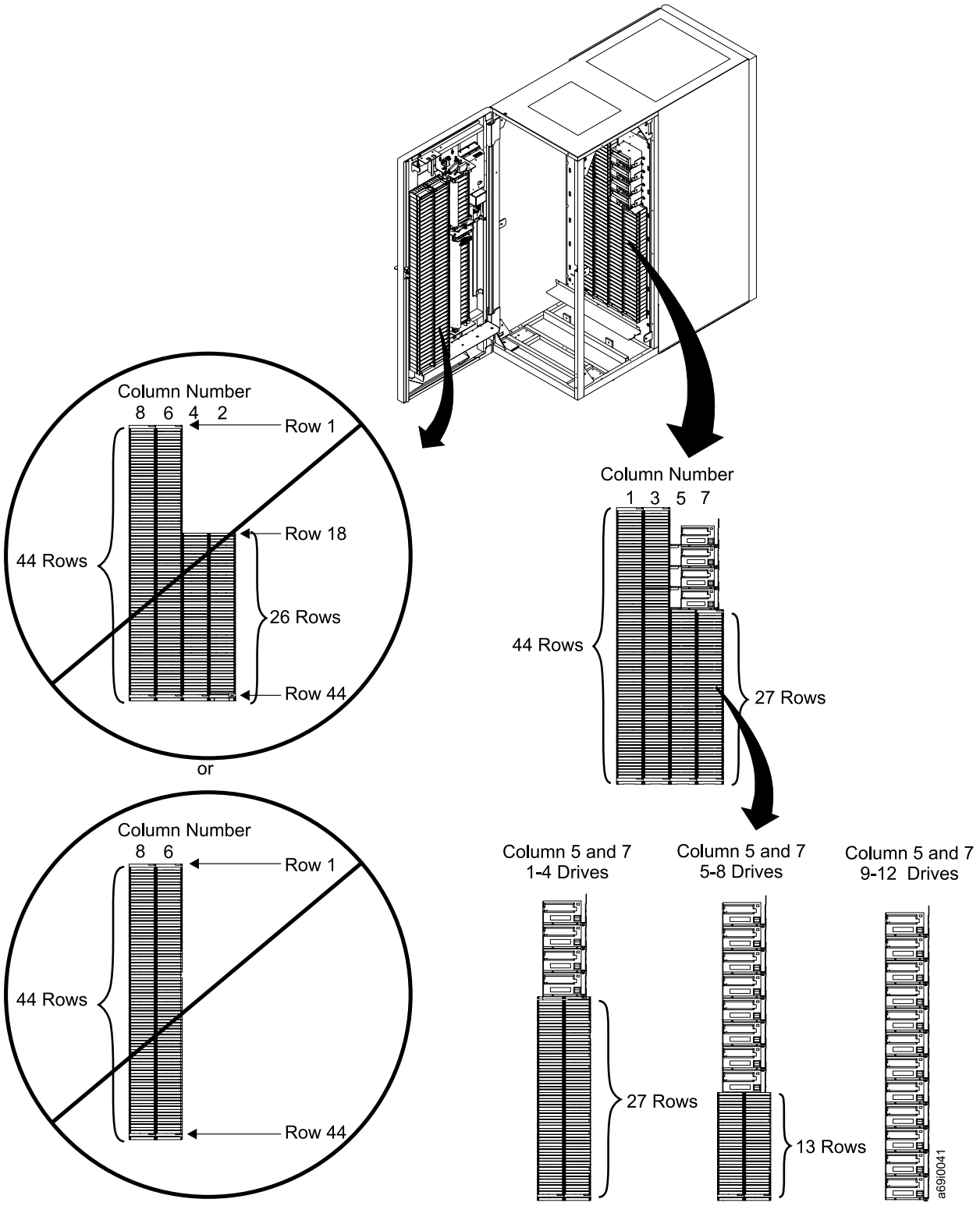

Figure 8. Location of storage elements in Model L32 without the capacity expansion feature. The storage slots on the door are unavailable.

Table 70. Quantity of SCSI-addressable storage slots (per column) in Model L32 frame without capacity expansion feature

Column Number	Quantity of Storage Slots in Model L32 Frame without Capacity Expansion Feature		
	1-4 Drives	**5-8 Drives**	**9-12 Drives**
1	43	43	43
2	0	0	0
3	44	44	44
4	0	0	0
5	27	13	0
6	0	0	0
7	27	13	0
8	0	0	0
Total	141	113	87
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Location and Quantity of Addressable Storage Elements in Model L32 with Capacity Expansion Feature

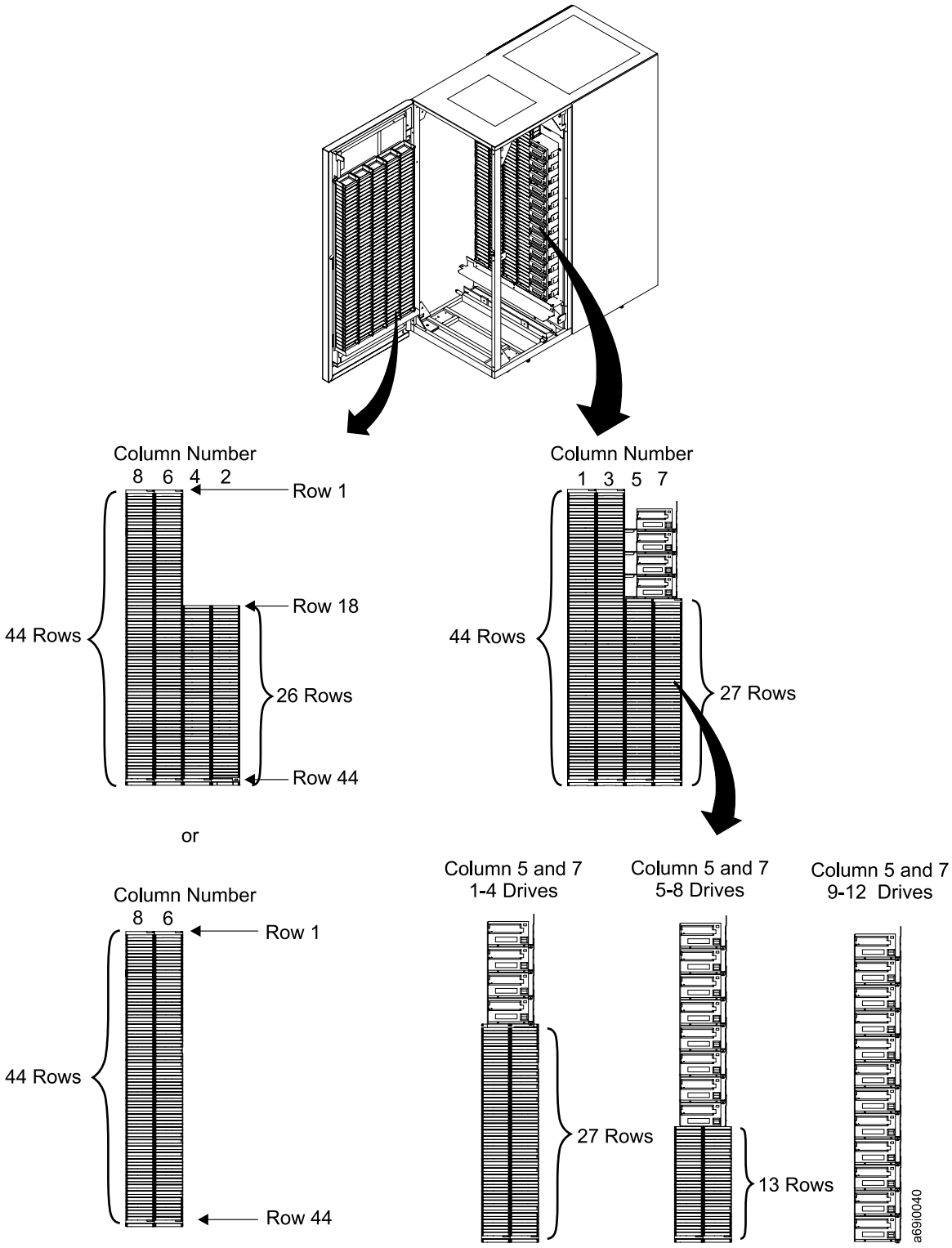

Figure 9. Location of storage elements in Model L32 with the capacity expansion feature. The storage slots on the door are available.

Table 71. Quantity of SCSI-addressable storage slots (per column) in Model L32 frame with capacity expansion feature and 10 I/O slots

Column Number	Quantity of Storage Slots in Model L32 Frame with Capacity Expansion Feature and 10 I/O Slots		
	1-4 Drives	5-8 Drives	9-12 Drives
1	43	43	43
2	26	26	26
3	44	44	44
4	26	26	26
5	27	13	0
6	44	44	44
7	27	13	0
8	44	44	44
Total	281	253	227
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Table 72. Quantity of SCSI-addressable storage slots (per column) in Model L32 frame with capacity expansion feature and 28 or 30 I/O slots

Column Number	Quantity of Storage Slots in Model L32 Frame with Capacity Expansion Feature and 28 or 30 I/O Slots		
	1-4 Drives	5-8 Drives	9-12 Drives
1	43	43	43
2	0	0	0
3	44	44	44
4	0	0	0
5	27	13	0
6	44	44	44
7	27	13	0
8	44	44	44
Total	229	201	175
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Location and Quantity of Addressable Storage Elements in Model D32

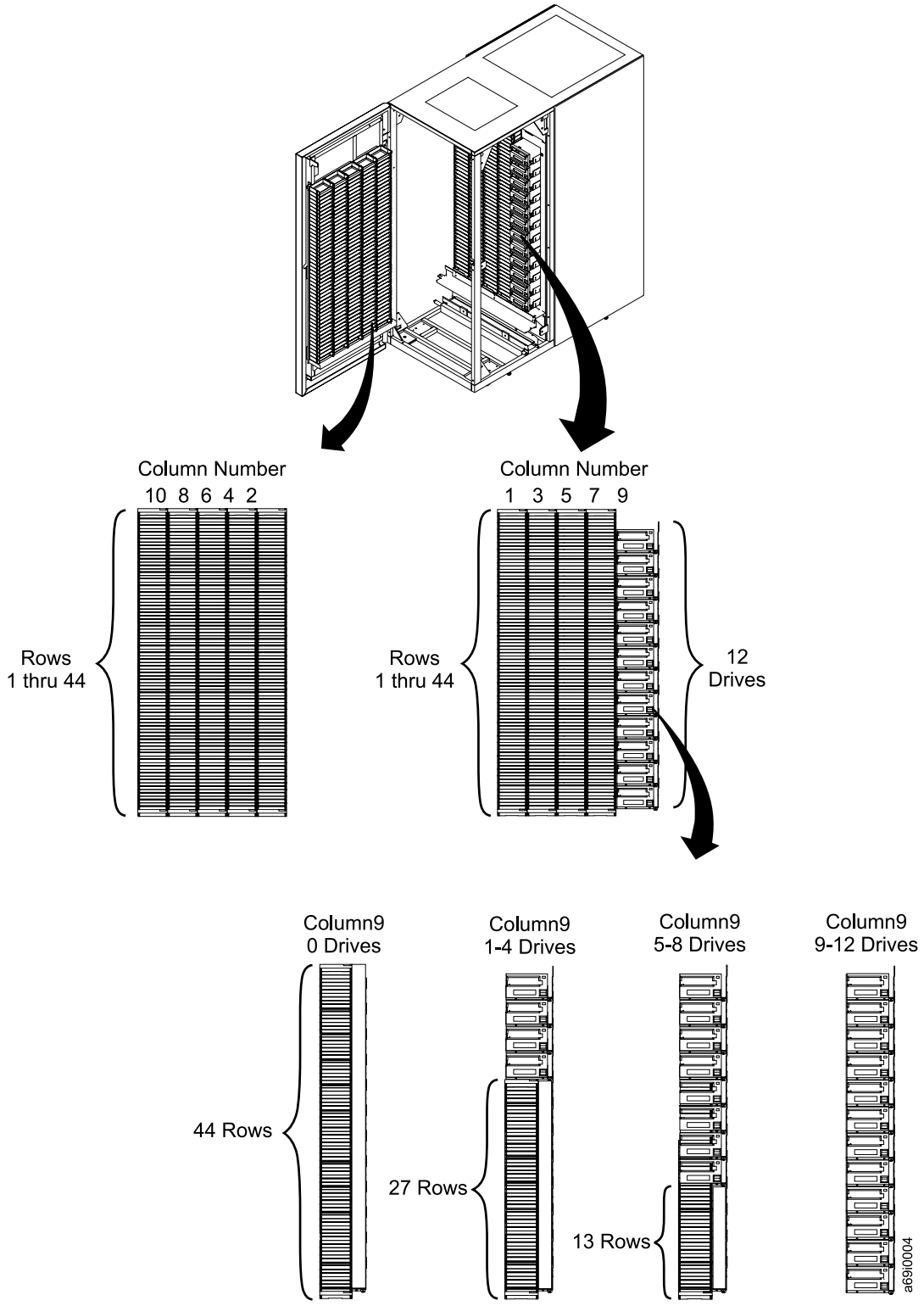

Figure 10. Location of storage elements in Model D32

Table 73. Quantity of SCSI-addressable storage slots (per column) in Model D32 frame

Column Number	Quantity of Storage Slots per Drives in Model D32 Frame			
	0 Drives	**1-4 Drives**	**5-8 Drives**	**9-12 Drives**
1	44	44	44	44
2	44	44	44	44
3	44	44	44	44
4	44	44	44	44
5	44	44	44	44
6	44	44	44	44
7	44	44	44	44
8	44	44	44	44
9	44	27	13	0
10	44	44	44	44
Total	440	423	409	396

Location of Storage Elements in Model D42

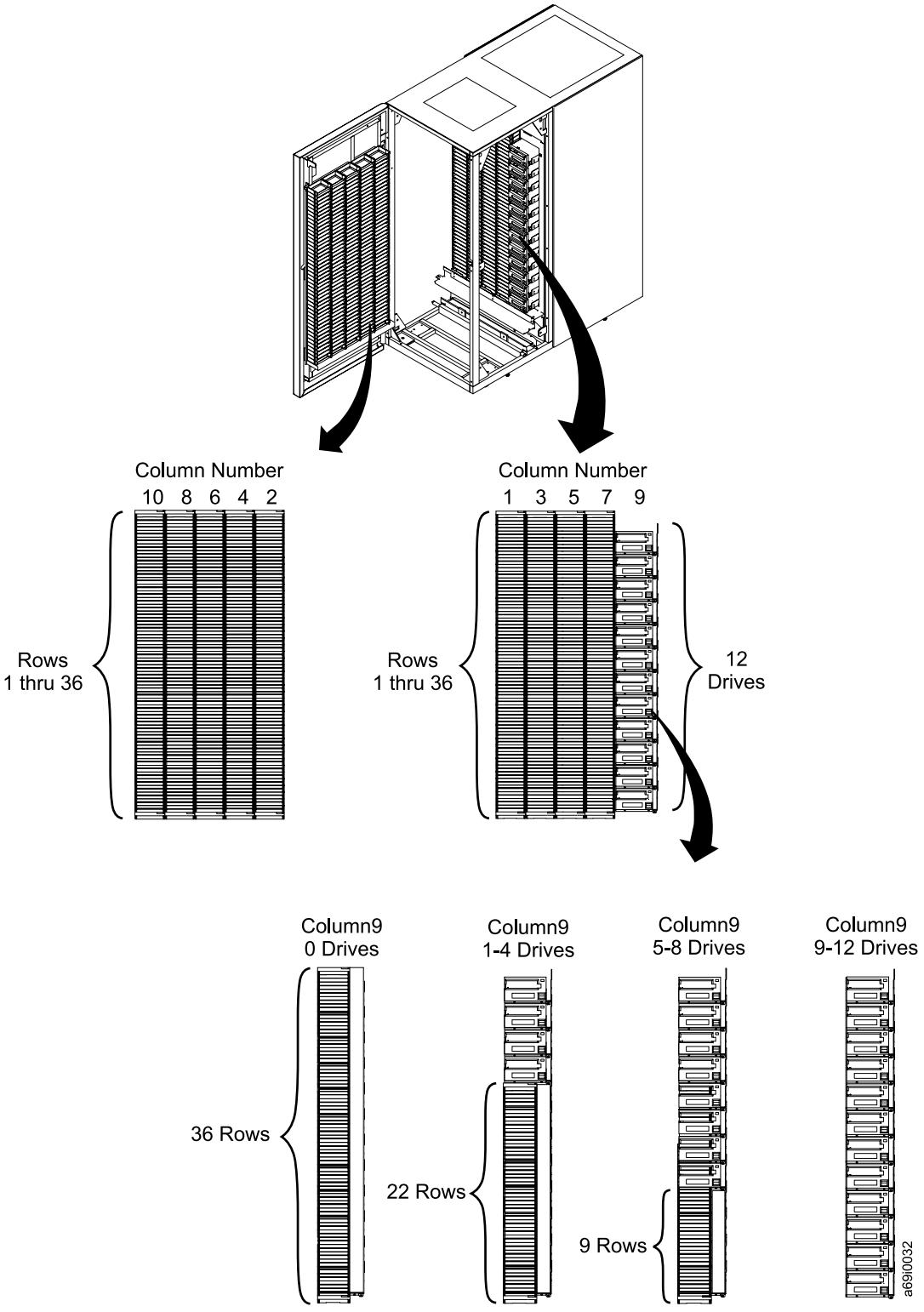

Figure 11. Storage elements in Model D42

Table 74. Quantity of SCSI-addressable storage slots (per column) in Model D42 frame

Column Number	Quantity of Storage Slots per Drives in Model D42 Frame			
	0 Drives	**1-4 Drives**	**5-8 Drives**	**9-12 Drives**
1 (see Note)	36	36	36	36
2	36	36	36	36
3	36	36	36	36
4	36	36	36	36
5	36	36	36	36
6	36	36	36	36
7	36	36	36	36
8	36	36	36	36
9	36	22	9	0
10	36	36	36	36
Total (see Note)	360	346	333	324

Note: For the first DLT frame in the library, Column 1, Rows 1 and 2 are reserved for diagnostic cartridges. In this case, the quantity of slots in Column 1 (and the totals) reduces by 2.

Determining SCSI Element Addresses

Apply the following rules when determining the SCSI element addresses of storage elements (storage slots), import/export elements (I/O slots), and data transfer elements (drives).

Storage Element Addresses for Storage Slots

The library assigns storage element (StE) addresses sequentially to all storage slots in each frame, regardless of media type. It uses the following scheme for addressing:

1. Begin with the Model L32 frame and assign the addresses from top to bottom, starting at Column 1, Row 1 with address 1024 (X'400').

   Note: Column 1, Row 1 of the first LTO frame is reserved for a diagnostic cartridge and is not addressable by the host application. Column 1, Rows 1 and 2 of the first DLT frame are reserved for diagnostic cartridges and are not addressable by the host application.
2. Move to Column 2 and continue the sequence from top to bottom, ignoring the I/O stations.
3. Continue to assign addresses in this manner (ignoring the I/O stations and drives) until each storage slot in the frame has been assigned a SCSI StE address.
4. If the library contains more than one frame, move right to the next frame and repeat this step (continuing with the next number in the sequence).

Figure 12 on page 101 shows one example of how the library assigns the SCSI storage element addresses.

Import/Export Element Addresses for I/O Slots

The library assigns import/export element (IEE) addresses sequentially to all I/O slots, from top to bottom, and regardless of media type, beginning at I/O slot 1 of the Model L32, with address 769 (X'301').

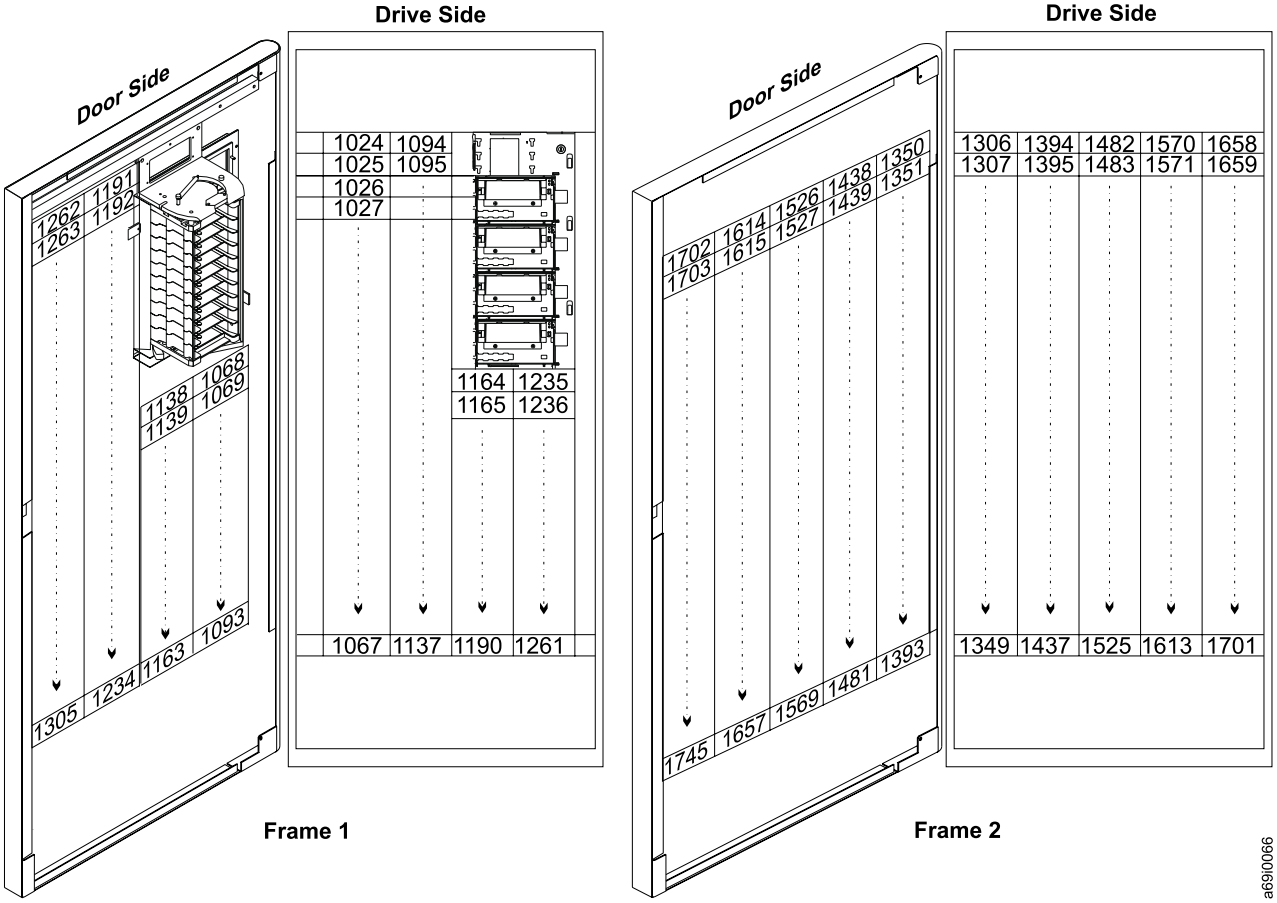

Figure 12. Assigning SCSI StE addresses to storage slots. The example shows two LTO frames, each with their front doors open. When assigning StE addresses, the library ignores the I/O stations and drives, and assigns the addresses to the slots beneath them.

Data Transfer Element Addresses for Drives

The library assigns data transfer element (DTE) addresses sequentially to all 12 possible drive positions in each frame, regardless of media type. It uses the following scheme for addressing:

1. Begin with the Model L32 frame and assign the addresses from top to bottom.
2. If the library contains more than one frame, move right to the next frame and continue the sequence from top to bottom.
3. Continue to assign addresses in this manner until each drive in every frame has been assigned a SCSI DTE address

Table 75 lists the SCSI addresses for the DTEs.

Table 75. SCSI Data Transfer Element (DTE) addresses for tape drives

SCSI DTE Addresses for Tape Drives						
	Frame 1	**Frame 2**	**Frame 3**	**Frame 4**	**Frame 5**	**Frame 6**
Row 1	257(X'101')	269(X'10D')	281(X'119')	293(X'125')	305(X'131')	317(X'13D')
Row 2	258(X'102')	270(X'10E')	282(X'11A')	294(X'126')	306(X'132')	318(X'13E')
Row 3	259(X'103')	271(X'10F')	283(X'11B')	295(X'127')	307(X'133')	319(X'13F')
Row 4	260(X'104')	272(X'110')	284(X'11C')	296(X'128')	308(X'134')	320(X'140')
Row 5	261(X'105')	273(X'111')	285(X'11D')	297(X'129')	309(X'135')	321(X'141')
Row 6	262(X'106')	274(X'112')	286(X'11E')	298(X'12A')	310(X'136')	322(X'142')
Row 7	263(X'107')	275(X'113')	287(X'11F')	299(X'12B')	311(X'137')	323(X'143')
Row 8	264(X'108')	276(X'114')	288(X'120')	300(X'12C')	312(X'138')	324(X'144')
Row 9	265(X'109')	277(X'115')	289(X'121')	301(X'12D')	313(X'139')	325(X'145')
Row 10	266(X'10A')	278(X'116')	290(X'122')	302(X'12E')	314(X'13A')	326(X'146')
Row 11	267(X'10B')	279(X'117')	291(X'123')	303(X'12F')	315(X'13B')	327(X'147')
Row 12	268(X'10C')	280(X'118')	292(X'124')	304(X'130')	316(X'13C')	328(X'148')
Note: Addresses are given in decimal and hexadecimal format.						

Appendix D. TapeAlert Flags

TapeAlert is a standard that defines status conditions and problems experienced by devices such as tape drives, autoloaders, and libraries. The standard enables a server to read TapeAlert messages (called *flags*) from a tape drive or library via SCSI commands. The server reads the flags from Log Sense Page 0x2E.

The IBM TotalStorage UltraScalable Tape Library 3584 is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the server.

TapeAlert flags that are supported by the Ultrium Tape Drives and the UltraScalable Tape Library generate SNMP traps; those that are supported by the DLT 8000 Tape System do not. Because library and drive firmware may change periodically, the SNMP interface in the library does not require code changes if devices add additional TapeAlerts that are not supported today. However, should this occur the MIB is written to minimize impact to the SNMP monitoring station. At the time of this writing, the TapeAlert flags in this appendix correctly represent TapeAlerts that will be sent. The MIB file should not be taken to mean that all traps that are defined in the MIB will be sent by the library or that they will be sent in the future.

This appendix lists TapeAlert flags that are supported by the Ultrium Tape Drives, the DLT 8000 Tape System, and the UltraScalable Tape Library.

TapeAlert Flags Supported by the Ultrium Tape Drives

TapeAlert Flags Supported by the Ultrium Tape Drives			
Flag Number	**Flag**	**Description**	**Action Required**
3	Hard error	Set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, or 6.)	See the Action Required column for Flag Number 4, 5, or 6 in this table.
4	Media	Set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.
5	Read failure	Set for any unrecoverable read error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 4 is also set, retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive. If Flag Number 4 is not also set, the problem could be caused by drive firmware or by a drive hardware failure. Contact your IBM Service Representative.

TapeAlert Flags Supported by the Ultrium Tape Drives			
Flag Number	**Flag**	**Description**	**Action Required**
6	Write failure	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape. Make sure that the write-protect switch is set so that data can be written to the tape. If Flag Number 4 is also set, retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive. If Flag Number 4 is not also set, the problem could be caused by drive firmware or by a drive hardware failure. Contact your IBM Service Representative.
8	Not data grade	Set when the cartridge is not data-grade. Any data that you write to the tape is at risk.	Replace the tape with a data-grade tape.
9	Write protect	Set when the tape drive detects that the tape cartridge is write protected.	Make sure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape (see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*).
10	No removal	Set when the tape drive receives an unload command after the host prevented the tape cartridge from being removed.	Refer to the documentation for your host operating system.
11	Cleaning media	Set when you load a cleaning cartridge into the drive.	No action required.
12	Unsupported format	Set when you load an unsupported cartridge type into the drive or when the cartridge format has been corrupted.	Use a supported tape cartridge.
14	Unrecoverable snapped tape	Set when the operation failed because the tape in the drive snapped.	Do not attempt to extract the old tape cartridge. Call the tape drive supplier help line.

TapeAlert Flags Supported by the Ultrium Tape Drives			
Flag Number	**Flag**	**Description**	**Action Required**
15	Cartridge memory chip failure	Set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	If Flag Number 4 is also set, the problem could be caused by defective media. Replace the cartridge. If Flag Number 4 is not also set, retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative.
16	Forced eject	Set when you manually unload the tape cartridge while the drive was reading or writing.	No action required.
18	Tape directory corrupted in the cartridge memory	Set when the drive detects that the tape directory in the cartridge memory has been corrupted.	Re-read data from the tape to rebuild the tape directory.
20	Clean now	Set when the tape drive detects that it needs cleaning.	Clean the tape drive.
21	Clean periodic	Set when the drive detects that it needs routine cleaning.	Clean the tape drive. See the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*.
22	Expired clean	Set when the tape drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge.
23	Invalid cleaning tape	Set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.
30	Hardware A	Set when a hardware failure occurs which requires that you reset the tape drive to recover.	Contact your IBM Service Representative.
31	Hardware B	Set when the tape drive fails its internal Power-On Self Test (POST).	Retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive.
32	Interface	Set when the tape drive detects a problem with the SCSI or RS-422 interface.	Contact your IBM Service Representative.
33	Eject media	Set when a failure occurs that requires you to unload the cartridge from the drive and discard it.	Unload the tape cartridge, then reinsert it and restart the operation.
34	Download fail	Set when an FMR image is unsuccessfully downloaded to the tape drive via the SCSI interface.	Download the FMR image again (ensure that it is the correct image).

TapeAlert Flags Supported by the Ultrium Tape Drives			
Flag Number	**Flag**	**Description**	**Action Required**
36	Drive temperature	Set when the drive temperature sensor indicates that the drive is too hot.	Ensure that the operating temperature is within the specified range (see the specifications in the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*). If the operating temperature is within the specified range, contact your IBM Service Representative to replace the tape drive.
37	Drive voltage	Set when the drive detects that the externally supplied voltages are outside of the specified voltage limits.	Contact your IBM Service Representative.
39	Diagnostics required	Set when the drive detects a failure that requires diagnostics for isolation.	Contact your IBM Service Representative.
51	Tape directory invalid at unload	Set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Use your backup software to rebuild the tape directory by reading all the data.
52	Tape system area write failure	Set when the tape cartridge that was previously unloaded could not write its system area successfully.	Copy the data to another tape cartridge, then discard the old cartridge.
53	Tape system area read failure	Set when the tape system area could not be read successfully at load time.	Copy the data to another tape cartridge, then discard the old cartridge.

TapeAlert Flags Supported by the DLT 8000 Tape System

TapeAlert Flags Supported by the DLT 8000 Tape System			
Flag Number	**Flag**	**Description**	**Action Required**
1	Read warning	Set when the tape drive has severe problems reading data from the tape. No data has been lost, but performance is reduced.	Perform one of the following: • If this flag occurs for multiple tape cartridges, contact your IBM Service Representative to replace the tape drive. • If this flag occurs for only one tape cartridge, the cartridge is defective. Copy any data from the tape and discard it.
2	Write warning	Set when the tape drive has severe problems writing data to the tape. No data has been lost.	Try the operation on a different tape cartridge: • If this flag occurs for multiple tape cartridges, contact your IBM Service Representative to replace the tape drive. • If this flag occurs for only one tape cartridge, the cartridge is defective. Copy any data from the tape and discard it.
3	Hard error	Set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, or 6.)	See the Action Required column for Flag Number 4, 5, or 6 in this table.
5	Read failure	Set for any unrecoverable read error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 4 is also set, retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive. If Flag Number 4 is not also set, the problem could be caused by drive firmware or by a drive hardware failure. Contact your IBM Service Representative.

TapeAlert Flags Supported by the DLT 8000 Tape System			
Flag Number	**Flag**	**Description**	**Action Required**
6	Write failure	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape. Make sure that the write-protect switch is set so that data can be written to the tape. If Flag Number 4 is also set, retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive. If Flag Number 4 is not also set, the problem could be caused by drive firmware or by a drive hardware failure. Contact your IBM Service Representative.
9	Write protect	Set when the tape drive detects that the tape cartridge is write protected.	Make sure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape (see the *IBM TotalStorage UltraScalable Tape Library 3584 Planning and Operator Guide*).
10	No removal	Set when the tape drive receives an unload command after the host prevented the tape cartridge from being removed.	Refer to the documentation for your host operating system.
11	Cleaning media	Set when you load a cleaning cartridge into the drive.	No action required.
20	Clean now	Set when the tape drive detects that it needs cleaning.	Clean the tape drive.
22	Expired cleaning media	Set when the tape drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge.
31	Hardware B	Set when the tape drive fails its internal Power-On Self Test (POST).	Retry the job using a different tape cartridge. If the retry was successful, the original tape cartridge is defective. Copy any data from the tape and discard it. If the retry was not successful, contact your IBM Service Representative to replace the tape drive.
32	Interface	Set when the tape drive detects a problem with the SCSI or RS-422 interface.	Contact your IBM Service Representative.
34	Download fail	Set when an FMR image is unsuccessfully downloaded to the tape drive via the SCSI interface.	Download the FMR image again (ensure that it is the correct image).

TapeAlert Flags Supported by the Library

TapeAlert Flags Supported by the UltraScalable Tape Library			
Flag Number	**Flag**	**Description**	**Action Required**
1	Library hardware A	The library has trouble communicating with the drive.	1. Restart the operation. 2. If the problem persists, call your IBM Service Representative.
2	Library hardware B	The library has a hardware failure.	1. Restart the operation. 2. If the problem persists, call your IBM Service Representative.
4	Library hardware D	The library has a hardware fault that is not mechanically related.	1. Restart the operation. 2. If the problem persists, call your IBM Service Representative.
11	Library voltage limits	A potential failure of a power supply exists.	Call your IBM Service Representative.
16	Library door	A library door is open and prevents the library from functioning.	1. Close the library door. 2. If the problem persists, call your IBM Service Representative.
17	Library I/O station	A problem with an I/O station exists.	1. Ensure that there is no obstruction in the I/O station. 2. Restart the operation. 3. If the problem persists, call your IBM Service Representative.
23	Library scan retry	The operation to scan the bar code on a cartridge had to perform an excessive number of retries before succeeding. A potential problem exists with the bar code label or the scanner hardware in the library mechanism.	1. Check for damaged, misaligned, or peeling bar code labels on cartridges. 2. If the problem persists, call your IBM Service Representative.
24	Library inventory	An inventory of the media was inconsistent.	1. Run a library inventory to correct the inconsistency. 2. Restart the operation. 3. If the problem persists, call your IBM Service Representative.
25	Library illegal operation	The library detected an illegal operation.	If the problem persists, call your IBM Service Representative.
28	Power supply	A redundant power supply failure exists inside the library.	Call your IBM Service Representative.
32	Unreadable bar code label	During an inventory or scan, the library was unable to read a bar code label on a cartridge.	1. Check for damaged, misaligned, or peeling bar code labels on the cartridge. 2. If no problem is found, call your IBM Service Representative.

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IBM TotalStorage UltraScalable Tape Library 3584

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Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication.

Numbers

2:1 compression. The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2:1 compression, twice as much data can be stored with compression as can be stored without compression.

A

accessor controller. The logic card for the cartridge accessor. The accessor controller handles accessor motion requests, including calibrations, moves, and inventory updates. It also provides centralized management for other aspects of the entire library, including configuration, insert and eject operations, automatic drive cleaning, and determination of element status.

Activity screen. The primary screen on the IBM TotalStorage UltraScalable Tape Library 3584's touchscreen. The Activity screen gives the level of firmware in the library, shows whether the library is online or offline, and tells the quantity of tape cartridges currently in the I/O stations. The screen also indicates the current activity being performed, the VOLSER of the cartridge associated with the activity, and a history of previous activities. The Activity screen leads to the Main Menu.

adapter. See *adapter card*.

adapter card. A circuit board that adds function to a computer.

aggregate sustained data transfer rate. For all of the drives in the IBM TotalStorage UltraScalable Tape Library 3584, the sum of their average throughput of uninterrupted data.

ANSI. American National Standards Institute.

archiving. The storage of backup files and associated journals, usually for a given period of time.

archiving application. The retention of records, in machine-readable form, for historical purposes.

argument. Any value of an independent variable.

ASC. Additional Sense Code.

ASCQ. Additional Sense Code Qualifier.

automatic cleaning. A method by which the IBM TotalStorage UltraScalable Tape Library 3584 automatically responds to any tape drive's request for cleaning by beginning the cleaning process. An operator enables or disables automatic cleaning by using the menus on the library's touchscreen or the UltraScalable Specialist web interface.

automatic inventory. A survey of the location of cartridges in the IBM TotalStorage UltraScalable Tape Library 3584. The library performs the survey at power-on or whenever the front door of any frame is opened during operation.

B

backup and recovery application. The short-term retention of records used for restoring essential business and system files when vital data has been lost because of program or system errors or malfunctions.

bar code. A code that represents characters by sets of parallel bars of varying thickness and separation. The bars are read optically by transverse scanning.

bar code label. A slip of paper bearing a bar code and having an adhesive backing. The bar code label must be affixed to a tape cartridge to enable the library to identify the cartridge and its volume serial number.

bar code reader. Located on the dual-gripper transport mechanism of the UltraScalable Tape Library, a laser device specialized for scanning and reading bar codes and converting them into either the ASCII or EBCDIC digital character code. The bar code reader reads the bar code on the labels of cartridges or at the rear of empty storage slots.

base frame. The primary unit of the IBM TotalStorage UltraScalable Tape Library 3584 (also known as Model L32). The base frame is distinguished from an expansion frame by its I/O stations and operator panel. The base frame includes a rail assembly for the cartridge accessor, and 12 tape drives.

beginning of tape (BOT). The location on a magnetic tape that indicates the beginning of the permissible recording area.

bit. Either of the digits 0 or 1 when used in the binary numbering system.

block. A collection of contiguous records recorded as a unit. Blocks are separated by interblock gaps, and each block may contain one or more records.

BOT. Beginning of tape.

bpi. Bits per inch.

BPI. Bytes per inch.

browser. A client program that initiates requests to a web server and displays the information that the server returns.

buffer. A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another.

buffered mode. The buffered mode allows a number of logical blocks to accumulate in the control unit buffer before the data is transferred to the device or channel. This mode is suppressed automatically, if the record exceeds the maximum buffered capacity.

bus. See *SCSI bus*.

byte. A string consisting of a certain number of bits (usually 8) that are treated as a unit and represent a character. A byte is a fundamental data unit.

C

calibration. Adjustment, tuning.

Call Home. A feature that allows the IBM TotalStorage UltraScalable Tape Library 3584 to report failures to a support center by using a modem.

capacity. See *media capacity*.

capacity. The amount of data that can be contained on storage media and expressed in bytes of data.

Capacity Expansion Feature. Applicable only to the base frame (Model L32) of the UltraScalable Tape Library, the cartridge storage slots that are located on the interior of the front door and enabled for additional storage. The Capacity Expansion Feature increases the maximum quantity of storage slots in the base frame.

cartridge. See *tape cartridge*.

cartridge accessor. The mechanism in the IBM TotalStorage UltraScalable Tape Library 3584 that moves cartridges between the storage slots, tape drives, and the I/O stations. The accessor includes the X-axis motion assembly, Y-axis motion assembly, pivot assembly, cartridge gripper, bar code reader, and calibration sensor.

cartridge gripper. An electromechanical device on the cartridge accessor of the UltraScalable Tape Library that gets or puts cartridges from or to a storage slot, tape drive, or I/O station. Two grippers (Gripper 1 and Gripper 2) are located on the pivot assembly of the accessor. One gripper can grip a single cartridge.

cartridge inventory time. The amount of time required for the IBM TotalStorage UltraScalable Tape Library 3584 to determine whether each cartridge storage slot in the library is empty or full.

cartridge move time. The time required for a cartridge accessor to pick a cartridge from a slot (or drive), move the cartridge to a drive (or slot), pivot (if required), and insert the cartridge into the drive (or slot).

cartridge storage slot. One of several containers that are mounted inside the frames of the IBM TotalStorage UltraScalable Tape Library 3584 and are used to store tape cartridges.

CDB. Command description block.

circuit board. A thin plate on which chips and other electronic components are placed. Computers consist of one or more boards, often called cards or adapters.

cleaning cartridge. A tape cartridge that is used to clean the heads of a tape drive. Contrast with *data cartridge*.

command. A control signal that initiates an action or the beginning of a sequence of actions.

compression. The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

configure. To describe to a system the devices, optional features, and programs installed on the system.

controller. A device that coordinates and controls the operation of one or more input/output devices (such as sensors and actuators), and synchronizes the operation of such devices with the operation of the system as a whole.

control path. (1) Designated by the operator of the IBM TotalStorage UltraScalable Tape Library 3584, a logical path into the library through which a server sends standard SCSI Medium Changer commands to control a specific logical library. (2) A tape drive that is designated by the operator of the IBM TotalStorage UltraScalable Tape Library 3584 to manage communication to and from a server and the library.

D

data. Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

data base. A set of data, consisting of at least one file, that is sufficient for a given purpose or for a given data-processing system.

data transfer element (DTE). In SCSI terms, a tape drive.

data transfer rate. The average number of bits, characters, or blocks per unit of time that pass between

corresponding equipment in a data transmission system. The rate is expressed in bits, characters, or blocks per second, minute, or hour.

device. Any hardware component or peripheral, such as a tape drive or tape library, that can receive and send data.

device driver. A file that contains the code needed to use an attached device.

diagnostic cartridge. A tape cartridge that enables the detection and isolation of errors in programs and faults in equipment.

differential. See *High Voltage Differential*.

DLT 8000 Tape System. Located within the IBM TotalStorage UltraScalable Tape Library 3584, a high-performance, high-capacity streaming cartridge tape product designed for efficient back-up for mid-range and high-end computing systems. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 40 GB; with 2:1 compression, its capacity is 80 GB.

drive. See *IBM Ultrium Tape Drive* or *DLT 8000 Tape System*.

drive head. The component that records an electrical signal onto magnetic tape, or reads a signal from tape into an electrical signal.

DTE. See *data transfer element*.

dual-gripper transport mechanism. Located on the cartridge accessor of the IBM TotalStorage UltraScalable Tape Library 3584 and mounted on the pivot assembly, the device that contains the two grippers which get and put cartridges into storage slots, drives, or the I/O stations.

dump. To write the contents of storage, or of a part of storage, usually from an internal storage to a external medium, for a specific purpose such as to allow other use of storage, as a safeguard against faults or errors, or in connection with debugging.

E

eject. To remove or force out from within.

electronic mail. Correspondence in the form of messages transmitted between user terminals over a computer network.

e-mail. See *electronic mail*.

ERA. Error-recovery action performed by the host.

ERP. See *error-recovery procedures*.

error-recovery procedures (ERP). Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used with programs that record the statistics of machine malfunctions.

Ethernet. A 100-Mbps baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and delayed retransmission.

Expanded I/O Station. On the front door of the IBM TotalStorage UltraScalable Tape Library 3584, the lower compartment into which you insert and remove cartridges into and from the library. The station can contain 20 slots for LTO Ultrium Tape Cartridges or 18 slots for DLT Tape Cartridges. Both stations are accessed by the cartridge accessor.

expansion frame. A unit that may be added to the base frame of the IBM TotalStorage UltraScalable Tape Library 3584UltraScalable Tape Library. Also known as the Model D32 or D42, the expansion frame includes a rail assembly for the cartridge accessor and up to 12 tape drives.

F

FCB. Frame control box.

fetch rate. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, a measure of the overall capability of the cartridge accessor without tape drive involvement. It is defined as the number of cartridges that the tape library can fetch in one hour. A fetch involves moving the cartridge from an I/O slot to a random storage slot or returning it from that storage slot to the I/O slot. Each move is considered a fetch.

Fibre Channel. A 200-MB-per-second, full-duplex, serial communications technology that is capable of interconnecting Ultrium Tape Drives and servers which are separated by as much as 11 kilometers (7 miles). Fibre Channel technology combines features of the input/output (I/O) and networking interfaces.

file. A named set of records stored or processed as a unit.

file transfer protocol (FTP). In the Internet suite of protocols, an application layer protocol that uses TCP and Telnet services to transfer bulk-data files between machines or hosts.

firmware. Proprietary code that is usually delivered as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and is more adaptable to change than pure hardware circuitry.

An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC motherboard.

frame. (1) In Fibre Channel technology, a unit of transmission that includes delimiters, control characters, information, and checking characters. (2) See *library frame*.

frame control assembly. A group of parts that consist of a frame control box (FCB), one or two 37 V power supplies for the cartridge accessor, operator panel, and I/O stations, and an MCC card pack that runs the firmware that controls the AC and DC power distribution in the UltraScalable Tape Library. The assembly also provides an RS-422 communication port to each tape drive in a frame. The FCB contains 3 circuit protectors, 10 AC outlets for powering the tape drives and all other components in that frame, and a receptacle for the incoming main AC power.

front door. Located at the front of each frame in the IBM TotalStorage UltraScalable Tape Library 3584, the swinging barrier by which entry is closed or opened to the frame.

FTP site. Any electronic repository of information that uses the File Transfer Protocol (FTP) for transferring files to and from servers. Use of an FTP site requires a user ID and possibly a password.

full duplex. Simultaneous transmission and reception of data between two nodes of a network.

G

GB. See *gigabyte*.

get. In library operation, the act of a cartridge gripper retrieving a tape cartridge from a storage slot, drive, or I/O station.

gigabyte (GB). 1 000 000 000 bytes.

H

head. See *drive head*.

heterogeneous. Of unlike kind.

hex, hexadecimal. (1) Pertaining to a selection, choice, or condition that has 16 possible different values or states. (2) Pertaining to a fixed-radix numeration system, with radix of 16. (3) Pertaining to a system of numbers to the base 16; hexadecimal digits range from 0 through 9 and A through F, where A represents 10 and F represents 15.

High Voltage Differential (HVD). A logic signaling system that enables data communication between a supported server and the IBM TotalStorage UltraScalable Tape Library 3584. HVD signaling uses a paired plus and minus signal level to reduce the effects of noise on the SCSI bus. Any noise injected into the signal is present in both a plus and minus state, and is thereby canceled. Synonymous with *differential*.

homogeneous. Of the same kind.

host. The controlling or highest-level system in a data communication configuration. Synonymous with *server*.

host cleaning. A method that enables the host (server) to detect the need to clean a tape drive and to control the cleaning process. Host cleaning with a cleaning cartridge is only supported when automatic cleaning is disabled, and only for the logical library in which each cleaning cartridge is stored.

hub. A communications device to which nodes on a multi-point bus or loop are physically connected. Hubs are commonly used in Fibre Channel networks to improve the manageability of physical cables. They maintain the logical loop topology of the network of which they are a part, while creating a “hub and spoke” physical star layout. Unlike switches, hubs do not aggregate bandwidth. They typically support the addition or removal of nodes from the bus while it is operating.

HVD. See *High Voltage Differential*.

I

IBM TotalStorage UltraScalable Tape Library 3584. A device that can be attached to a supported server and used to write data to and from magnetic tape. The IBM TotalStorage UltraScalable Tape Library 3584 can include up to 6 frames and 72 drives, and any combination of IBM TotalStorage LTO Ultrium 2 Tape Drives and Ultrium 1 Tape Drives in Ultrium frames.

IBM TotalStorage LTO Ultrium 2 Tape Drive. A data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 200 GB per cartridge; with 2:1 compression, its capacity is up to 400 GB.

IBM Ultrium 1 Tape Drive. Located within the UltraScalable Tape Library, a data-storage device that controls the movement of the magnetic tape in IBM LTO Ultrium Tape Cartridges. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 100 GB per cartridge; with 2:1 compression, its capacity is up to 200 GB. The drive is also known as the IBM Ultrium Internal Tape Drive.

ID. Identifier.

IEE. See *import/export element*.

import/export element (IEE). In SCSI terms, an I/O slot.

initiator. In SCSI terms, a SCSI device that requests an I/O process to be performed by another SCSI device (a target). In many cases, an initiator can also be a target.

input/output (I/O) station. On the front door of the IBM TotalStorage UltraScalable Tape Library 3584, one or two compartments into which you insert and remove cartridges into and from the library. The upper I/O station contains 10 slots for LTO Ultrium Tape Cartridges; the lower I/O station (also called the *Expanded I/O Station*) can contain 20 slots for LTO Ultrium Tape Cartridges or 18 slots for DLT Tape Cartridges. Both stations are accessed by the cartridge accessor.

insert. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, a term used to describe the act of putting a tape cartridge into an I/O station.

install. (1) To set up for use or service. (2) The act of adding a product, feature, or function to a system or device either by a singular change or by the addition of multiple components or devices.

Internet. The worldwide collection of interconnected networks that use the Internet suite of protocols and permit public access.

interposer. An adapter-like device that allows a connector of one size and style to connect to a mating connector of a different size and style.

inventory. (1) A survey of tape cartridges in the library and frames. (2) To make an inventory of.

I/O station. See *input/output station*.

L

label. See *bar code label*.

LAN. See *local area network*.

LCD. See *liquid crystal display*.

library frame. The basic unit of the IBM TotalStorage UltraScalable Tape Library 3584. The frame includes the hardware support structure, covers, mechanisms, and parts. Two types of frames are available: base frame (Model L32) and expansion frame (Models D32 and D42).

library power switch. Located on the front of the IBM TotalStorage UltraScalable Tape Library 3584, a toggle switch that enables you to turn the power to the library on and off.

Linear Tape-Open (LTO). A type of tape storage technology developed by the IBM Corporation, Hewlett-Packard, and Seagate. LTO technology is an "open format" technology, which means that its users have multiple sources of product and media. The "open" nature of LTO technology enables compatibility between different vendors' offerings by ensuring that vendors comply with verification standards. The LTO technology is implemented in two formats: the Accelis format focuses on fast access; the Ultrium format focuses on high capacity. The Ultrium format is the preferred format when capacity (rather than fast access) is the key storage consideration. An Ultrium 2 cartridge has a compressed data capacity of up to 400 GB (at 2:1 compression) and a native data capacity of up to 200 GB. The Ultrium format is designed with a four-generation road map that provides for up to 1.6 TB per cartridge (2:1 compression) in Generation 4 and a compressed transfer rate of up to 320 MB per second.

liquid crystal display (LCD). A low-power display technology used in computers and other I/O devices.

load. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584 and following the insertion of a tape cartridge into a cartridge storage slot, the act (performed by the cartridge accessor) of transferring the cartridge from the storage slot to the drive and of positioning the tape (performed by the tape drive) for reading or writing by the drive head.

load-to-ready time. After a cartridge has been inserted into a drive, the amount of time between when the drive threads the tape and when the drive becomes ready to accept server commands.

local area network (LAN). (1) A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. (2) A network in which a set of devices is connected to other sets of devices for communication and that can be connected to a larger network.

logical library. A set of cartridge storage slots and tape drives that are defined as a library by an operator. The operator identifies the slots and drives to the IBM TotalStorage UltraScalable Tape Library 3584 by their location or count. The UltraScalable Tape Library's ability to create logical libraries makes it possible for similar and dissimilar hosts (servers) to share its robotics. As a result, hosts can simultaneously run separate applications in separate logical libraries.

logical library bar code label. A specially coded label that can be affixed to the tops of storage slot columns and drives inside the IBM TotalStorage UltraScalable Tape Library 3584. The tape library reads the labels and uses them to establish the boundaries of one or more logical libraries.

logical unit number (LUN). A number associated with the target address of a drive. The server uses the number to identify the address of the drive.

Low Voltage Differential (LVD). A low-noise, low-power, and low-amplitude electrical signaling system that enables data communication between a supported server and the IBM TotalStorage UltraScalable Tape Library 3584. LVD signaling uses two wires to drive one signal over copper wire. The use of wire pairs reduces electrical noise and crosstalk.

LSB. Least significant bit.

LTO. See *Linear Tape-Open*.

LTO cartridge memory (LTO-CM). Within each LTO Ultrium Data Cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.

LTO-CM. See *LTO cartridge memory*.

LUN. See *logical unit number*.

LVD. See *Low Voltage Differential*.

M

m. Meter.

magnetic tape. A tape with a magnetizable surface layer on which data can be stored by magnetic recording.

manual cleaning. A method by which an operator selects a menu option from the IBM TotalStorage UltraScalable Tape Library 3584's touchscreen or IBM TotalStorage UltraScalable Tape Library Specialist web interface to perform cleaning on one or more of its tape drives.

MB. See *megabyte*.

Mbps. Megabits per second.

media. The plural of *medium*.

media capacity. See *capacity*.

Medium Changer card pack (MCP). In the IBM TotalStorage UltraScalable Tape Library 3584, a circuit board that provides a communication path to each tape drive (via the RS-422 interface) so that library commands can be funneled from the tape drives to the accessor. It includes one RS-422 interface allotted for each drive in the frame and two Controller Area Network (CAN) ports (one for each CAN bus that can be installed in the library). It also provides management and service interfaces to outside servers. For each library frame that contains at least one drive, there is one MCP. The electronics of the card pack are located in the FCB.

megabyte (MB). 1 000 000 bytes.

meter. In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

mid-range systems. A set of multi-user servers with a hard disk capacity of between 50 GB and 250 GB.

mixed media. The concept of using both LTO Ultrium Tape Cartridges and DLT Tape Cartridges in the IBM TotalStorage UltraScalable Tape Library 3584. A library can consist of frames that house all LTO Ultrium Tape Cartridges or all DLT Tape Cartridges, but the two types of cartridges cannot be mixed in a single frame. However, both types of cartridges may be inserted or removed from the library through the base frame, provided that a lower, 18-slot I/O station is installed for the DLT Tape Cartridges.

mount. The act of making a tape available for processing by a specific tape device. A mount consists of removing the cartridge from a drive, returning it to its storage slot, collecting another cartridge from a storage slot, moving it to the drive, and loading it into the drive.

mount/demount cycle. See *mount*.

mounted. The state of a tape while it is available for processing by a specific tape device.

mount throughput. The number of cartridges that a tape library can mount in a one-hour period.

MSB. Most significant bit.

N

native data capacity. The amount of data that can be stored without compression on a tape cartridge.

network. A configuration of data processing devices and software connected for information interchange.

network server. In a local area network, a personal computer that provides access to files for all of the workstations in the network.

nominal. Approximate.

non-volatile memory. Types of memory that retain their contents when the power is turned off. ROM is nonvolatile, whereas RAM is volatile.

O

operating system. The master computer control program that translates the user's commands and allows software application programs to interact with the computer's hardware.

operator panel. A functional unit that contains buttons to control the tape library. The unit's LCD touchscreen

provides information about the operation of the IBM TotalStorage UltraScalable Tape Library 3584, and one or two I/O stations for inserting and removing cartridges.

P

partition. A fixed-size division of storage.

patch panel. Located at the rear of a UltraScalable Tape Library's base or expansion frame, an optional unit that houses the fiber cable connections between the servers and the individual drives.

PDF. See *Portable Document Format*.

port. (1) A system or network access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. (3) The representation of a physical connection to the link hardware. A port is sometimes referred to as an adapter; however, there can be more than one port on an adapter.

Portable Document Format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact, can be distributed globally (via e-mail, the web, intranets, or CD-ROM), and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

power-off, powered-off. (1) To remove electrical power from a device. (2) The state of a device when power has been removed from it.

power-on, powered-on. (1) To apply electrical power to a device. (2) The state of a device when power has been applied to it.

power-on indicator. Located beside the library power switch on the operator panel, a green light that, when lit, indicates that DC power is available within the IBM TotalStorage UltraScalable Tape Library 3584.

power switch. See *library power switch*.

Q

quiesce. To bring a device or system to a halt by a rejection of new requests for work.

R

rail system. Within the IBM TotalStorage UltraScalable Tape Library 3584, the support structure over which the cartridge accessor moves.

read. To acquire or interpret data from a storage device, from a data medium, or from another source.

remote support. See *Call Home*.

remove. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, a term used to describe the act of taking a tape cartridge out of an I/O station.

repeater. A device that regenerates signals to extend the range of transmission between data stations or to interconnect two branches. A repeater is a node of a local area network.

robotics. The cartridge accessor and any associated mechanisms that move a tape cartridge within the IBM TotalStorage UltraScalable Tape Library 3584.

RS-422 interface. An electrical interface standard approved by the Electronic Industries Association (EIA) for connecting serial devices. The RS-422 standard, which supports higher data rates and greater immunity to electrical interference, is an alternative to the older RS-232 interface and uses individual differential signal pairs for data transmission. Depending on data transmission rates, RS-422 can be used at distances to 1,275 m (4,000 ft). The RS-422 interface also supports multi-point connections.

S

SAN. See *Storage Area Network*.

scalable. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, capable of being expanded by adding up to five expansion (Model D32 or Model D42) frames. A scalable library may be used by multiple servers, but does not share cartridges and drives among them. Contrast with *ultrascalable*.

SCSI. See *Small Computer Systems Interface*.

SCSI-2. A variation of the SCSI interface. See *Small Computer Systems Interface*.

SCSI address. See *SCSI ID*.

SCSI device. Anything that can connect into the SCSI bus and actively participate in bus activity.

SCSI element address. A value that defines a logical location in the IBM TotalStorage UltraScalable Tape Library 3584 to the SCSI interface. This logical address is represented on the operator panel or UltraScalable Specialistweb interface as xxxx(yyyh), where xxxx is a decimal value and yyyh is a hexadecimal value. It is assigned and used by the server when the server processes SCSI commands. The SCSI element address is not unique to a storage slot, drive, or I/O slot; it varies, depending on the quantity of drives in the library, whether the Capacity Expansion feature is installed, and whether an Expanded I/O Station is included.

SCSI ID. The hexadecimal representation of the unique address (0-F) assigned to a SCSI device. This

identifier would normally be assigned and set in the SCSI device during system installation.

search time. The average time it takes for a tape drive to locate the starting point of a block of data.

sequential access. The processing of information on a tape cartridge in a manner that requires the device to access consecutive storage locations (logical blocks) on the medium.

Sequential Access Device. In SCSI terms, a tape drive.

serial number. See *volume serial number*.

server. A functional unit that provides services to one or more clients over a network. Examples include a file server, a print server, and a mail server. The IBM @server pSeries, IBM @server iSeries, HP, and Sun are servers. Synonymous with *host*.

Small Computer Systems Interface (SCSI). A standard used by computer manufacturers for attaching peripheral devices (such as tape drives, hard disks, CD-ROM players, printers, and scanners) to computers (servers). Pronounced ″scuzzy.″ Variations of the SCSI interface provide for faster data transmission rates than standard serial and parallel ports (up to 320 megabytes per second). The variations include:

- Fast/Wide SCSI: Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1: Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2: Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra SCSI: Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI: Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra160 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra320 SCSI: Uses a 16-bit bus and supports data rates of 160 or 320 MBps.

special feature. A specific design addition to an IBM product that is quoted in the IBM Sales Manual and ordered separately.

stand-alone. Pertaining to operation that is independent of any other device, program, or system.

StE. See *storage element*.

Storage Area Network (SAN). A high-speed subnetwork of shared storage devices. A SAN's architecture makes all storage devices available to all servers on a LAN or WAN. As more storage devices are added to a SAN, they too will be accessible from any server in the larger network. Because stored data does not reside directly on any of a network's servers, server power is used for business applications, and network capacity is released to the end user.

storage element (StE). In SCSI terms, a cartridge storage slot.

Specialist web interface. A platform-independent, web-based interface that allows a user to configure and monitor the IBM TotalStorage UltraScalable Tape Library 3584 from a remote location.

sustained data transfer rate. Between the server and the tape drive, the average transfer rate of data across the SCSI interface to and from the tape drive during a transition from one end of the tape to the other end.

switch. A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have the ability to switch node connections from one to another. A typical switch can facilitate several simultaneous bandwidth transmissions between different pairs of nodes.

T

TapeAlert. A patented technology from Hewlett-Packard that monitors the status of a tape device and media, and detects problems as they occur.

TapeAlert flags. Status and error messages that are generated by the TapeAlert utility and display on the host console. The messages indicate the type of problem and tell how to resolve it.

tape cartridge. A removable storage device that consists of a housing containing a belt-driven magnetic tape wound on a supply reel and a takeup reel.

tape drive. See *IBM Ultrium Tape Drive* or *DLT 8000 Tape System*.

target. A SCSI device that performs an operation requested by the initiator. A target can also be an initiator.

TB. Terabyte.

TCP/IP. See *transmission control protocol/Internet protocol*.

terabyte. 1 000 000 000 000 bytes.

terminator. (1) A part used to end a SCSI bus. (2) A single-port, 75-Ω device that is used to absorb energy from a transmission line. Terminators prevent energy from reflecting back into a cable plant by absorbing the radio frequency signals. A terminator is usually shielded, which prevents unwanted signals from entering or valid signals from leaving the cable system.

touchscreen. See *liquid crystal display*.

transfer rate. See *data transfer rate*.

transmission control protocol/Internet protocol (TCP/IP). (1) The Transmission Control Protocol and the Internet Protocol, which together provide reliable end-to-end connections between applications over interconnected networks of different types. (2) The suite of transport and application protocols that run over the Internet Protocol.

U

Ultra SCSI. See *Small Computer Systems Interface*.

Ultra2 SCSI. See *Small Computer Systems Interface*.

Ultra3 SCSI. See *Small Computer Systems Interface*.

Ultra160 SCSI. See *Small Computer Systems Interface*.

Ultra320 SCSI. See *Small Computer Systems Interface*.

ultrascalable. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, capable of being expanded by adding up to five expansion (Model D32 or Model D42) frames. An ultrascalable library may be used by multiple servers and can share cartridges and drives among them. Contrast with *scalable*.

Ultrium Tape Drive. See *IBM Ultrium Tape Drive*.

uniform resource locator (URL). The address of an item on the World Wide Web. It includes the protocol followed by the fully qualified domain name (sometimes called the host name) and the request. The web server typically maps the request portion of the URL to a path and file name. For example, if the URL is http://www.networking.ibm.com/nsg/nsgmain.htm, the protocol is http; the fully qualified domain name is www.networking.ibm.com; and the request is /nsg/nsgmain.htm.

unload. Pertaining to the IBM TotalStorage UltraScalable Tape Library 3584, a term used to describe the act of the drive unthreading the tape from the internal tape path and returning the leader block to the tape cartridge.

URL. See *uniform resource locator*.

V

VOLSER. Volume serial number.

volume. (1) A certain portion of data, together with its data carrier, that can be handled conveniently as a unit. (2) A data carrier that is mounted and demounted as a unit, for example, a reel of magnetic tape, a disk pack.

volume serial number (VOLSER). A number that a computer assigns to a tape cartridge when it prepares (initializes) the cartridge for use.

W

web. See *World Wide Web*.

World Wide Web. A network of servers that contain programs and files. Many of the files contain hypertext links to other documents available through the network.

write. To make a permanent or transient recording of data in a storage device or on a data medium.

write protected. A tape cartridge is write protected if some logical or physical mechanism causes the device that is processing the tape to prevent the program from writing on the tape.

write-protect switch. Located on the LTO Ultrium Tape Cartridge or DLT Tape Cartridge, a switch that prevents accidental erasure of data. Pictures of a locked and unlocked padlock appear on the switch. When you slide the switch to the locked padlock, data cannot be written to the tape. When you slide the switch to the unlocked padlock, data can be written to the tape.

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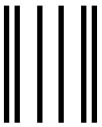

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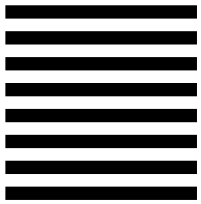

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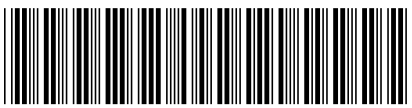

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