

IBM System Storage TS3500 Tape Library



# Introduction and Planning Guide

*IBM 3584 Tape Library*



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**Note!**

Before using this guide and the product it supports, read the information in “Safety and Environmental Notices” on page xiii and Appendix B, “Notices,” on page 179.

**Second Edition (September 2006)**

This edition applies to the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide* and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces GA32-0559-00.

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## Read This First

This is the second edition of the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide* (September 2006).

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## What's New In This Edition (September 2006)

Revision bars (|) appear next to all of the information that has been added or changed since the previous edition (GA32-0559-00).

Changes include:

- | • For Models L22, D22, L23, and D23, support for encryption-capable TS1120 Tape Drives. In these frames, any combination of 3592 J1A Tape Drives and TS1120 Tape Drives may be used.
- | • Support for Application-Managed, System-Managed, and Library-Managed encryption in Open Systems environments, and for System-Managed encryption in mainframe environments.
- | • For Models L22, L23, L52, and L53, two new, lower-priced offerings of the Advanced Library Management System (ALMS).
- | • Support for the following model conversions, which must be performed by an IBM Service Representative:
  - | – Model L22 to L23
  - | – Model D22 to D23
  - | – Model L52 to L53
  - | – Model D52 to D53
  - | – Model L23 to L53
  - | – Model D23 to D53
  - | – Model L53 to L23
  - | – Model D53 to D23

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- Page numbers to which you are referring



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## Safety and Environmental Notices

When using this product, observe the danger, caution, and attention notices that are contained in this guide. The notices are accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the *@server Safety Notices*, G229-9054.

The sections that follow define each type of safety notice and give examples.

---

### Danger Notice

A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:



**DANGER**

An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (D004)

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### Caution Notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A hazardous electrical condition with less severity than electrical danger.
	A generally hazardous condition not represented by other safety symbols.

If the symbol is...	It means...
 <p data-bbox="548 373 646 394">Class II</p>	<p data-bbox="771 220 1404 367">A hazardous condition due to the use of a laser in the product. Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).</p>
	<p data-bbox="771 445 1404 508">A hazardous condition due to mechanical movement in or around the product.</p>
 <p data-bbox="557 798 638 850">&gt; 18 kg (40 lb)</p>	<p data-bbox="771 644 1404 739">A hazardous condition due to the weight of the unit. Weight symbols are accompanied by an approximation of the product's weight.</p>

Sample caution notices follow:



**CAUTION:**

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call.(C007)



**CAUTION:**

Energy hazard present. Shorting may result in system outage and possible physical injury. Remove all metallic jewelry before servicing. (C001)



Class II

**CAUTION:**

This product contains a Class II laser. Do not stare into the beam. (C029)



> 18 kg  
(40 lb)

**CAUTION:**

The weight of this part or unit is between 18 and 32 kilograms (39.7 and 70.5 pounds). It takes two persons to safely lift this part or unit. (C009)



**CAUTION:**  
This assembly contains mechanical moving parts. Use care when servicing this assembly. (C025)

---

## Attention Notice

An attention notice indicates the possibility of damage to a program, device, or system, or to data. An exclamation point symbol may accompany an attention notice, but is not required. Sample attention notices follow:



**Attention:** If you use a power screwdriver to perform this procedure it could destroy the tape.

**Attention:** Do not operate the 3584 Tape Library in a poor air-quality environment.

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## Possible Safety Hazards

Possible safety hazards to the operation of this product are:

**Electrical** An electrically charged frame can cause serious electrical shock.

**Mechanical** Hazards, such as a safety cover missing, are potentially harmful to people.

**Chemical** Do not use solvents, cleaners, or other chemicals not approved for use on this product.

Repair any of the preceding problems before you use the 3584 Tape Library.

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## Laser Safety and Compliance

Before using the 3584 Tape Library, review the following laser safety information.

### Class II Laser Product

The 3584 Tape Library is a Class II laser product. It is important for you to be aware of the laser caution label. See Figure 1 on page xvi for an example of the label.



Figure 1. Laser safety caution label

This product complies with the performance standards set by the U.S. Food and Drug Administration for a Class II Laser product. This product belongs to a class of laser products that requires precautions be taken to avoid prolonged viewing of the laser beam. Under normal working conditions, you must not come in direct contact with the laser beam. This classification was accomplished by providing the necessary protective housings and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class II limits. These products have been reviewed by external safety agencies and have obtained approvals to the latest standards as they apply to this product type.

## Class I Laser Product

The 3584 Tape Library contains a laser assembly that complies with the performance standards set by the U.S. Food and Drug Administration for a Class I laser product. Class I laser products do not emit hazardous laser radiation. Protective housing and scanning safeguards ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies have reviewed the library and have obtained approvals to the latest standards as they apply.

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## End of Life (EOL) Plan

This box is a purchased unit. Therefore, it is the sole responsibility of the purchaser to dispose of it in accordance with local laws and regulations at the time of disposal.

This unit contains recyclable materials. The materials should be recycled where facilities are available and according to local regulations. In some areas, IBM may provide a product take-back program that ensures proper handling of the product. Contact your IBM representative for more information.

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## Product Recycling and Disposal

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at <http://www.ibm.com/ibm/environment/products/prp.shtml>.

Esta unidad debe reciclarse o desecharse de acuerdo con lo establecido en la normativa nacional o local aplicable. IBM recomienda a los propietarios de equipos de tecnología de la información (TI) que reciclen responsablemente sus equipos cuando éstos ya no les sean útiles. IBM dispone de una serie de programas y servicios de devolución de productos en varios países, a fin de ayudar a los propietarios de equipos a reciclar sus productos de TI. Se puede encontrar información sobre las ofertas de reciclado de productos de IBM en el sitio web de IBM <http://www.ibm.com/ibm/environment/products/prp.shtml>.



**Notice:** This mark applies only to countries within the European Union (EU) and Norway.

Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

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## Battery Return Program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or a lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

For Taiwan:



Please recycle batteries

廢電池請回收

For the European Union:



For California:

Perchlorate Material - special handling may apply. See [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate).

The foregoing notice is provided in accordance with California Code of Regulations Title 22, Division 4.5 Chapter 33. Best Management Practices for Perchlorate Materials. This product/part may include a lithium manganese dioxide battery which contains a perchlorate substance.

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## Flat Panel Display

The fluorescent lamp or lamps in the liquid crystal display contain mercury. Dispose of it as required by local ordinances and regulations.

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## Preface

This guide contains information about how to plan for the IBM® System Storage™ TS3500 Tape Library, formerly known as the IBM TotalStorage® 3584 Tape Library. It includes the following chapters:

Chapter 1, “Introduction,” provides an overview of the 3584 Tape Library, tells how it can interact in both mainframe and Open Systems environments, describes how it can process both Linear Tape-Open (LTO) Ultrium Tape Cartridges and IBM TotalStorage 3592 Enterprise Tape Cartridges, summarizes its primary components, addresses its Multi-Path architecture capabilities, describes the method for determining supported servers and operating systems, describes methods for cleaning its tape drives, and outlines performance considerations.

Chapter 2, “Physical Planning Specifications,” lists dimensions of the 3584 Tape Library. It describes clearance requirements, sets forth fire-suppression provisions, and defines specifications for the library and the media. In addition, the requirements for the power cord, power plug, and power receptacle are addressed.

Chapter 3, “Standard Features,” gives the codes that you need when ordering features for all models of the 3584 Tape Library.

Chapter 4, “Using Ultrium Media,” describes the data and cleaning cartridges to use in Ultrium Tape Drives. It defines the information that appears on a bar code label, gives requirements for a bar code label, tells how to set the write-protect switch on a tape cartridge, provides tips about storing, shipping, and handling cartridges, and offers information about where to order cartridges and supplies.

Chapter 5, “Using 3592 Tape Drive Media,” describes the data and cleaning cartridges to use in the 3592 J1A Tape Drive and the TS1120 Tape Drive. It defines the information that appears on a bar code, gives requirements for a bar code label, tells how to set the write-protect switch on a tape cartridge, provides tips on storing, shipping, and handling cartridges, tells how to clean a tape drive, describes how to inspect a cartridge leader, and offers information about where to order cartridges and supplies.

Chapter 6, “Using the Fibre Channel Interface,” describes the requirements of the Fibre Channel interface, lists the types of topologies that the 3584 Tape Library supports, discusses the address scheme for the Fibre Channel tape drives, discusses the role of World Wide Names, and provides information about connectors and adapters.

Chapter 7, “Frame Capacity,” provides tables that show the quantity of storage slots that are available in library frames, depending on whether the Capacity On Demand or Capacity Expansion Features are installed, the upper and lower I/O stations are used, and a specified quantity of drives are installed.

Chapter 8, “TS1120 Encryption Overview,” explains how encryption-enabled tape drives, encryption key management, and encryption policy configuration are the three elements that comprise the TS1120 Tape Drive solution. It describes the Encryption Key Manager (EKM) software that generates and stores the encryption keys which encrypt and decrypt information on the tape cartridges. It also gives

information about supported servers and operating systems, methods of encryption, and encryption keys. A checklist for installing and configuring encryption is provided.

Appendix A, "Statement of Limited Warranty," contains the warranty statement for the 3584 Tape Library.

Appendix B, "Notices," tells where and how to send your comments about this book. It also gives information about the electronic emission regulations that pertain to the 3584 Tape Library in the United States and other countries or regions.

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## Related Information

Refer to the following sources for additional information about the 3584 Tape Library and its associated products. To ensure that you have the latest publications, visit the web at:

<http://www.ibm.com/storage/lto>

To view the IBM System Storage TS3500 Tape Library Information Center, go to:

<http://publib.boulder.ibm.com/infocenter/ts3500tl/v1r0/index.jsp>

## Publications about the 3584 Tape Library

- *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560
- *IBM System Storage TS3500 Tape Library 3584 Maintenance Information* (part number 23R6441; provided with the 3584 Tape Library)
- *IBM System Storage TS3500 Tape Library SCSI Reference*, GA32-0561

## IBM System i5 and AS/400 Source

For information about the IBM System i5™ and the AS/400® servers, visit the web at <http://publib.boulder.ibm.com/series/>. The IBM System i5 is the follow-on product line to the IBM eServer™ i5 and iSeries™ Systems.

## IBM System p5 and RS/6000 Source

For information about the IBM System p5™ and the RS/6000® servers, visit the web at <http://www.ibm.com/servers/eserver/pseries>. The IBM System p5 is the follow-on product line to the IBM eServer p5, OpenPower™, and pSeries® servers.

## IBM System z9 Source

For information about the IBM System z9 server, visit the web at <http://www.ibm.com/servers/eserver/zseries>. The IBM System z9 is the follow-on product line to the IBM eServer zSeries® servers.

## Other Sources

- For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at <http://www.ibm.com/storage/lto>. Under IBM System Storage TS3500 Tape Library, select Product details. Under Learn more, select Interoperability matrix or select Independent Software Vendor (ISV) matrix for LTO.

- For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at <http://www.ibm.com/servers/storage/tape/drives>. Under IBM System Storage TS1120 Tape Drive, select Product details. Under Learn more, select Interoperability matrix or Independent Software Vendor (ISV) matrix.
- For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at <http://www.ibm.com/servers/storage/tape/drives>. Under IBM TotalStorage 3592 Tape Drive, select Product details. Select Resource library. Select Interoperability, then 3592 Tape Drive. Or select Compatibility information, then Independent Software Vendor (ISV) Matrix for 3592 Tape Drive.
- *IBM Encryption Key Manager component for the Java™ platform Introduction, Planning, and User's Guide*, GA76-0148
- *IBM 3953 Tape System Introduction and Planning Guide*, GA32-0557
- *IBM 3953 Library Manager Model L05 Operator Guide*, GA32-0558
- *IBM 3953 Tape Frame Model F05 Maintenance Information* (part number 23R6439; provided with the 3953 Tape System)
- *IBM TotalStorage Enterprise Silo Compatible Tape Frame 3592 Introduction, Planning, and User's Guide Model C20*, GA32-0463
- *IBM System Storage TS1120 Tape Drive and Controller Operator Guide*, GA32-0556
- *IBM System Storage TS1120 Tape Drive and Controller Introduction and Planning Guide*, GA32-0555
- *IBM System Storage TS1120 Tape Drive Maintenance Information*, part number 23R9281
- *IBM System Storage TS1120 Tape Drive SCSI Reference*, GA32-0466
- *IBM System Storage TS3000 System Console (TSSC) Maintenance Information*, part number 23R6513
- *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767.
- *IBM TotalStorage SMI-S Agent for Tape on Linux Systems Installation Guide*, GC35-0512. This book is available through the IBM Publications Center on the web at <http://www.elink.ibm.com/public/applications/publications/cgibin/pbi.cgi>.
- *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*, GA32-0450
- *Systems Safety Notices*, G229-9054. This publication is available at <http://www.ibm.com/servers/resourceLink>. To access, register for a userid and password, then select Library in the navigation area.
- *IBM TotalStorage and System Storage Tape Device Drivers Installation and User's Guide*, GC35-0154
- *IBM TotalStorage and System Storage Tape Device Drivers Programming Reference*, GC35-0346
- *IBM Ultrium Device Drivers Installation and User's Guide*, GA32-0430
- *IBM Ultrium Tape Device Drivers Programming Reference*, GC35-0483
- *IBM Tape Device Drivers: Encryption Support*, GA32-0565
- *Implementing IBM Tape in Linux and Windows*, SG24-6268. This book is available on the web at <http://www.redbooks.ibm.com/redpieces/pdfs/sg246268.pdf>.
- *Implementing IBM Tape in Unix Systems*, SG24-6502. This book is available on the web at <http://www.redbooks.ibm.com/redbooks/pdfs/sg246502.pdf>.
- *The IBM TotalStorage Tape Libraries Guide for Open Systems*, SG24-5946
- *The LTO Ultrium Primer for IBM eServer iSeries Customers*, REDP-3580. This book is available on the web at [www.redbooks.ibm.com](http://www.redbooks.ibm.com). Search on REDP-3580.

- *IBM TotalStorage 3584 Tape Library Performance*, a white paper that is available from your IBM Representative.
- To access installation instructions for customer-setup units (CSUs) from the web, go to <http://www-03.ibm.com/servers/storage/tape/resource-library.html#publications>. Under the Publications category, select 3584 Tape Library.
- *IBM LTO Ultrium Cartridge Label Specification (Revision 2)*. This document is available on the web at <http://www.ibm.com/servers/storage/support/lto/3584/>. Under Additional resources, select LTO Ultrium media. Under Learn more, select LTO label specifications. Under Abstract, select the .pdf file to access the document.
- *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. This document is available on the web at [www.storage.ibm.com/media/tapecartridges/index.html](http://www.storage.ibm.com/media/tapecartridges/index.html). Under Enterprise storage media, select 3592 tape cartridges. Under Learn more, select Barcode Label Specification for use with 3592 Tape Media. Under Content, select the .pdf file to access the document. You can also contact your IBM Marketing Representative for this specification.

## Authorized Suppliers of Bar Code Labels

You can order bar code labels directly from the authorized label suppliers listed in Table 1.

**Attention:** The IBM System Storage TS3500 Tape Library is designed to work with bar code labels that meet the specifications and requirements set forth in the *IBM LTO Ultrium Cartridge Label Specification (Revision 2)* and the *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. The following label providers have demonstrated the ability to produce finished bar code labels that meet the foregoing specifications and requirements. This information is provided for the convenience of 3584 Tape Library users only, and is not an endorsement or recommendation of such providers. IBM is not responsible for the quality of bar code labels procured from sources other than IBM. This information is applicable to bar code labels actually printed by the listed companies. IBM has not reviewed the quality of any labels produced by software or services offered by such companies which allow end users to print labels on their own printing equipment.

Table 1. Authorized suppliers of custom bar code labels

In the Americas	In Europe and Asia
Dataware 7570 Renwick Houston, TX 77081 U. S. A. Telephone: 800-426-4844 <a href="http://www.datawarelabels.com/">http://www.datawarelabels.com/</a>	Not applicable
EDP/Colorflex 2550 West Midway Boulevard Broomfield, CO 80020-1633 U. S. A. Telephone: 800-522-3528 or 303-666-2160 Fax: 303-666-2166 <a href="http://www.colorflex.com/colortrax.asp">http://www.colorflex.com/colortrax.asp</a>	EDP Europe Limited 43 Redhills Road South Woodham Ferrers Chelmsford, Essex CM3 5UL U. K. Telephone: 44 (0) 1245 322380 Fax: 44 (0)1245 323484 <a href="http://www.edpeurope.com/media-labels.html">http://www.edpeurope.com/media-labels.html</a>
Netc, L. L. C. P. O. Box 320784 Fairfield, CT 06825 U. S. A. Telephone: 203-372-6382 <a href="http://www.NetcLabels.com">http://www.NetcLabels.com</a>	Netc Europe Ltd Town Farm Bungalow North Curry Taunton Somerset U. K. TA3 6LX Telephone: 44 (0) 1823 491439 <a href="http://www.NetcLabels.co.uk">http://www.NetcLabels.co.uk</a>
	Netc Asia Pacific Pty Ltd Locked Bag 14 Kenthurst NSW Australia 2156 Telephone: 61 (0) 2 4563 6556 <a href="http://www.NetcLabels.com.au">http://www.NetcLabels.com.au</a>



## Two-Node Direct Connection Topology

A two-node direct connection occurs when two Fibre Channel end points are connected together. The difference is in the topology. Either Arbitrated Loop or Point-to-Point topology is usable, but both end points must use the same topology. Most Fibre Channel adapters have settings that allow selection of the topology or they default to the loop topology when they are not directly connected to a fabric. In addition, the 3584 Tape Library allows you to set the drive port to any of these topologies. To set a port to a topology, see the section about viewing or changing Fibre Channel port speeds and topologies in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Use the Arbitrated Loop (L\_port) topology in a two-node direct connection. This topology is supported when you attach the 3584 Tape Library through the Ultrium 1, Ultrium 2, Ultrium 3, or 3592 Tape Drives. Use of the Point-to-Point topology in a two-node direct connection in the library to an N\_port is not supported.

## Fibre Channel Addressing

This section defines and lists the default Loop ID and Arbitrated Loop Physical Address (AL\_PA) for each Ultrium Tape Drive and 3592 Tape Drive that communicates in a Fibre Channel topology.

Each Ultrium Tape Drive and 3592 Tape Drive in a 3584 Tape Library must have a Loop ID and corresponding Arbitrated Loop Physical Address (AL\_PA) to communicate in a Fibre Channel topology. Table 46 lists the default Loop IDs and AL\_PAs for each drive in the library.

The AL\_PAs defined here are used when connecting to other devices in Arbitrated Loop topology only. When connected in a switched fabric point-to-point topology, the AL\_PA is assigned by the fabric and these AL\_PAs are not used.

**Note:** In Table 46, the values for Port 2 do not apply to tape drives that have a single port.

Table 46. Default Loop IDs and their associated AL\_PAs for drives with single or dual ports. For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

Drive	Frames 1, 7, 13		Frames 2, 8, 14		Frames 3, 9, 15		Frames 4, 10, 16		Frames 5, 11		Frames 6, 12	
	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												
Port 1	17	X'CC'	33	X'B1'	49	X'97'	65	X'71'	81	X'54'	97	X'39'
Port 2	81	X'54'	97	X'39'	18	X'CB'	34	X'AE'	17	X'CC'	33	X'B1'
Row 2												
Port 1	18	X'CB'	34	X'AE'	50	X'90'	66	X'6E'	82	X'53'	98	X'36'
Port 2	82	X'53'	98	X'36'	19	X'CA'	35	X'AD'	18	X'CB'	34	X'AE'
Row 3												
Port 1	19	X'CA'	35	X'AD'	51	X'8F'	67	X'6D'	83	X'52'	99	X'35'
Port 2	83	X'52'	99	X'35'	20	X'C9'	36	X'AC'	19	X'CA'	35	X'AD'
Row 4												
Port 1	20	X'C9'	36	X'AC'	52	X'88'	68	X'6C'	84	X'51'	100	X'34'
Port 2	84	X'51'	100	X'34'	21	X'C7'	37	X'AB'	20	X'C9'	36	X'AC'

Table 46. Default Loop IDs and their associated AL\_PAs for drives with single or dual ports (continued). For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

Drive	Frames 1, 7, 13		Frames 2, 8, 14		Frames 3, 9, 15		Frames 4, 10, 16		Frames 5, 11		Frames 6, 12	
	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 5												
Port 1	21	X'C7'	37	X'AB'	53	X'84'	69	X'6B'	85	X'4E'	101	X'33'
Port 2	85	X'4E'	101	X'33'	22	X'C6'	38	X'AA'	21	X'C7'	37	X'AB'
Row 6												
Port 1	22	X'C6'	38	X'AA'	54	X'82'	70	X'6A'	86	X'4D'	102	X'32'
Port 2	86	X'4D'	102	X'32'	23	X'C5'	39	X'A9'	22	X'C6'	38	X'AA'
Row 7												
Port 1	23	X'C5'	39	X'A9'	55	X'81'	71	X'69'	87	X'4C'	103	X'31'
Port 2	87	X'4C'	103	X'31'	24	X'C3'	40	X'A7'	23	X'C5'	39	X'A9'
Row 8												
Port 1	24	X'C3'	40	X'A7'	56	X'80'	72	X'67'	88	X'4B'	104	X'2E'
Port 2	88	X'4B'	104	X'2E'	25	X'BC'	41	X'A6'	24	X'C3'	40	X'A7'
Row 9												
Port 1	25	X'BC'	41	X'A6'	57	X'7C'	73	X'66'	89	X'4A'	105	X'2D'
Port 2	89	X'4A'	105	X'2D'	26	X'BA'	42	X'A5'	25	X'BC'	41	X'A6'
Row 10												
Port 1	26	X'BA'	42	X'A5'	58	X'7A'	74	X'65'	90	X'49'	106	X'2C'
Port 2	90	X'49'	106	X'2C'	27	X'B9'	43	X'A3'	26	X'BA'	42	X'A5'
Row 11												
Port 1	27	X'B9'	43	X'A3'	59	X'79'	75	X'63'	91	X'47'	107	X'2B'
Port 2	91	X'47'	107	X'2B'	28	X'B6'	44	X'9F'	27	X'B9'	43	X'A3'
Row 12												
Port 1	28	X'B6'	44	X'9F'	60	X'76'	76	X'5C'	92	X'46'	108	X'2A'
Port 2	92	X'46'	108	X'2A'	29	X'B5'	45	X'9E'	28	X'B6'	44	X'9F'
<b>Note:</b> Loop IDs are given in decimal format and AL_PA values are given in hexadecimal format.												

You can change a Loop ID by using the library's operator panel or Tape Library Specialist web interface (see the section about changing the Loop ID in the *IBM System Storage TS3500 Tape Library Operator Guide*). Using a method called hard addressing, the drive then automatically selects the corresponding AL\_PA, which is the identifier that devices use to communicate. Valid Loop ID values range between 0 and 125. The higher the number of the Loop ID (which relates to AL\_PA), the higher the priority of the device in the loop.

You can also specify Loop IDs that allow the drive to dynamically arbitrate the AL\_PA with other Fibre Channel devices on the loop. This method avoids conflicts over the address and is called soft addressing. To dynamically arbitrate the AL\_PA, specify a Loop ID of 126 or 127.

For a complete list of Loop IDs and their corresponding AL\_PAs, see Table 47 on page 157.

Table 47. Valid Loop IDs and their associated AL\_PAs for Ultrium Tape Drives, 3592 Tape Drives, and TS1120 Tape Drives in the IBM System Storage TS3500 Tape Library

7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)	7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)	7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)
0	X'EF'	43	X'A3'	86	X'4D'
1	X'E8'	44	X'9F'	87	X'4C'
2	X'E4'	45	X'9E'	88	X'4B'
3	X'E2'	46	X'9D'	89	X'4A'
4	X'E1'	47	X'9B'	90	X'49'
5	X'E0'	48	X'98'	91	X'47'
6	X'DC'	49	X'97'	92	X'46'
7	X'DA'	50	X'90'	93	X'45'
8	X'D9'	51	X'8F'	94	X'43'
9	X'D6'	52	X'88'	95	X'3C'
10	X'D5'	53	X'84'	96	X'3A'
11	X'D4'	54	X'82'	97	X'39'
12	X'D3'	55	X'81'	98	X'36'
13	X'D2'	56	X'80'	99	X'35'
14	X'D1'	57	X'7C'	100	X'34'
15	X'CE'	58	X'7A'	101	X'33'
16	X'CD'	59	X'79'	102	X'32'
17	X'CC'	60	X'76'	103	X'31'
18	X'CB'	61	X'75'	104	X'2E'
19	X'CA'	62	X'74'	105	X'2D'
20	X'C9'	63	X'73'	106	X'2C'
21	X'C7'	64	X'72'	107	X'2B'
22	X'C6'	65	X'71'	108	X'2A'
23	X'C5'	66	X'6E'	109	X'29'
24	X'C3'	67	X'6D'	110	X'27'
25	X'BC'	68	X'6C'	111	X'26'
26	X'BA'	69	X'6B'	112	X'25'
27	X'B9'	70	X'6A'	113	X'23'
28	X'B6'	71	X'69'	114	X'1F'
29	X'B5'	72	X'67'	115	X'1E'
30	X'B4'	73	X'66'	116	X'1D'
31	X'B3'	74	X'65'	117	X'1B'
32	X'B2'	75	X'63'	118	X'18'
33	X'B1'	76	X'5C'	119	X'17'
34	X'AE'	77	X'5A'	120	X'10'
35	X'AD'	78	X'59'	121	X'0F'
36	X'AC'	79	X'56'	122	X'08'
37	X'AB'	80	X'55'	123	X'04'

Table 47. Valid Loop IDs and their associated AL\_PAs for Ultrium Tape Drives, 3592 Tape Drives, and TS1120 Tape Drives in the IBM System Storage TS3500 Tape Library (continued)

7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)	7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)	7-bit Loop ID (decimal)	8-bit AL_PA (hexadecimal)
38	X'AA'	81	X'54'	124	X'02'
39	X'A9'	82	X'53'	125	X'01'
40	X'A7'	83	X'52'	126	X'00'
41	X'A6'	84	X'51'	127	--
42	X'A5'	85	X'4E'	--	--

## LUN Assignments

This section defines the logical unit number (LUN) for a Sequential Access device (drive) and the Medium Changer device (library).

The logical unit number (LUN) for the Sequential Access device (the SCSI term for a drive) is always LUN 0, and the LUN for the Medium Changer device (the SCSI term for the library) 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 drives, see the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference* or *IBM System Storage TS1120 Tape Drive and Controller SCSI Reference*. For information about the SCSI commands for the library, see the *IBM System Storage TS3500 Tape Library SCSI Reference*.

**Note:** The Medium Changer SCSI ID is the same as the SCSI ID for Drive 1, Frame 1. You can enable additional drives to optionally provide Medium Changer (LUN 1) addressing by configuring more than one logical library or by enabling additional control paths (see the sections about configuring the library with partitions or changing a control path in the *IBM System Storage TS3500 Tape Library Operator Guide*).

## Using World Wide Names

This section discusses the World Wide Name (WWN) addresses that the 3584 Tape Library assigns to drives. The WWN does not change when the drive is swapped or replaced, and host parameters do not need to be changed or reconfigured.

Normally, blocks of World Wide Name (WWN) addresses are assigned to manufacturers by the IEEE Standards Committee, and are built into devices during manufacture. In the case of the 3584 Tape Library, however, the library assigns World Wide Node Names and World Wide Port Names to the drives. This technique is referred to as “library-centric world wide names.” Potential drive slots are each assigned a WWN which does not change when a drive is swapped or replaced.

In the 3584 Tape Library, a WWN for a drive is implemented through an algorithm that uses the frame serial number of the library and the drive’s position within the library. Only the last two digits change within the library. The second-to-the-last digit represents the frame number (starting at 0 for Frame 1) and the last digit is the drive row (starting at 1). The WWN of the drive is location-dependent and not device-dependent. That is, each time that the drive is reset or powered on, the library reestablishes the WWN so that a drive in frame x, row y always keeps the same WWN, even if the drive is replaced. The design of a WWN is such that if a

drive needs service or replacement, host parameters do not need to be changed or reconfigured. The library's configuration can also easily survive a reboot. The following sections describe methods that involve World Wide Names in resolving these issues.

## Using Persistent Binding to Ensure SCSI ID Assignment

When a server is booted, devices are discovered and assigned SCSI target and LUN IDs. It is possible for these SCSI assignments to change between boots. Some operating systems do not guarantee that devices will always be allocated the same SCSI target ID after rebooting. Also, some software depends on this association, so you do not want it to change. The issue of SCSI ID assignment is addressed by persistent binding.

Persistent binding is a host bus adapter (HBA) function that allows a subset of discovered targets to be bound between a server and device. Implemented by a World Wide Node Name (WWNN) or World Wide Port Name (WWPN), persistent binding causes a tape drive's World Wide Name to be bound to a specific SCSI target ID. After a configuration has been set, it survives reboots and any hardware configuration changes because the information is preserved. If a drive needs to be replaced, the new drive assumes the WWNN of the old drive because the WWNN for the drive is location-dependent within the library. Because the WWNN does not change, persistent binding does not need to be changed which would cause an outage.

## Using Zoning to Isolate Devices and Enhance Security

For security reasons, it is important to limit the devices that a server or servers can recognize or access. Also, some performance configurations and Storage Area Network (SAN) configurations can result in a device being seen multiple times from the same server. For example, if you have two host bus adapters (HBAs) from the same server connected to a tape drive in the 3584 Tape Library, the drive will be detected and appear as two logical devices. That is, there will be two special files for one physical device. Zoning can address these issues.

Zoning allows you to partition your SAN into logical groupings of devices so that each group is isolated from the other and can only access the devices in its own group. Two types of zoning exist: hardware zoning and software zoning. Hardware zoning is based on physical fabric port number. Software zoning is defined with the World Wide Node Name (WWNN) or World Wide Port Name (WWPN). While zoning can be reconfigured without causing an outage, some zoning configurations can become complicated. The advantage of the library's WWNN implementation is that you can avoid the exposure of introducing zoning errors because you do not have to change the zoning configuration if a drive needs service or replacement.

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## Connectors and Adapters

This section provides web sites that give information about the latest connectors and adapters for the 3584 Tape Library.

The 3584 Tape Library is supported by a wide variety of servers (mainframe hosts), operating systems, and adapters. These attachments can change throughout the product's life cycle. To determine the latest attachments, visit the following web sites or contact your IBM Sales Representative.

- For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at <http://www.ibm.com/storage/1to>. Under IBM

System Storage TS3500 Tape Library, select Product details. Under Learn more, select Interoperability matrix or select Independent Software Vendor (ISV) matrix for LTO.

- For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at <http://www.ibm.com/servers/storage/tape/drives>. Under IBM System Storage TS1120 Tape Drive, select Product details. Under Learn more, select Interoperability matrix or Independent Software Vendor (ISV) matrix.
- For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at <http://www.ibm.com/servers/storage/tape/drives>. Under IBM TotalStorage 3592 Tape Drive, select Product details. Select Resource library. Select Interoperability, then 3592 Tape Drive. Or select Compatibility information, then Independent Software Vendor (ISV) Matrix for 3592 Tape Drive.

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## Connecting the Library to the iSeries Server

This section gives information that is necessary for connecting the 3584 Tape Library to the iSeries server (mainframe host).

The OS/400 operating system supports a maximum of:

- 96 tape drives per logical library
- 32 tape drives per library device description
- 16 devices per tape adapter (a device is a media changer or tape drive)

The iSeries does not require or allow you to set the Fibre Channel adapter settings. The adapter automatically detects the connection type and device addressing. OS/400 support is as follows:

- For V5R1, the adapter supports:
  - A single target with multiple LUNs
  - 1 Gbps connection
  - For a Fibre Channel-Arbitrated Loop topology, connection through an L\_ port to a device, hub or switch
  - Does not support fabric
- For V5R2, the adapter supports:
  - Up to 16 devices, including multiple targets and multiple LUNs (each LUN on each target counts as a device)
  - 2 Gbps connection (but will negotiate down to 1 Gbps if necessary)
  - For a Fibre Channel-Arbitrated Loop topology, connection through an L\_ port to a device, hub or switch
  - For a point-to-point topology, connection through an N\_port to an F\_port

The iSeries Fibre Channel adapter does not support D-mode Alternate IPL. The Alternate Installation function is used to restore a system from a Fibre Channel-attached device. With Alternate Installation support, the system is loaded from a compact disc (CD) and directed to the Fibre Channel-attached device for a restore from the tape that contains the saved data. The code on the CD is only used to get the restore from tape started. All code and program temporary fixes (PTFs) are restored from the tape that contains the saved data.

When enabled in the 3584 Tape Library, the Advanced Library Management System (ALMS) allows for changes in the logical library and drive configurations

without taking the library off-line. These changes are not transparent to iSeries and OS/400 servers that are attached to any logical libraries which have changed. Any time that changes are made to the logical library or device configuration, you must reset the associated adapter or perform an initial program load (IPL) of the associated system to reconfigure the changes.

For additional information, see *The LTO Ultrium Primer for IBM eServer iSeries Customers* available on <http://www.redbooks.ibm.com>.

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## Sharing on a Storage Area Network

This section gives guidelines for sharing drives with software and systems.

With Storage Area Network (SAN) components, the possibilities for connecting multiple systems and multiple drives have increased. Not all software and systems are designed to share drives. Before you install a drive that would allow two systems to share it, check that the systems and their software support sharing. If your software does not support sharing, note that Fibre Channel switches have a zoning capability to form a SAN partition. For systems that do not cooperate, use zoning to prevent the systems from sharing the same drive. You can remove zoned partitions as you upgrade software and system levels.



## Chapter 7. Frame Capacity

This section introduces the quantity of LTO Ultrium Tape Cartridges and 3592 Tape Cartridges that the 3584 Tape Library supports, depending on whether the Capacity On Demand or Capacity Expansion Features are installed, the upper and lower I/O stations are used, and a specified quantity of drives are installed.

### Capacity of Model L22, D22, L23, and D23 Frames

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

*Table 48. Quantity of storage slots in L22, D22, L23, and D23 frames.* The quantity depends on the type of Capacity On Demand feature installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

Type of Frame	Type of Capacity On Demand Feature	Quantity of Drives	Quantity of I/O Slots	Quantity of Storage Slots
L22, L23	Entry	0 to 12	16	58
L22, L23	Intermediate	0 to 12	16	117
L22, L23	Full	0 to 4	16	260
L22, L23	Full	5 to 8	16	248
L22, L23	Full	9 to 12	16	237
L22, L23	Full	0 to 4	32	222
L22, L23	Full	5 to 8	32	210
L22, L23	Full	9 to 12	32	199
D22, D23 <sup>1</sup>	N/A <sup>2</sup>	0	N/A	400
D22, D23 <sup>1</sup>	N/A	1 to 4	N/A	383
D22, D23 <sup>1</sup>	N/A	5 to 8	N/A	371
D22, D23 <sup>1</sup>	N/A	9 to 12	N/A	360

**Notes:**

1. If the L frame is not an L22 or L23, then the first D frame of a mixed media library will have one less storage slot to accommodate a diagnostic cartridge.
2. N/A = not applicable.

#### Related reference

“Capacity of Model L32 and D32 Frames” on page 164

This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

“Capacity of Model L52, D52, L53, and D53 Frames” on page 165

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Capacity of Model L32 and D32 Frames

This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

*Table 49. Quantity of storage slots in Model L32 and D32 frames.* The quantity depends on whether the Capacity Expansion feature is installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

Type of Frame	Quantity of Drives	Quantity of Slots in Frame (without Capacity Expansion Feature)	Quantity of Slots with Capacity Expansion Feature and 26 or 30 I/O Slots	Quantity of Slots with Capacity Expansion Feature and 10 I/O Slots
L32	1 to 4	141	229	281
L32	5 to 8	113	201	253
L32	9 to 12	87	175	227
D32	0	440	N/A (see Note)	N/A
D32	1 to 4	N/A	423	423
D32	5 to 8	N/A	409	409
D32	9 to 12	N/A	396	396

**Note:** N/A = not applicable.

### Related reference

“Capacity of Model L22, D22, L23, and D23 Frames” on page 163

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

“Capacity of Model L52, D52, L53, and D53 Frames” on page 165

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Capacity of Model L52, D52, L53, and D53 Frames

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

*Table 50. Quantity of storage slots in Model L52, D52, L53, and D53 frames.* The quantity depends on the type of Capacity On Demand Expansion feature installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

Type of Frame	Type of Capacity On Demand Feature	Quantity of Drives	Quantity of I/O Slots	Quantity of Storage Slots
L52, L53	Entry	0 to 12	16	64
L52, L53	Intermediate	0 to 12	16	129
L52, L53	Full	0 to 4	16	287
L52, L53	Full	5 to 8	16	273
L52, L53	Full	9 to 12	16	261
L52, L53	Full	0 to 4	32	245
L52, L53	Full	5 to 8	32	231
L52, L53	Full	9 to 12	32	219
D52, D53 <sup>1</sup>	N/A <sup>2</sup>	0	N/A	440
D52, D53 <sup>1</sup>	N/A	1 to 4	N/A	422
D52, D53 <sup>1</sup>	N/A	5 to 8	N/A	408
D52, D53 <sup>1</sup>	N/A	9 to 12	N/A	396

**Notes:**

1. If the L frame is not an L32, L52, or L53, then the first D frame of a mixed media library will have one less storage slot to accommodate a diagnostic cartridge.
2. N/A = not applicable.

**Related reference**

“Capacity of Model L22, D22, L23, and D23 Frames” on page 163

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

“Capacity of Model L32 and D32 Frames” on page 164

This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.



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## Chapter 8. Tape Encryption Overview

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while maintaining its availability are priorities in our security-conscious world. Data encryption is a tool that answers many of these needs.

The IBM System Storage TS1120 Tape Drive is capable of encrypting data as it is written to any size IBM TotalStorage Enterprise Tape Cartridge 3592, including WORM cartridges. Encryption is performed at full line speed in the tape drive after compression. (Compression is more efficiently done before encryption.) This new capability adds a strong measure of security to stored data without the processing overhead and performance degradation associated with encryption performed on the server or the expense of a dedicated appliance.

Three major elements comprise the TS1120 Tape Drive encryption solution:

### **The encryption-enabled tape drive**

All TS1120 Tape Drives with Feature Code 5592 or 9592 are *encryption-capable*. This means that they are functionally capable of performing hardware encryption, but this capability has not yet been activated. In order to perform hardware encryption, the TS1120 Tape Drives must be *encryption-enabled*. In an IBM System Storage TS3500 Tape Library, TS1120 Tape Drives can be encryption-enabled through the IBM System Storage Tape Specialist. For all other TS1120 Tape Drives this process consists of having an IBM representative set up the drive for encryption. Only encryption-enabled TS1120 Tape Drives can be used to read and write encrypted 3592 tape cartridges.

### **Encryption key management**

Encryption involves the use of several kinds of keys, in successive layers. How these keys are generated, maintained, controlled, and transmitted depends upon the operating environment where the TS1120 Tape Drive is installed. Some applications are capable of performing key management. For environments without such applications, IBM provides the IBM Encryption Key Manager component for the Java platform (EKM) to perform all necessary key management tasks. “Managing Encryption” describes these tasks in more detail.

### **Encryption policy configuration**

This is the set of rules, or policies, that specify which volumes are to be encrypted. How and where these rules are set up depends on the operating environment. See “Managing Encryption” for more information.

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## Managing Encryption

The IBM Encryption Key Manager component for the Java platform (EKM) is a Java software program that assists IBM encryption-enabled tape drives in generating, protecting, storing, and maintaining encryption keys that are used to encrypt information being written to, and decrypt information being read from, tape media (tape and cartridge formats). EKM operates on z/OS®, i5/OS®, AIX®, Linux®, HP-UX, Sun Solaris, and Windows®, and is designed to be a shared resource deployed in several locations within an Enterprise. EKM is capable of serving numerous IBM encrypting tape drives, regardless of where those drives

reside (for example, in tape library subsystems, connected to mainframe systems through various types of channel connections, or installed in other computing systems.)

EKM acts as a process awaiting key generation or key retrieval requests sent to it through a TCP/IP communication path between EKM and tape library, tape subsystem, or tape drive. When a tape drive writes encrypted data, it first requests an encryption key from EKM. Upon receipt of the request, EKM generates an Advanced Encryption Standard (AES) key and serves it to the tape drives in two protected forms:

- Encrypted or *wrapped*, using Rivest-Shamir-Adleman (RSA) key pairs. The tape drive writes this copy of the key to the cartridge memory and three additional places on the tape for redundancy.
- Separately wrapped for secure transfer to the tape drive where it is unwrapped upon arrival and used to encrypt the data being written to tape.

When an encrypted tape cartridge is read, the protected AES key on the tape is sent to EKM where the AES key is decrypted. The AES key is then wrapped for secure transfer back to the tape drive, where it is unwrapped and used to decrypt the data stored on the tape. EKM also allows AES keys to be rewrapped, or *rekeyed*, using different RSA keys from the original ones that were used. (See “About Encryption Keys” on page 170 for more information.) This is useful when shipping tapes for use on external systems.

EKM supports the following IBM keystores: JCEKS, JCE4758KS/JCECAAKS, JCE4785RACFKS/JCECCARACFKS, JCERACFKS, PKCS11 | mplKS, and IBMi5OSKeyStore. See *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User’s Guide*, GA76-0148, for detailed information about the EKM and its supported keystores.

There are three methods of encryption management to choose from. These methods differ in where you choose to locate your EKM application. Your operating environment determines which is the best for you, with the result that key management and the encryption policy engine may be located in any one of the following three environmental layers.

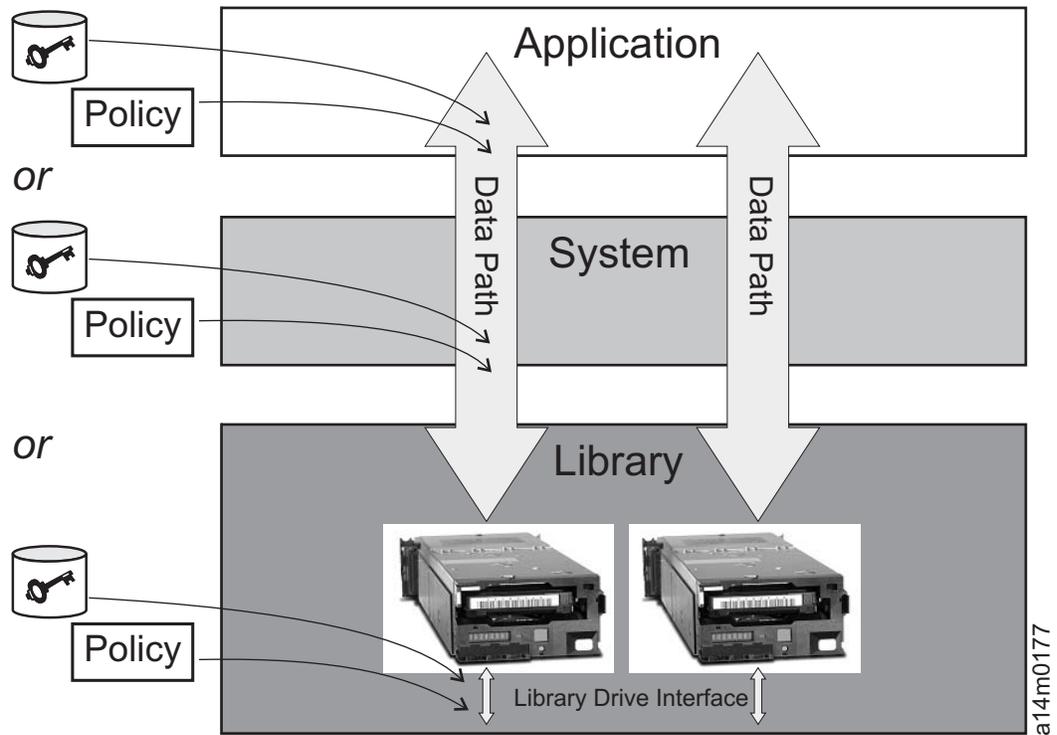


Figure 51. Three possible locations for encryption policy engine and key management.

**Application Layer**

Initiates data transfer for tape storage, for example TSM.

**System Layer**

Everything between the application and the tape drives, for example the operating system, z/OS DFSMS, device drivers, and FICON/ESCON controllers.

**Library Layer**

The enclosure for tape storage, such as the IBM System Storage TS3500 Tape Library. A modern tape library contains an internal interface to each tape drive within it.

**Application-Managed Tape Encryption**

This method is best where operating environments run an application already capable of generating and managing encryption policies and keys, such as Tivoli Storage Manager (TSM). Policies specifying when encryption is to be used are defined through the application interface. The policies and keys pass through the data path between the application layer and the TS1120 Tape Drives. Encryption is the result of interaction between the application and the encryption-enabled tape drive, and is transparent to the system and library layers.

For details on setting up Application-Managed tape encryption for TS1120 Tape Drives in an IBM System Storage TS3500 Tape Library, IBM TotalStorage 3494 Tape Library, IBM TotalStorage 3952 Tape Frame Model C20, or rack, see your Tivoli Storage Manager documentation or visit <http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp> for more information.

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## System-Managed Tape Encryption

This method is best for z/OS and Open Systems operating environments where no application capable of key management runs. Encryption policies specifying when to use encryption are set up in z/OS DFSMS (Distributed Facility Storage Management Subsystem) or implicitly through each instance of IBM device driver. Additional software products such as IBM Integrated Cryptographic Service Facility (ICSF) and IBM Resource Access Control Facility (RACF®) may also be used. Key generation and management is performed by the Encryption Key Manager (EKM), a Java application running on the host. Policy controls and keys pass through the data path between the system layer and the TS1120 Tape Drives. Encryption is transparent to the applications.

For details on setting up system-managed encryption on TS1120 Tape Drives in an AIX environment, see *IBM Tape Device Drivers: Encryption Support, IBM TotalStorage and System Storage Tape Device Drivers Installation and User's Guide*, or *IBM TotalStorage and System Storage Tape Device Drivers Programming Reference*.

For details on setting up system-managed encryption on TS1120 Tape Drive in a System z™ platform environment, see *z/OS DFSMS Software Support for IBM TotalStorage Enterprise Tape Drive TS1120 ( 3592 )*.

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## Library-Managed Tape Encryption

This method is best for TS1120 Tape Drives in an open-attached IBM System Storage TS3500 Tape Library. Scratch encryption policies specifying when to use encryption are set up through the IBM System Storage Tape Library Specialist Web interface. Policies are based on cartridge volume serial numbers. Key generation and management is performed by EKM, a Java application running on a library-attached host. Policy control and keys pass through the library-to-drive interface, therefore encryption is transparent to the applications.

For details on setting up Library-Managed encryption on TS1120 Tape Drives, see *IBM System Storage TS3500 Tape Library Operator Guide*.

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## About Encryption Keys

An Advanced Encryption Standard (AES) encryption key is typically a random string of bits generated specifically to scramble and unscramble data. Encryption keys are created using algorithms designed to ensure that each key is unique and unpredictable. The longer the key string, the harder it is to break the encryption code. TS1120 Tape Drive encryption uses 256-bit AES algorithm keys to encrypt data. 256-bit AES is the encryption standard currently recognized and recommended by the U.S. government.

Two types of encryption algorithms are used by EKM for encryption on the TS1120 Tape Drive: symmetric algorithms and asymmetric algorithms. Symmetric, or secret key encryption, uses a single key for both encryption and decryption. Symmetric key encryption is generally used for encrypting large amounts of data in an efficient manner. Asymmetric encryption uses a pair of keys. Data encrypted using one key can only be decrypted using the other key in the asymmetric key pair.

When an asymmetric, or public/private key pair is generated, the public key is typically used to encrypt, and the private key is typically used to decrypt. TS1120 Tape Drive encryption uses both types; symmetric encryption for high-speed

encryption of user or host data, and asymmetric encryption (which is necessarily slower) for protecting the symmetric key used to encrypt the data (key wrapping).

When unencrypted data (clear text) is sent to the TS1120 Tape Drive for encryption, it is converted to ciphertext through AES encryption, a symmetric (or secret) key type of encryption requiring a symmetric Data Key (DK), and is then written to tape. The 256-bit AES Data Key is also encrypted, or wrapped, using the public key from an asymmetric Key Encrypting Key (KEK) pair to create an Externally Encrypted Data Key (EEDK). This EEDK is written to the cartridge memory and to three additional places on the 3592 Tape Cartridge. The tape cartridge now has both the encrypted data and the means to decrypt it for anyone who holds the private KEK.

The DK may also be wrapped a second time, using the public key of another party, to create an additional EEDK. Both EEDKs can be stored on the tape cartridge. In this way, the tape cartridge can be shipped to a business partner holding the corresponding private key that would allow the DK to be unwrapped and the tape decrypted on a different TS1120 Tape Drive.

Encryption keys are generated either by applications such as TSM, or by the EKM. Depending on the operating system and server where the EKM is installed, it may work in conjunction with RACF or ICSF to manage encryption keys.

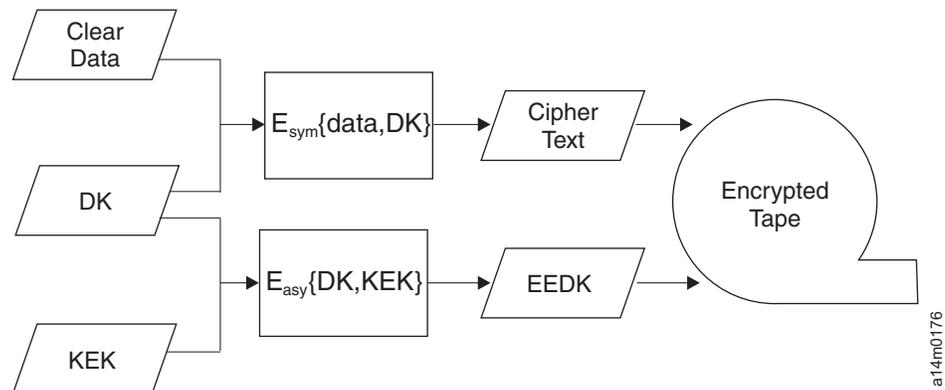


Figure 52. EKM Uses both Symmetric and Asymmetric Encryption Keys

## Encryption Setup Tasks at a Glance

Before you can use the encryption capability of the TS1120 Tape Drive, you must be sure that certain software and hardware requirements are met. The following checklists are intended to help you meet these requirements.

**Note:** Please contact your IBM Representative for additional information about encryption on the TS1120 Tape Drive.

## Planning for Application-Managed Tape Encryption

In order to perform encryption on the TS1120 Tape Drive, the following is required:

- Encryption-capable TS1120 Tape Drive(s)

## Application-Managed Tape Encryption Setup Tasks

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task).
  - Update library firmware (3494, 3584)
  - Update tape drive firmware (3592 Models E05, J1A in same library or environment)
2. Encryption-enable the TS1120 (3592 E05) Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 Tape Drive on TS3500. For all others, this is an IBM service task.
3. Install appropriate IBM tape device driver level (Atape, for example).
4. Set up encryption policies. Refer to *IBM Tivoli Storage Manager for AIX Administrator's Guide*.
5. Perform write/read operation to test encryption.
6. Verify encryption of the test volume by Autonomic Management Engine (AME): issue  
QUERY VOLUME FORMAT=DETAILED

Verify that Drive Encryption Key Manager is set to Tivoli Storage Manager.

## Planning for System-Managed Tape Encryption

In order to perform system-managed encryption on the TS1120 Tape Drive, the following is required:

- Encryption-capable TS1120 Tape Drive(s).
- Keystore
- IBM Encryption Key Manager component for the Java platform (EKM).
- Routers and cables for out-of-band EKM-to-TS1120 Tape Drive path (System z platforms only).

## Setup Tasks for System-Managed Tape Encryption on IBM System z Platforms

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task).
  - Update tape drive firmware (3592 Models E05, J1A in same environment)
  - Update 3494, 3584, and 3953 tape system library firmware (System z platforms or 3953 in heterogeneous environment)
  - Update 3592 Models C06, J70 Tape Controller firmware (System z platforms or tape controllers in heterogeneous environment)
2. Encryption-enable the TS1120 (3592 E05) Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 Tape Drive on TS3500. For all others, this is an IBM service task.
3. Install tape controller code update, Feature Code 5595 (IBM service task).
4. Install, cable, and configure routers to EKM, Feature Code 5593 (for out-of-band path to EKM only) (IBM service task).
5. Define Primary/Secondary EKM IP ports (for out-of-band path to EKM only).
6. Set up FICON proxy in host(s) for the EKM interface to encryption-enabled TS1120 Tape Drive(s).
7. Update z/OS and DFSMS host software (++APARs).
8. Set up encryption policies.

- Update DFSMS Data Class to specify encryption (recording format EE2) and other optional parameters (media type, performance scaling, etc.) as appropriate.
- Specify the key labels through the DD statement, data class or EKM defaults.
- Update other DFSMS polices (as appropriate) to steer allocation to correct library.

Refer to *IBM z/OS DFSMS Software Support for IBM TS1120 Tape Drive*.

9. Set up in-band key management (IECIOSxx PARMLIB member or SETIOS command; also define the IOSAS OMVS segment to RACF).
10. Make the appropriate HCD changes.
11. Determine if coexistence support is needed.
12. Contact your tape management system or application vendor for any required code changes and any installation exit changes that are needed.
13. Set up the system-managed encryption method. For 3494 or stand-alone drives, have the your IBM service representative update the drives. For 3584, update using the IBM System Storage Tape Library Specialist.
14. Schedule an IPL
15. Use RAS functions to verify (IBM service task) EKM paths and encryption configuration.

## Setup Tasks for System-Managed Tape Encryption on Open Systems Platforms

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task).
  - Update tape drive firmware (3592 Models E05, J1A in same environment)
  - Update 3494, 3584, and 3953 tape system library firmware (System z platforms or 3953 in heterogeneous environment)
  - Update 3592 Models C06, J70 Tape Controller firmware (System z platforms or tape controllers in heterogeneous environment)
2. Encryption-enable the TS1120 (3592 E05) Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 Tape Drive on TS3500. For all others, this is an IBM service task.
3. Update Atape device driver.
4. Update Atape EKM Proxy Config file with EKM IP Addresses.
5. Update device attributes (rmtx)
  - Use System Encryption FCP Proxy Manager.
  - System Encryption for Write Commands at BOP.

Refer to:

*IBM Tape Device Drivers: Encryption Support*

*IBM TotalStorage and System Storage Tape Device Drivers Installation and User's Guide*

6. Use tapeutil functions to verify EKM paths and encryption configuration.

## Planning for Library-Managed Tape Encryption

In order to perform encryption on the TS1120 Tape Drive, the following is required:

- Encryption-capable TS1120 Tape Drive(s)

- Keystore
- IBM Encryption Key Manager component for the Java platform (EKM)

## **Library-Managed Tape Encryption Tasks**

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task).
  - Update tape system library firmware (3584)
  - Update tape drive firmware (3592 Models E05, J1A in same library)
2. Use IBM System Storage Tape Library Specialist to enable TS1120 Tape Drive and TS3500 Tape Library for library-managed tape encryption (refer to *IBM System Storage TS3500 Operator's Guide*).
  - Add EKM IP addresses
  - Set up scratch encryption policy (optional)
3. Use library diagnostic functions to verify EKM paths and encryption configuration.

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## Appendix A. Statement of Limited Warranty

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**Machine:** IBM System Storage TS3500 Tape Library, IBM System Storage 3588 Tape Drive Model F3A, and IBM System Storage TS1030 Tape Drive Model F3B

**Warranty Period\*:** 1 year

*\*Contact your place of purchase for warranty service information. Some IBM Machines are eligible for On-site warranty service, depending on the country or region where service is performed.*

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Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to:

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
3. where applicable, before service is provided
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  - b. secure all programs, data, and funds contained in a Machine,

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- EN60950
- IEC60825
- EN60825
- CSA-950
- UL-1950
- IBM Internal Safety Standards

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### IBM System Storage TS3500 Tape Library

## Federal Communications Commission (FCC) Class A Statement

**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

IBM is not responsible for any radio or television interference caused by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Konformitätserklärung nach Paragraph 5 des EMVG ist die: IBM Deutschland Informationssysteme GmbH 70548 Stuttgart.

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## Glossary

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

## Numbers

**2:1 or 3:1 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. In 3:1 compression, three times as much data can be stored with compression as can be stored without compression.

**2N.** Twice the amount of a system's electrical power load. If the system has 2N power supplies, then there are two power supplies available for every load, which means greater redundancy and availability of electrical power. The Enhanced Frame Control Assembly of the 3584 Tape Library offers a 2N power design with no single point of failure or single point of repair.

**3584 Tape Library.** See *IBM System Storage TS3500 Tape Library*.

**3588 Tape Drive.** See *IBM System Storage 3588 Tape Drive Model F3A* or *IBM System Storage TS1030 Tape Drive Model F3B*. Also known as the *Ultrium 3 Tape Drive*.

**3592 Tape Controller Model J70.** See *IBM TotalStorage 3592 Tape Controller Model J70*.

**3592 Tape Drive.** See *IBM TotalStorage 3592 Tape Drive Model J1A* or *IBM System Storage TS1120 Tape Drive*.

**3593 Tape System.** The IBM 3953 Tape Frame Model F05 and the IBM 3953 Library Manager Model L05.

## A

**A.** Ampere.

**AAP.** See *authorized assembler program*.

**ac.** See *alternating current*.

**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.

**ac line voltage.** The input voltage (in volts) that is required by the 3584 Tape Library for normal operation.

**Activity screen.** The primary screen on the touchscreen of the 3584 Tape Library. The Activity screen gives the level of firmware in the library, shows whether the library is ready, not ready, or initializing, and tells the quantity of tape cartridges currently in the I/O stations. The screen also indicates the current activity being performed, the volume serial (VOLSER) number 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.

**addressable cartridge storage slots.** Within the 3584 Tape Library, units that can contain tape cartridges and that are recognizable to the library by both a physical address (such as F01-C05-R19) and a SCSI element (logical) address (such as 1112(X'458'). Addressable cartridge storage slots do not include I/O station slots or the non-addressable slots that are reserved for the diagnostic cartridges. The quantity of addressable cartridge storage slots per frame varies, depending on the quantity of drives that are installed in the frame.

| **Advanced Interactive eXecutive (AIX).** A UNIX operating system developed by IBM that is designed and optimized to run on POWER microprocessor-based hardware such as servers, workstations, and blades.

**Advanced Library Management System (ALMS).** The next generation of IBM's patented Multi-Path Architecture. ALMS enables logical libraries to consist of unique drives and ranges of VOLSERs, instead of fixed locations. It offers the ability to assign tape drives to any logical library by using the IBM System Storage Tape Library Specialist web interface. Logical libraries can also be added, deleted, or easily changed without disruption. ALMS is optional and requires a license key.

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

| **AIX.** See *Advanced Interactive eXecutive*.

**AL\_PA.** See *Arbitrated Loop Physical Address*.

**alphanumeric.** Pertaining to a character set that contains letters, numerals, and usually other characters, such as punctuation marks.

**alternating current (ac).** An electric current that reverses its direction at regularly recurring intervals.

**amp.** Ampere.

**ampere (A, amp).** A unit of measure for electric current that is equivalent to a flow of one coulomb per second, or to the current produced by one volt applied across a resistance of one ohm.

**Arbitrated Loop Physical Address (AL\_PA).** An 8-bit value used to identify a device in an arbitrated loop. Device ports communicate by using AL\_PAs.

**authorized assembler program (AAP).** A training program for selected IBM Business Partners that enables them to purchase incomplete machines and parts, and provides them with the knowledge to assemble the components into a final configured product for sale to customers.

**automatic cleaning.** A method by which the 3584 Tape Library 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 IBM System Storage Tape Library Specialist web interface.

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

## B

**backhitch.** When the speed of the host server is slower than that of the drive, the action of stopping the tape, rewinding some distance, and restarting.

**backup.** 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.

**Backup Recovery and Media Services (BRMS).** A software program that runs on OS/400 and allows a business to plan, control, and automate the backup, recovery, and media management services for its AS/400 systems.

**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 3584 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 3584 Tape Library (also known as Models L22, L23, L32, L52, or L53). 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 up to 12 tape drives.

**bel.** Ten decibels.

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

**bpi.** Bits per inch.

**bridge.** A storage controller that forms a bridge between two external I/O buses.

**British thermal unit (Btu).** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at a specified temperature.

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

**BRSM.** See *Backup Recovery and Media Services*.

**Btu.** See *British thermal unit*.

**bulk load.** To manually insert large quantities of tape cartridges into a tape library's empty storage slots.

**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.

**calibration sensor.** Located on the cartridge accessor of the 3584 Tape Library, the component that provides the means to find certain positions within the library very precisely during the calibration operation.

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

**capacity.** See *media capacity*.

**Capacity Expansion Feature.** Applicable only to the base frame (Models L22, L23, L32, L52, or L53) of the 3584 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.

**Capacity On Demand.** Applicable only to Models L22, L23, L52, and L53, a feature that adds capacity to the library and that is only available through the field.

**cartridge.** See *tape cartridge*.

**cartridge accessor.** The mechanism in the 3584 Tape Library 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 3584 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 3584 Tape Library to determine whether each cartridge storage slot in the library is empty or full.

**cartridge manual rewind tool.** A device that can be fitted into the reel of a cartridge and used to rewind tape into or out of the cartridge.

**cartridge memory.** See *LTO cartridge memory*.

**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 3584 Tape Library and are used to store tape cartridges.

**caster.** One of four wheels that are mounted in swivel frames and used to support the weight of the 3584 Tape Library.

**CETool.** CETool is a software program that is used by IBM Service personnel (also known as customer engineers or CEs) to update library and drive firmware, configure the Call Home program for the 3584 Tape Library, collect library and drive logs, backup and restore the configuration for non-volatile random access memory (NVRAM), and perform other service-related tasks.

**cell top cap.** Located on each column of storage slots within the 3584 Tape Library, a plastic component to which a bar code label holder can be attached. The library uses the bar code label to establish the boundary of a logical library.

**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*.

**clearance.** The distance by which one object clears another or the clear space between them.

**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 3584 Tape Library, 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 3584 Tape Library to manage communication to and from a server and the library.

**control path failover.** In the event of a command failure, an optional feature of the 3584 Tape Library that enables the host device driver to resend the command to an alternate control path for the same logical library. The device driver initiates error recovery and continues the operation on the alternate control path without interrupting the application.

**current.** The quantity of charge per unit of time. Measured in amperes (amps, A).

## D

**daisy-chain.** To serially interconnect a series of SCSI connectors for multiple devices on the SCSI bus.

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

**data cartridge.** A tape cartridge dedicated to storing data. Contrast with *cleaning cartridge*.

**data compression.** See *compression*.

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

| class, management class, storage group, and automatic  
| class selection routine definitions.

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

**data transfer element (DTE) address.** In SCSI terms, the physical location of 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.

**dB.** Decibel.

**decibel.** A unit of measure that expresses the ratio of two amounts of electric or acoustic signal power that is equal to 10 times the common logarithm of this ratio.

| **decrypt.** (1) To decipher data. (2) In Cryptographic  
| Support, to convert ciphertext into plaintext. See also  
| *encrypt*.

**dc.** Direct current.

**degauss.** To make a magnetic tape nonmagnetic by means of electrical coils carrying currents that neutralize the magnetism of the tape.

**degausser.** A device that makes magnetic tape nonmagnetic.

**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.

| **DFSMS.** See *Data Facility Storage Management*  
| *Subsystem*.

**differential.** See *High Voltage Differential*.

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

**differential.** See *High Voltage Differential*.

**disable.** To make nonfunctional.

**door safety switch.** Located on each frame of the 3584 Tape Library, a mechanism that automatically turns off the power to the cartridge accessor whenever you open the front door.

**drive.** See *IBM TotalStorage LTO Ultrium 1 Tape Drive*, *IBM TotalStorage LTO Ultrium 2 Tape Drive*, *IBM System Storage 3588 Tape Drive Model F3A*, *IBM System Storage*

*TS1030 Tape Drive Model F3B*, *IBM System Storage TS1120 Tape Drive* or *IBM TotalStorage 3592 Tape Drive Model J1A*.

**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 3584 Tape Library 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.

## E

**eject.** To remove or force out from within.

| **EKM.** See *enterprise key manager*.

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

**element address.** The SCSI term for the host's view of a cartridge location.

**e-mail.** See *electronic mail*.

**enable.** To make functional.

| **encrypt.** In Cryptographic Support, to systematically  
| scramble information so that it cannot be read without  
| knowing the coding key. See also *decrypt*.

| **encryption.** The conversion of data into a cipher. A  
| key is required to encrypt and decrypt the data.  
| Encryption provides protection from persons or  
| software that attempt to access the data without the  
| key.

| **encryption key manager (EKM).** A Java software  
| program that assists IBM-encrypting tape drives in  
| generating, protecting, storing, and maintaining  
| encryption keys, which encrypt information written to  
| and decrypt information read from tape media.

**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 10-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 3584 Tape Library, the lower compartment into which you insert and remove cartridges into and from the library. Both stations are accessed by the cartridge accessor.

**expansion frame.** A unit that may be added to the base frame of the 3584 Tape Library. Also known as the Model D22, D23, D32, D52, or D53, the expansion frame includes a rail assembly for the cartridge accessor and up to 12 tape drives.

## F

**FCA.** See *frame control assembly*.

**FCB.** Frame control box. See *frame control assembly*.

**Fibre Channel.** A high-speed, full-duplex, serial communications technology that is capable of interconnecting Ultrium Tape Drives and 3592 Tape Drives to 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.

**Fibre Channel address.** For a tape drive that uses a Fibre Channel interface, an identifier (such as an AL\_PA or Loop ID) that enables other device ports to communicate with that drive.

**Fibre Channel cable.** The cable that connects a Fibre Channel tape drive to another device. The conductive element within the cable is constructed of either copper wires or optical fibers. Generally, copper wires are used for short distances (up to 30 meters or 98 feet); optical fibers are used for longer distances. Fiber-optic cabling is referred to by mode or the frequencies of light waves that are carried by a particular cable type. Multi-mode fiber cables are generally used for distances up to 500 meters (1640 feet) and with short-wave (780 nanometer) laser light. Single-mode fiber cables are used for distances greater than 500 m (1640 feet) and with long-wave (1300 nanometer) laser light.

**fiber optics.** A branch of optics dealing with the transmission of light through fibers or thin rods of glass or some other transparent material of high refractive index.

**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 (FCA).** The power structure for Models L22, D22, L32, D32, L52, and D52. The assembly is a group of parts that consists 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 3584 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 3584 Tape Library, 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 capacity expansion.** A feature that increases the initial capacity of Model L22, L23, L52, and L53 frames. Models L22 and L23 increase from 58 to 199 or 260 cartridge slots for 3592 Tape Cartridges. Models L52 and L53 increase from 64 to 219 or 287 cartridge slots for LTO Ultrium Tape Cartridges.

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

## G

**GB.** See *gigabyte*.

**Gb.** See *gigabit*.

**Gbps.** Gigabits per second. One gigabit equals 1 000 000 000 bits.

**get.** (1) In library operation, the act of a cartridge gripper retrieving a tape cartridge from a storage slot, drive, or I/O station. (2) In Simple Network Management Protocol (SNMP), a request for information about the library that the operator issues through a monitoring server and which is transmitted by SNMP.

**get-response.** The information that is provided in response to an SNMP get.

**gigabit (Gb).** 1 000 000 000 bits.

**gigabyte (GB).** 1 000 000 000 bytes.

## H

**HACMP.** See *High Availability Clustered Multiprocessing*.

**HBA.** See *host bus adapter*.

**head.** See *drive head*.

**heat output.** The amount of heat (in kBtu/hr) that the 3584 Tape Library dissipates during normal operation.

**hertz (Hz).** A unit of frequency equal to cycle per second.

**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 Availability Clustered Multiprocessing (HACMP).** An IBM AIX solution that automatically detects system or network failures and eliminates a single point of failure by managing failover to a recovery processor. High availability clustering refers to the linking of two or more computers, one of which can provide operation if the other one fails.

**High Voltage Differential (HVD).** A logic signaling system that enables data communication between a supported server and the 3584 Tape Library. 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 bus adapter (HBA).** An adapter that provides I/O processing and physical connectivity between a server and storage.

**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.

**HTTP.** See *Hyper Text Transfer Protocol*.

**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*.

**Hyper Text Transfer Protocol (HTTP).** The primary Internet protocol that is used to connect to most web servers. HTTP delivers content for web pages or downloads files.

**Hz.** Hertz.

## I

**IBM System Storage 3588 Tape Drive Model F3A.** 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 400 GB per cartridge; with 2:1 compression, its capacity is up to 800 GB. The Model F3A drive provides 2 Gbps Fibre Channel connectivity. Also known as the Ultrium 3 Tape Drive.

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

**IBM System Storage TS1030 Tape Drive Model F3B.** 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 400 GB per cartridge; with 2:1 compression, its capacity is up to 800 GB. The Model F3B drive provides 4 Gbps Fibre Channel connectivity. Also known as the Ultrium 3 Tape Drive.

**IBM System Storage TS1120 Tape Drive.** Located within the 3584 Tape Library, 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. When the media is formatted for a J1A format, the drive's native data capacity is 300 GB and its data rate is 40 MB/s; with 3:1 compression, its capacity is 900 GB. When the media is formatted for a E05 format, the drive's native data capacity is 500 GB and its data rate is 100 MB/s; with 3:1 compression, its capacity is 1.5 TB. Formerly known as the IBM TotalStorage 3592 Tape Drive Model E05.

**IBM System Storage TS3500 Tape Library.** Formerly known as the IBM TotalStorage 3584 Tape Library, a

device that can be attached to one or more supported servers and used to write data to and from magnetic tape. The library, also known as the 3584 Tape Library, can include up to 16 frames and 192 drives, and any combination of Ultrium 3, Ultrium 2, and Ultrium 1 Tape Drives in Ultrium frames, and 3592 Tape Drives in 3592 frames.

**IBM TotalStorage 3592 Tape Drive Model J1A.**

Located within the 3584 Tape Library, 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 300 GB; with 3:1 compression, its capacity is 900 GB. The drive has a native data rate of 40 MB/s (80 MB/s at 2:1 compression).

**IBM TotalStorage 3592 Tape Controller Model J70.**

Located in the Tape Frame Model F05, a device that links the IBM eServer zSeries server (mainframe host), the L05 Library Manager, and the 3592 Tape Drives in the 3584 Tape Library.

**IBM TotalStorage LTO Ultrium 1 Tape Drive.**

Located within the 3584 Tape Library, a data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge (Ultrium 1). 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.

**IBM TotalStorage LTO Ultrium 2 Tape Drive.**

Located within the 3584 Tape Library, a data-storage device that controls the movement of the magnetic tape in an IBM TotalStorage 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 TotalStorage Productivity Center (TPC).** A software solution that manages storage infrastructures in Open Systems environments.

**ID.** Identifier.

**IEE.** See *import/export element*.

**IEEA.** See *import/export element address*.

**IEEE.** Institute of Electrical and Electronics Engineers.

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

**import/export element address (IEEA).** In SCSI terms, the location of an I/O slot.

**independent software vendor (ISV).** A company that makes and sells software products that run on one or more computer hardware or operating system platforms.

**initial program load (IPL).** (1) The initialization procedure that causes an operating system to commence operation. (2) The process by which a configuration image is loaded into storage at the beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs.

**initialize.** To format a magnetic tape, write a label (VOLSER) on the tape, and leave the tape empty except for the system files containing the structure information. All former contents of the tape are lost.

**initializing.** The act of performing an inventory on the 3584 Tape Library.

**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 3584 Tape Library, one or two compartments into which you insert and remove cartridges into and from the library. Both stations are accessed by the cartridge accessor.

**inrush current.** The momentary peak current (in amperes) into the 3584 Tape Library when the ac line voltage is first applied.

**insert.** Pertaining to the 3584 Tape Library, 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.

**interchange.** The ability to process (read or write) given tape data on any one of a set of tape devices that support the form factor and recording format of the tape data.

**interchange application.** The preparation of tapes for use on other systems or devices, either local or remote, or the use of tape data prepared by another system.

**intermediate capacity expansion.** A feature that increases the initial capacity of Model L22, L23, L52, and L53 frames. Models L22 and L23 increase from 58 to 117 cartridge slots for 3592 Tape Cartridges. Models L52 and L53 increase from 64 to 129 cartridge slots for LTO Ultrium Tape Cartridges.

**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*.

**IPL.** Initial program load.

**ISV.** See *independent software vendor*.

## K

**kBtu.** KiloBtu.

| **key label.** An alias to a encryption key (cipher) used  
| by the encryption key manager.

| **key manager.** In cryptography, a software application  
| that manages one or more secret encryption keys.

| **key manager address.** In cryptography, the IP address  
| of an encryption key manager.

| **keystore.** A database of private keys and their  
| associated digital certificate chains used to authenticate  
| the corresponding public keys.

**KiloBtu.** 1000 Btu's.

**KiloVolt.** 1000 volts.

**KiloWatt.** 1000 watts.

**kVA.** KiloVolt.

**kW.** KiloWatt.

## L

**label.** See *bar code label*.

**label area.** On the LTO Ultrium Tape Cartridge or 3592 Tape Cartridge, a recessed area next to the write-protect switch where a bar code label must be affixed.

**LAN.** See *local area network*.

**LCD.** See *liquid crystal display*.

**leader pin.** On the LTO Ultrium Tape Cartridge and 3592 Tape Cartridge, a small metal column attached to the end of the magnetic tape. During tape processing the leader pin is grasped by a threading mechanism, which pulls the pin and the tape out of the cartridge, across the drive head, and onto a takeup reel. The head can then read or write data from or to the tape.

**leveling jackscrews.** Located on the bottom the 3584 Tape Library, one of four screw-operated jacks for raising or lowering the library.

**library frame.** The basic unit of the 3584 Tape Library. The frame includes the hardware support structure, covers, mechanisms, and parts. Two types of frames are available: base frame (Models L22, L23, L32, L52, or L53) and expansion frame (Models D22, D23, D32, D52, or D53).

**Library Manager.** See *IBM 3953 Library Manager Model L05*.

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

**license key.** A password or table that is needed to decipher encoded data.

**Linear Tape-Open (LTO).** A type of tape storage technology developed by the IBM Corporation, Hewlett-Packard, and Certance. 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 Accellis 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 cartridge has a compressed data capacity of up to 800 GB (at 2:1 compression) and a native data capacity of up to 400 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.

**line frequency.** The frequency (in hertz) of the ac line voltage that the 3584 Tape Library requires for normal operation.

**link.** In Fibre Channel technology, the physical (optical) connection between two nodes of a network, which includes the combination of the link connection (the transmission medium) and two link stations, one at each end of the link connection.

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

**load.** Pertaining to the 3584 Tape Library 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 and unload cycle.** The act of inserting a cartridge into a tape drive, loading the tape to load point, rewinding the tape into the cartridge, and ejecting the cartridge from the drive.

**load point.** The beginning of the recording area on magnetic tape.

**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 library by their location or count. The ability of the 3584 Tape Library 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 3584 Tape Library. The tape library reads the labels and uses them to establish the boundaries of one or more logical libraries.

**logical library configuration.** A way of using the 3584 Tape Library so that its robotics are shared by homogenous (similar) and heterogeneous (dissimilar) servers. The 3584 Tape Library can be partitioned into individual logical libraries that independently communicate with individual servers via individual control paths.

**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.

**loop ID.** In Fibre Channel technology, the identifier that the 3584 Tape Library assigned to an Ultrium Tape Drive or 3592 Tape Drive. The ID is based on the drive's physical location within the library and is used by other devices in the topology to communicate.

**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 3584 Tape Library. LVD signaling uses two wires to drive one signal over copper wire. The use of wire pairs reduces electrical noise and crosstalk.

**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.

**Management Information Base (MIB).** Units of managed information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration. A collection of related MIB objects is defined as a MIB. The 3584 Tape Library can use the MIB to interpret problem alerts that are transmitted by SNMP traps.

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

**master console.** Located in the 3953 Tape Frame Model F05, a device that attaches to each installed 3953 L05 Library Manager, 3592 J70 Controller, 3494 B10 VTS, 3494 B20 VTS, and TS7700 Virtualization Engine. The master console monitors these components for early detection of unusual conditions and for error information that the components send to IBM's Remote Technical Assistance Information Network (RETAIN).

**MB.** See *megabyte*.

**Mbps.** Megabits per second.

**MCA.** See *Medium Changer assembly*.

**MCC.** See *Medium Changer card pack*.

**MCP.** See *Medium Changer card pack*.

**media.** The plural of *medium*.

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

**media-type identifier.** Pertaining to the bar code on the bar code label of the IBM LTO Ultrium Tape Cartridge, a 2-character code (Lx), that represents

information about the cartridge. L identifies the cartridge as one that can be read by devices that incorporate LTO technology; x indicates the generation of cartridge (1 represents the Ultrium 1 Tape Cartridge, 2 represents the Ultrium 2 Tape Cartridge, 3 represents the Ultrium 3 Tape Cartridge, and T represents the Ultrium 3 WORM Tape Cartridge).

**medium.** A physical material in or on which data may be represented, such as magnetic tape.

**Medium Changer assembly (MCA).** In the enhanced frame control assembly power structure, the device that facilitates communication between host applications and the library. The MCA is located above the drives and the fixed power trays in Model L23, D23, L53, and D53 frames. It houses two Ethernet ports for connection to the Tape Library Specialist web interface or a master console.

**Medium Changer card pack (MCC or MCP).** In the 3584 Tape Library, 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. 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.

**Medium Changer Device.** In SCSI terms, an instrument that moves removable storage units from and to storage slots and tape drives. The 3584 Tape Library is a Medium Changer Device.

**megabyte (MB).** 1 000 000 bytes.

**metal-particle tape.** In the LTO Ultrium Tape Cartridges and 3592 Tape Cartridge, tape that uses very small, pure metal particles (rather than oxide coatings) in the magnetic layer.

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

**MIB.** See *Management Information Base*.

**middleware.** A vague term that refers to the software between an application program and the lower-level platform functions.

**micron.** One millionth of a meter (.000001 m).

**Microsoft Systems Management Server (SMS) and Clustered Server Environments.** A solution from Microsoft that automatically detects system or network failures in Windows operating systems and eliminates a single point of failure by managing failover to a recovery processor.

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

**mixed drive types.** The concept of using both LTO Ultrium Tape Cartridges and 3592 Tape Cartridges in the 3584 Tape Library. A library can consist of frames that house all LTO Ultrium Tape Cartridges or all 3592 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 I/O station is installed for the 3592 Tape Cartridges.

**Model J1A.** See *IBM TotalStorage 3592 Tape Drive Model J1A*.

**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.

## N

**N.** A measure of the electrical power load in a system. If there are N loads in the system, N power supplies are required to power all of the loads.

**N/A.** Not applicable.

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

**NetView.** (1) Pertaining to an IBM licensed program that is used to monitor a network, manage it, and diagnose its problems. The NetView licensed program can be used to provide network management services for OSI Communications Subsystem. (2) A network management product that can provide automated operations and rapid notification of events.

**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.

**node.** In Fibre Channel technology, a communicating device.

**node card.** Within the 3584 Tape Library, one of four circuit assemblies (accessor controller card, motor driver assembly, Medium Changer card pack, and operator panel assembly) that communicate with each other.

**nominal.** Approximate.

**nominal power.** The amount of power (in kilowatts) that the 3584 Tape Library dissipates during normal operation.

**non-addressable cartridge storage slot.** A cartridge storage slot that is designated for the diagnostic cartridge, which is used during service procedures. The Models L22, L23, L32, L52, and L53 base frames each contain one non-addressable cartridge storage slot for a diagnostic cartridge at physical address F01,C01,R01. Additionally, the first expansion frame of a different media type (3592 or LTO) in a mixed media library contains one non-addressable cartridge slot for a diagnostic cartridge at physical addresses Fxx,C01,R01 (where xx equals the first expansion frame for the second type of media).

**nondisruptive firmware update.** The ability to update drive or library firmware without scheduling downtime. The 3584 Tape Library provides the ability to perform a nondisruptive update for its library firmware as well as firmware for the 3592 J1A Tape Drive, TS1120 Tape Drive, IBM System Storage 3588 Tape Drive Model F3A, and IBM System Storage TS1030 Tape Drive Model F3B.

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

## O

**Oersted.** The unit of magnetic field strength in the unrationalized centimeter-gram-second (cgs) electromagnetic system. The Oersted is the magnetic field strength in the interior of an elongated, uniformly wound solenoid that is excited with a linear current density in its winding of one abampere per  $4\pi$  centimeters of axial length.

**operating environment.** The temperature, relative humidity rate, and wet bulb temperature of the room in which the 3584 Tape Library routinely conducts processing.

**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 controls the tape library. The unit's LCD touchscreen provides information about the operation of the 3584 Tape Library, and one or two I/O stations for inserting and removing cartridges.

**operator panel controller.** Within the 3584 Tape Library, a circuit board that facilitates communication between the accessor controller and the operator panel. The controller provides input to and output from the

LCD, and senses and locks the I/O stations. In addition, the LCD activity and service menus are executed in the operator panel controller with support from the accessor controller and the drives (via the Medium Changer card packs).

**optimized dual gripper.** An electromechanical device that is mounted on the pivot assembly and gets or puts cartridges from or to a storage slot, tape drive, or I/O station.

## P

**partition.** A fixed-size division of storage.

**patch panel.** Located at the rear of the base or expansion frame in a 3584 Tape Library, an optional unit that houses the fiber cable connections between the servers and the individual drives.

**Pause key.** On the touchscreen of the 3584 Tape Library, a touch key that causes the cartridge accessor to park itself and provide clear access to the library's interior when you power-off the library or open the front door. The Pause key enables quick recovery when you power-on the library or close the front door.

**PDF.** See *Portable Document Format*.

| **ping.** (1) A command that calls an IP address. (2) The  
| act of issuing a command that calls an IP address.

**pivot assembly.** On the cartridge accessor of the 3584 Tape Library, a group of parts that provides a mounting platform for the gripper mechanism and the bar code reader. The pivot assembly is capable of 180° rotation about the vertical axis.

**point load.** On a floor, one or more locations where the weight of an object is concentrated.

**point-to-point topology.** In communications, the physical or logical arrangement of nodes in a network to facilitate data transmission between two locations without the use of any intermediate display station or computer.

**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 cord.** A cable that connects a device to a source of electrical power.

**power cord plug.** On a power cord, the male fitting for making an electrical connection to a circuit by insertion into a receptacle.

**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 3584 Tape Library.

**power receptacle.** The mounted female electrical fitting that contains the live parts of the circuit.

**power supply.** The electrical component of a computer system that converts standard ac current to the lower voltage dc current used by the computer. The amount of current a power supply can provide is rated in amperes.

**power switch.** See *library power switch*.

**protocol.** The meanings of, and the sequencing rules for, requests and responses used for managing a network, transferring data, and synchronizing the states of network components.

**put.** Pertaining to the 3584 Tape Library, to place, by means of a robotic device, a tape cartridge into a storage slot, drive, or I/O station.

## Q

**quiesce.** To put a device into a temporarily inactive or inhibited state, but not remove it from the system.

## R

**RABF.** See *recursive accumulating backhitchless flush*.

**rail system.** Within the 3584 Tape Library, 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.

**ready.** The operating condition that the 3584 Tape Library is in when the host applications can interact with it.

**recursive accumulating backhitchless flush (RABF).**

A non-volatile caching technique that is used by the IBM TotalStorage 3592 Tape Drive Model J1A or the IBM System Storage TS1120 Tape Drive.

| **rekey.** In cryptography, the process of encrypting a  
| data key a second time by using the public key of  
| another party to create an additional externally  
| encrypted data key. The cartridge can then be shipped  
| to a business partner that holds the corresponding  
| private key which allows the data key to be  
| unwrapped and the tape decrypted on a different  
| TS1120 Tape Drive.

**relative humidity.** The ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature.

**remote support.** See *Call Home*.

**Remote Technical Assistance Information Network (RETAIN).** Used by IBM Service Representatives, an internal host-based software application that contains records of service problems with IBM hardware and software, as well as tips on how to deal with the problems.

**remove.** Pertaining to the 3584 Tape Library, 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.

**RETAIN.** See *Remote Technical Assistance Information Network*.

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

**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*.

**SARS.** See *Statistical Analysis and Reporting System*.

| **scratch cartridge.** A labeled cartridge that is blank or  
| contains no valid data, that is not currently defined,  
| and that is available for use.

| **scratch encryption policy.** A means of identifying to a  
| TS1120 Tape Drive which scratch cartridges will be  
| encrypted on the next attempt to write from the  
| beginning of the tape. A scratch encryption policy  
| specifies what scratch cartridges to encrypt; it does not  
| indicate which cartridges are currently encrypted.  
| When used with library-managed encryption, a policy  
| optionally lets you control cartridge encryption by  
| VOLSER ranges in all logical libraries.

**SCSI.** See *Small Computer Systems Interface*.

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

**SCSI bus.** (1) A collection of wires through which data is transmitted from one part of a computer to another. (2) A generic term that refers to the complete set of signals that define the activity of the Small Computer Systems Interface (SCSI).

**SCSI address.** See *SCSI ID*.

**SCSI connector.** One of the set of all female and male connectors on the SCSI bus.

**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 3584 Tape Library to the SCSI interface. This logical address is represented on the operator panel or IBM System Storage Tape Library Specialist web interface as xxxx(yyyh), where xxxx is a decimal value and yyh is a hexadecimal value. It is assigned by the library 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) that is 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 pSeries, IBM iSeries, HP, and Sun are servers. Synonymous with *host*.

**service clearance.** Surrounding the 3584 Tape Library, the space required for an IBM Service Representative to perform maintenance on the unit.

**service ratings.** The values for criteria associated with an electrical power cord. The criteria include maximum voltage, current, phases, and wires.

**ship group.** The group of supplies, cords, or documentation that is shipped with the 3584 Tape Library.

**shipping environment.** The temperature, relative humidity rate, and wet bulb temperature of the environment to which the 3584 Tape Library is exposed when being transferred from one location to another.

**short-wave cable.** In Fibre Channel technology, a laser cable that uses a wavelength of 780 nanometers and is only compatible with multi-mode fiber.

**Simple Network Management Protocol (SNMP).** In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices that are managed is defined and stored in the application's Management Information Base (MIB).

**single-phase power.** Pertaining to the 3584 Tape Library, electricity that is transmitted via three wires (line, neutral, and ground), with a line-to-neutral voltage of 200-240 V ac.

**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 160 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.

**SMI-S.** See *Storage Management Initiative - Specification*.

**SMI-S Agent for Tape.** See *Storage Management Initiative - Specification (SMI-S) Agent for Tape*.

**SNMP.** See *Simple Network Management Protocol*.

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

**speed matching.** The ability of the Ultrium 3 and Ultrium 2 Tape Drives to adjust their native data rate as closely as possible to the net host data rate (after data compressibility has been factored out).

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

**Statistical Analysis and Reporting System (SARS).** Firmware that is built into the 3592 Tape Drives and the Ultrium Tape Drives and which is used by the drive during problem determination to identify which single-character display code, ASC/ASCQ, and/or TapeAlert to report.

**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.

**storage environment.** The temperature, relative humidity rate, and wet bulb temperature of the environment in which the 3584 Tape Library is nonoperational and being kept for future use.

**Storage Management Initiative - Specification (SMI-S).** A design specification of the Storage Management Initiative (SMI) that was launched by the Storage Networking Industry Association (SNIA). The SMI-S specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a Storage Area Network (SAN).

**Storage Management Initiative - Specification (SMI-S) Agent for Tape.** Software that is used by management software to communicate with storage devices in a SAN environment. The SMI-S Agent for Tape communicates by using the Web-Based Enterprise Management (WBEM) protocol, which allows management software to communicate with the 3584 Tape Library.

**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 TotalStorage LTO Ultrium 1 Tape Drive, IBM TotalStorage LTO Ultrium 2 Tape Drive, IBM System Storage 3588 Tape Drive Model F3A, IBM System Storage TS1030 Tape Drive Model F3B, IBM TotalStorage 3592 Tape Drive Model J1A, or IBM System Storage TS1120 Tape Drive*.

**Tape Frame.** See *IBM 3953 Tape Frame Model F05*.

**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.

**terminate, termination.** To prevent unwanted electrical signal reflections by applying a device (a terminator) that absorbs the energy from the transmission line.

**terminator.** (1) A part used to end a SCSI bus. (2) A single-port, 75- $\Omega$  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.

| **Tivoli Storage Manager (TSM).** An IBM client/server product that provides storage management and data access services in a heterogeneous environment. TSM

| supports various communication methods, provides  
| administrative facilities to manage the backup and  
| storage of files, and provides facilities for scheduling  
| backups.

**topology.** In communications, the physical or logical arrangement of nodes in a network, especially the relationships among nodes and the links between them.

**Total Productivity Center (TPC).** See *IBM Total Productivity Center*.

**touch keys.** On the touchscreen of the 3584 Tape Library, an array of small, touch-sensitive keypads that lets you select and navigate through menus. To acknowledge that it has been pressed, a touch key initiates an audible beep (if enabled) whenever you press it. The audible beep is the default.

**touchscreen.** See *liquid crystal display*.

**TPC.** See *IBM Total Productivity Center*.

**track.** A linear or angled pattern of data written on a tape surface.

**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.

**TS1120 Tape Drive.** See *IBM System Storage TS1120 Tape Drive*.

**TSM.** See *Tivoli Storage Manager*.

**two-node arbitrated loop.** In Fibre Channel technology, the connection of two nodes that communicate directly (without the use of a switch) and use the same protocol.

**two-node switched fabric loop.** In Fibre Channel technology, the connection of two or more nodes that may not use the same protocol and communicate by using a switch.

**two-phase power.** Pertaining to the 3584 Tape Library, electricity that is transmitted via three wires (line, line, and ground), with a line-to-line voltage of 200-240 V ac. Sometimes referred to as *single phase power*.

## U

**Ultra SCSI.** See *Small Computer Systems Interface*.

**Ultra160 SCSI.** See *Small Computer Systems Interface*.

**Ultra2 SCSI.** See *Small Computer Systems Interface*.

**Ultra3 SCSI.** See *Small Computer Systems Interface*.

**Ultra320 SCSI.** See *Small Computer Systems Interface*.

**Ultrium Tape Drive.** See *IBM TotalStorage LTO Ultrium 1 Tape Drive, IBM TotalStorage LTO Ultrium 2 Tape Drive, IBM System Storage 3588 Tape Drive Model F3A, or IBM System Storage TS1030 Tape Drive Model F3B*.

**Ultrium 3 Tape Drive.** See *IBM System Storage 3588 Tape Drive Model F3A or IBM System Storage TS1030 Tape Drive Model F3B*.

**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 3584 Tape Library, 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

**V ac.** Volts ac (alternating current).

**vital product data (VPD).** Pertaining to the 3584 Tape Library, information about a product such as a library, drive, or node card. The VPD may include a machine type, model number, serial number, part number, or level of firmware.

**void.** In character recognition, the inadvertent absence of ink within a character outline.

**VOLSER.** Volume serial number.

**volt.** The SI (international) unit of potential difference and electromotive force, formally defined to be the difference of electric potential between two points of a conductor carrying a constant current of one ampere, when the power dissipated between these points is equal to one watt.

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

**VPD.** See *vital product data*.

## W

**W.** Watts.

**watt.** A metric unit of measure of power; the power required to keep a current of one ampere flowing under a potential drop of one volt; about 1/736 of one horsepower.

**web.** See *World Wide Web*.

**wet bulb temperature.** The temperature at which pure water must be evaporated adiabatically at constant pressure into a given sample of air in order to saturate the air under steady-state conditions. Read from a wet-bulb thermometer.

**World Wide Node Name.** In Fibre Channel technology, the fixed, 64-bit name assigned to a device by its manufacturer and used to identify participants in a topology. The World Wide Node Name will be unique if the manufacturer has registered a range of addresses with the IEEE.

**World Wide Port Name.** Within a parent node, a unique 64-bit name that is assigned to a node port. The World Wide Port Name aids the accessibility of the port.

**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.

**WORM.** See *write once read many*.

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

**write once read many (WORM).** A technology that allows data to be written only once to LTO Ultrium 3 and 3592 tape cartridges. After being written, the data cannot be altered, but can be read any number of times.

**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 3592 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.

## X

**X-axis and Y-axis motion assemblies.** Within the 3584 Tape Library, a group of parts that provides the motive force to move the accessor side to side (on the X-axis) and up and down (on the Y-axis).

## Y

**Y-axis motion assembly.** See *X-axis and Y-axis motion assemblies*.

## Z

**zoning.** A method of subdividing a storage area network into disjoint zones, or subsets of nodes on the network. Storage area network nodes outside a zone are invisible to nodes within the zone. Moreover, with switched SANs, traffic within each zone may be physically isolated from traffic outside the zone.

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.csv

See comma-separated value (.csv) format

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IBM 3584 Tape Library

Publication No. GA32-0559-01

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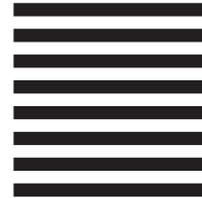
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