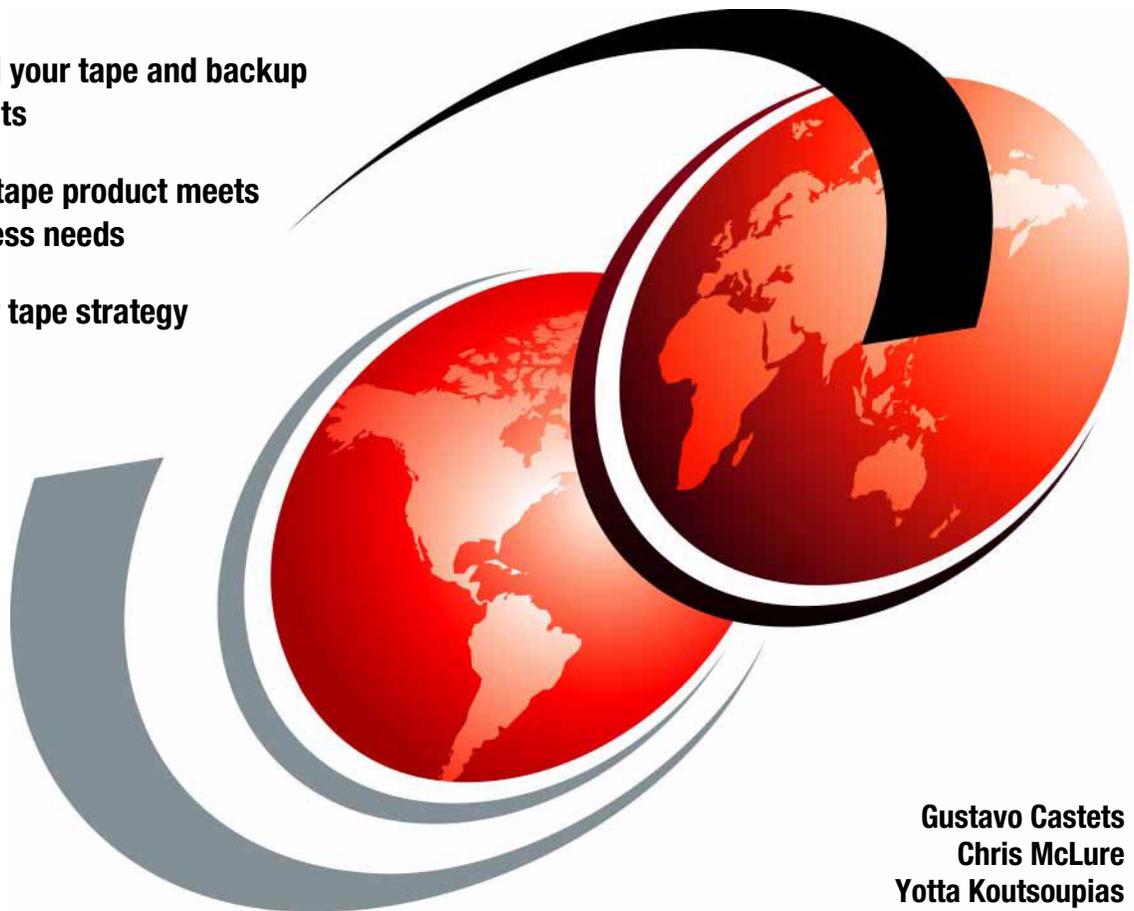# IBM

IBM TotalStorage Tape Selection and Differentiation Guide

Understand your tape and backup requirements

See which tape product meets your business needs

Define your tape strategy

Gustavo Castets
Chris McLure
Yotta Koutsoupias

Redbooks

IBM

International Technical Support Organization

IBM TotalStorage Tape Selection and Differentiation Guide

June 2004

Note: Before using this information and the product it supports, read the information in "Notices on page xiii."

Third Edition (June 2004)

This edition applies to the IBM TotalStorage Tape products as of April 2004.

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Preface

This IBM Redbook will help you select the appropriate tape solution for various backup scenarios found in open systems environments.

This redbook is a tape product selection and differentiation guide that is designed to assist you in finding all the information you will need to select the best tape solution for the designated backup environment. With this book, you will be able to determine the best solution for the specific backup scenarios from entry level to high-end markets.

This guide describes the information gathering process and product selection criteria to differentiate among the available IBM tape offerings. It provides a basis for tape differentiation. It is not, however, intended as a tape system sizing guide. For this purpose, you should use the sizing tools provided by each product family.

This guide focuses primarily on identifying backup environments for the IBM TotalStorage 358x Ultrium product family (LTO) and the environments for the IBM TotalStorage™ Enterprise Tape System 3590 and 3592 product family. Single user or departmental type backup environments are also addressed through providing information on the entry level tape product lines such as 4mm or 8mm, and so on. Total backup solution offerings are supported by the Tivoli® Storage Manager, as well as other backup applications offered by various vendors.

This edition of the redbook has been updated with information about the following: IBM 3592 tape drive; WORM and Economy cartridge support for the IBM 3592-J1A; new models of the IBM TotalStorage UltraScalable Tape Library 3584; and new models of the IBM TotalStorage Ultrium Tape 2U Autoloader 3581.

Who should read this guide?

System administrators, operational personnel, backup administrators, and IT operations managers are good candidates to read this guide. In addition, anyone interested in learning how to develop a strategy to determine tape requirements will find this guide beneficial.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

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Summary of changes

This section describes the technical changes made in this edition of the redbook. This edition may also include minor corrections and editorial changes that are not identified.

Summary of changes
for SG24-6946-02
for *IBM TotalStorage Tape Selection and Differentiation Guide*
as created or updated on June 28, 2004.

June 2004, First Edition

This revision reflects the addition, deletion, or modification of new and changed information described below.

New information
► IBM TotalStorage Enterprise Tape Drive 3592
► Enhanced cartridge support for the IBM 3592-J1A tape drive: Write Once Read Many (WORM) and Economy (short-length 60 GB) cartridge support
► IBM TotalStorage Ultrium Tape 2U Autoloader 3581 L28 and F28 models
► New models of the IBM TotalStorage UltraScalable Tape Library 3584: D22, D52, L22, L52
► Enhancements to the IBM TotalStorage Enterprise Automated Tape Library 3494: support of the IBM TotalStorage Master Console (TSMC) and WORM media support

Changed information
► Deleted information for products that were withdrawn from marketing
► Additional features and enhancements added to existing products.

1

Scope of this guide

In this chapter we introduce the scope intended for *The IBM TotalStorage Tape Selection and Differentiation Guide*. The following topics are covered:

- ► Definition of the terms *selection* and *differentiation*, as used in this guide
- ► The questioning format and the need for proper information gathering
- ► Listing of IBM tape product offerings
- ► Definition of the term *open systems*
- ► Discussion of backup software
- ► How to use this guide

1.1 Definition of the terms selection and differentiation

Although this may appear straightforward, it is necessary to define the terms selection and differentiation as they pertain to this guide. At times, it may seem that both terms are interchangeable, and they very well may be, but for the purpose of coming up with a solution that fits all the backup needs, a point of separation is also needed.

Selection
We use the term *selection* to mean a choice made from a variety of tape product offerings. The selection will be the end result of determining all the aspects of a backup environment and a solution which best fits that environment.

Differentiation
For the purposes of this guide, the term *differentiation* refers to situations where one particular tape product offering has a unique set of benefits and usage, something not in common with any other tape product. Differentiation should not be looked at in a competitive manner, but rather in the aspect of pointing out the unique set of highlights belonging to each of the different tape technologies.

1.2 Questioning format and information gathering

The focus of this guide is to obtain the right type and amount of information from the backup requirements to determine what tape solution best fits that backup environment. This is done through gathering all the needed information into a concise format, which points to a given solution. This process is intended to be completed by anyone responsible for providing a given tape solution.

Questioning format
In order to ensure that the information is exact and concise, it will be necessary to address "open-ended" questions while directing the flow of information. This means using questions which are open enough to cover any type of situation while directing that question to give a response that fits your needs. For example, asking "What type of hardware environment do you have currently?" is open to the point that any number of possible combinations may be given. At the same time, you are collecting much-needed information regarding the platforms for which you will be designing a backup solution. This technique is covered in much more detail in Chapter 2, "Information gathering format" on page 9.

In many situations, the answer to a given question will determine the next one asked, so go in with a script, keeping in mind that it may not be followed exactly. A script is a handy tool when it comes to keeping focused and ensuring that you get what you need.

Proper information gathering

An important result of the questioning is gathering all the proper information. This is important because in today's computing environment, so many variables make up the total picture, and not understanding all the variables will present a different picture. Make sure that the information you collect is completely understandable to you at a later date, and that it accurately represents the actual environment.

As mentioned in the previous section, using a script is a great way to ensure that all information is covered and organized in a manner that will make sense later on.

1.3 IBM tape product offerings

The list below encompasses the main products this guide focuses on, as well as those you will find in Appendix A, "Overview of IBM TotalStorage tape offerings" on page 61. The products are introduced and compared for the purpose of selection and differentiation. Use the Web to get the latest information on IBM's tape product offerings, accessing the URL below:

http://www.storage.ibm.com/hardsoft/tape/index.html

Linear Tape Open - Ultrium 2
► IBM TotalStorage Ultrium External Tape Drive 3580
► IBM TotalStorage Ultrium Tape 2U Autoloader 3581
► IBM TotalStorage Ultrium Tape Library 3582
► IBM TotalStorage Ultrium Scalable Tape Library 3583
► IBM TotalStorage UltraScalable Tape Library 3584

Enterprise Class Tape Products
► IBM TotalStorage Enterprise Tape Drive 3592 Model J1A
► IBM TotalStorage Enterprise Tape Drive 3590 Models B1A/E1A/H1A
► IBM TotalStorage Enterprise Tape Drive 3590 Models B11/E11/H11
► IBM TotalStorage Enterprise Automated Tape Library 3494
► IBM TotalStorage Virtual Tape Server (VTS)

> **Note:** Especially for the entry level servers, there are hosts with single drive tapes, and miscellaneous autoloaders and libraries. These products are not covered in this book. Some of them are listed in Appendix A, "Overview of IBM TotalStorage tape offerings" on page 61, and we refer you to the provided Web links throughout this redbook for further details.

1.4 Explaining the term open systems

It is important to understand what the phrase *open systems* means in the context of this guide.

By the nature of the term, "open" indicates a willingness to work with others or to be accessible to them. The same is true for open systems, which have non-proprietary systems architectures that are adaptable, interoperable, and reliable. Let us focus on how this relates to this guide.

For the purposes of this guide, open systems relates to any type of distributed server computing environment. This can include servers using the following types of operating systems:

► Windows NT
► Windows 2000
► Novell Netware
► Other Intel-based servers
► Versions of Linux
► IBM AIX
► OS/400
► Sun Solaris
► HPUX
► HP Tru64
► Digital UNIX
► Silicon Graphics IRIX

This list does not include all the various types of operating systems you may find, just the most common ones. An easier way of looking at the distinction between computing environments is to divide them into three sub-classes: mainframe (S/390, zSeries based), high-end enterprise, and distributed client/server systems.

1.5 Backup software

Even though this guide focuses on tape hardware solutions, an equally important component to any backup solution is the software application. In this section we describe the overall functionality of IBM's Tivoli Storage Manager backup suite, as well as providing URLs for the other major application vendors you will see.

Many of the configurations and solutions you design will depend upon the type of backup software currently in use at a backup site. It is often the case that the current application is not meeting the expectations for the backup and restore, or that a complete redesign of the entire backup environment is required. If there is no backup application in use, we would advocate the installation of an IBM tailored solution based on Tivoli Storage Manager (TSM).

1.5.1 Tivoli Storage Manager

Tivoli Storage Manager is a multi-function storage software product that addresses the challenges of complex storage management across distributed environments. It protects and manages a broad range of data, from the laptop to the corporate server environment. Over 30 different operating platforms are supported.

TSM highlights include:

► Centralized administration for data and storage management
► Efficient management of information growth
► High-speed, automated data recovery
► Compatibility with hundreds of storage devices, as well as local area networks (LANs), wide area networks (WANs), and storage area networks (SANs).
► Archival and retrieval of data
► HSM tasks

For details look up the TSM URL:

http://www-3.ibm.com/software/tivoli/products/storage-mgr/

In the following sections, we address a few key concepts that set TSM apart:

Progressive backup methodology
This can reduce time, disk space, and the amount of data sent across the network by backing up only new files and modified files. The progressive backup feature, often also called *incremental always*, uses its own relational database to track data wherever it is stored, assuring direct one-step file restore. The concept eliminates the need for base-plus-incremental file restore from multiple tapes, which is a commonly used procedure for restore in other storage management products. In addition, some platforms offer journal-based determination of files needing backup.

Tape resource sharing
This allows multiple Tivoli Storage Manager servers to use the same tape library and drives. This can improve backup and recovery performance, as well as tape library and drive asset utilization. It is an efficient way to consolidate many small backup servers with one larger tape system.

Network-free rapid recovery

TSM supports high-speed client data recovery directly from a tape, CD, zip-drive, jaz-drive, or micro-drive. This minimizes recovery time by eliminating the use of network and central server resources. It further improves availability, as it is a server-free restore that does not require the Tivoli Storage Manager server to be available.

LAN-free data transfer

TSM effectively exploits SAN environments by moving backup, archival, recovery, and IT data transfers from the communication network to a dedicated data network or SAN. Internet Protocol (IP) communication bandwidth can then be used to improve service levels for end users.

Server-free data transfer

Server-free backup takes LAN-free one step further, by lowering the involvement of the application server, and reducing the amount of CPU, memory, and I/O consumption during the backup process. Conceptually, the data moves directly from the server's disk through the SAN to a data mover router and onwards to a SAN attached tape device. This functionality is supported in TSM.

Dynamic multi-threaded transfer

This permits a client using multiple sessions to simultaneously transfer data to and from the same Tivoli Storage Manager server. This feature can boost performance of backups to more than three times the rate of a single-threaded session. This speed is achieved because Tivoli Storage Manager data transfer sessions are transparently optimized based on available system resources.

Adaptive differencing technology

This changes the way data is backed up, accommodating mobile computer users and other users who need to minimize backup data transmitted over the network. Adaptive subfile differencing backs up only new and changed portions of files after the initial full backup. This replaces the need to back up an entire file each time the file changes.

NAS backup through Network Data Management Protocol

Tivoli Storage Manager supports Network Data Management Protocol (NDMP) backup of Network Appliance (NAS) files to locally-attached tape libraries. This can improve performance and offer scalable backup and restore. The backup to local tape devices can occur without creating network traffic. Implementation is minimized because there is no special code required on NAS servers.

TSM is one component of an entire suite of storage and SAN management products offered by IBM and Tivoli. Please reference the URL given below for the latest and most complete information as to the value of TSM and the other products it integrates well with:

http://www-3.ibm.com/software/tivoli/products/storage-mgr/

1.5.2 Other backup application references

As stated earlier, you will find a myriad of different backup applications in use today. The following is a list of some of the more common ones. Each product name is followed by the URL referencing the latest available information:

► **Veritas Netbackup or BackupExec**

http://www.veritas.com/products/category/ProductFamily.jhtml?baseId=2021

► **Legato Networker**

http://portal2.legato.com/products/networker/

► **CA BrightStor ARCserve Backup**

http://www3.ca.com/Solutions/ProductFamily.asp?ID=115

► **CommVault Galaxy**

http://www.commvault.com/products.asp

► **Bakbone NetVault**

http://www.bakbone.com/products/backup_and_restore/

► **SyncSort Backup Express**

http://www.syncsort.com/bex/infobex.htm

► **HP OmniBack II**

http://www.openview.hp.com/products/omniback/index.asp

► **BRMS/400 (for AS400 series only)**

http://www-1.ibm.com/servers/eserver/iseries/service/brms/

► **Help/Systems Robot/SAVE (for AS400 series only)**

http://www.helpsystems.com/products/save.html

► **AMANDA - The Advanced Maryland Automatic Network Disk Archiver**

http://www.amanda.org/

1.6 How to use this guide

The intended purpose of this guide is to help you gather and categorize your system information into some type of meaningful flow, which will in turn help facilitate the selection of IBM's TotalStorage tape offerings. Let us now look at what the rest of the guide contains, and how to best put it to work:

► Chapter 2, "Information gathering format" on page 9 discusses the process of extracting the needed information from the backup. A series of questions are posed throughout the chapter, and a brief explanation and rationale follows each question to help you see what information is important to collect, as well as the possible need for asking additional questions. Remember, the goal here is to come up with a recommendation for the proper IBM tape product, so it is very important not to short-change yourself on gathering the necessary information.

► Chapter 3, "Data collection process" on page 27 begins with a scripted list of questions (which are introduced and explained in Chapter 2, "Information gathering format" on page 9). These questions are given in a logical order and will present a clear and distinct tape selection. These are the questions that you need to ask concerning the backup requirements. Take note of the additional hints or bits of information after each question. The remainder of this chapter positions IBM tape products according to the information gathered from the questions.

► Chapter 4, "Finding the solution" on page 33 contains chart and graphical information to support selection and differentiation material presented throughout this guide. You will find an overall selection matrix in the front of this chapter, followed by examples of additional supportive reference information.

► Appendix A, "Overview of IBM TotalStorage tape offerings" on page 61 provides a high-level overview of each IBM tape product covered in this guide. Brief explanations of each of the major products and models are covered, and Web links are provided so you can obtain up-to-date information of these products, as well as others not discussed in this guide.

2

Information gathering format

This chapter introduces the questions you need to ask, and goes into detail about how this will help you analyze your current and future tape backup requirements. In Chapter 3, "Data collection process" on page 27, these questions are put into a "script" to follow to assist in selecting the most relevant tape system.

Not all questions are relevant for all backup requirements, however, the questions outline the type of information you need to look for. The information gathering process has been grouped under these topics:

► Present environment
► Future environment
► Backup
► Restore
► Financial considerations
► Importance of data
► Other

2.1 Present environment

You should clearly define the backup environment, not only for the location in question, but also for the company in total. For many companies, this location is only one part of the total environment. What then are the corporate or subordinate branch office requirements? Identify both the computing systems installed, and the present tape backup systems in place.

One major differentiator will be whether or not you have mainframe class systems, as the mainframe generally will not directly attach to current LTO products. Also, another important consideration is to evaluate your need for fixed content data retention. Write Once Read Many (WORM) offers non-alterable non-rewritable tape media for long-term records retention. Backup environments are faced with the need to cost effectively store more digital information than ever before, often to meet growing regulatory and legal requirements.

2.1.1 Hardware

Identify each different type of computer system that will be part of the backup solution. Do these systems already include tape backup solutions of any sort? Are there any systems used solely as the server for a centralized backup solution, or that are being used additionally in that role? The operating system level may also dictate the possible solutions:

► Computer systems sorted by type

– Mainframe - S/390, IBM @server zSeries:

The possible tape solutions are focused on the 359x class systems. If the mainframe is used in a mixed environment, the backup tape system focus may also include LTO.

– UNIX - RS6000 IBM @server pSeries, SUN, HP, and others:

These systems may very often have digital linear tape (DLT) or even smaller tape solutions, but have a good growth path towards LTO.

Requirements for frequent tape changes, backup, and restore of many small files, and the maximum data security, may still call for 3590 class solutions.

– Linux:

Often Linux will be a IBM @server zSeries open systems offering with all the requirements of a 3590 class tape solution. On the other hand, Linux may be anything from a small Intel system to a large UNIX system, and may call for tape systems from DLT to LTO and 3590 class.

– Windows:

Windows servers come in a wide variety of systems. They can be anything from small to large Intel servers. These systems may very often have DLT or smaller tape solutions. Depending on the size of the server, the focus can be from DLT through LTO to the 3590 class.

– Netware:

Though not as common as Windows servers nowadays, the Netware server can also be anything from a small to a large Intel server. These systems may very often have DLT or smaller tape solutions. Depending on the size of the server, the focus for growth can be from DLT through LTO to the 3590 class.

► Present tape systems installed, single tape, and libraries:

Identify the backup solutions in effect, the manual efforts connected to these, the number of tapes in use, and the organization necessary to handle this. Especially identify any automated backup libraries and their utilization.

You should identify any compatibility or interchange problems, and address those as ideal for consolidation into the larger tape libraries like LTO or 3590 class tape offerings.

► General situation for corporate location:

The corporate information is important with a view towards standardization and available support organization.

► General situation for branch offices:

Branch office information is likewise important for possible standardization and consolidation.

► Planned replacement of any existing tape hardware, or consolidations:

The result of this questionnaire may be a new recommendation regarding the evolvement of tape systems and backup solutions. However, identify what is already in plan for the near term.

► The use of SAN:

More and more computer systems, disk storage, and tape systems are connected through a Storage Area Network. Many of the backup applications also provide functionality to take benefit of the SAN in terms of:

– LAN-free backup
– Server-free backup

► Library partitioning:

Through the use of SANs, the possibility of sharing resources such as tape drives and libraries becomes a benefit, not only in the area of cost reduction, but also in ease of management.

2.1.2 Software

Similarly, identify present tape backup software, both locally and corporate, including single tape solutions as well as any backup software solutions. The prime focus is on the full function backup storage products such as Veritas, Legato, Computer Associates, or Tivoli Storage Manager:

► Present tape backup server software:

With little or no centralized backup solutions in place, consolidating the backup processes will be ideal for the Tivoli Storage Manager application. Also, it is important to single out any problems or discomfort with the present backup situation, which may be another reason for consolidating the backup application into a Tivoli Storage Manager solution.

► Present single unit tape solutions:

Single unit tapes normally mean a lot of manual tape handling. Consolidation to tape server solutions such as Tivoli Storage Manager will help automate this. Sizing the manual effort involved is an important part of cost/justification.

► General situation for corporate location:

Corporate may look at standardizing or consolidating the backup solutions.

► General situation for branch offices:

Branch office information is likewise important for possible standardization and consolidation.

► Any plans for consolidating backup storage solution:

Identify if there are any current plans for consolidating the backup in this location, or even on the corporate scale. Current plans should be incorporated in the new recommendations for consolidation.

2.1.3 Data environment

Identify what types of data are included in the backup (files, databases), and the present backup methods. Especially identify the handling of database backup:

► Files, and mix of file sizes:

What sort of servers are being backed up? File servers with a mix of short, medium, or large files. Mail and database servers or other large file servers?

► Databases, type of database, and online or offline backup:

Databases generally consist of large files. How are they backed up at present? Online or offline backup routines, and full databases or incremental backup, utilizing database backup tools? Especially for databases, the backup and restore window is very important.

► Rewriteable or WORM

Key areas of concern with managing data for regulatory compliance:

– Assure that content is kept and not altered for a required period.
– Content is an asset when it needs to be kept.
– Content kept past its retention period may be a liability.
– Content retention can vary during its life due to factors such as litigation.
– To improve corporate operations

2.1.4 Library sharing

Library *sharing* has been practiced for some time by partitioning a physical library into multiple logical libraries. Alternatively, the library can appear to be shared by multiple hosts when, in reality, one of the hosts (the library manager) is issuing all the library commands both for itself and for the other hosts (clients), but all of them have direct access to the tape drives (tape pooling).

At this point, we need to clarify the terms *homogeneous* and *heterogeneous* as they apply to library sharing. The terms refer to the library management or backup software, not to the platforms on which they are running. For example, the IBM Tivoli Storage Manager library manager may be running on an IBM @server xSeries, and several Tivoli Storage Manager clients may be running on a mixture of HP-UX, Sun Solaris, and Windows NT servers. This is still a homogeneous environment, because Tivoli Storage Manager is the only application using the library, although the other hosts may be sending data directly to the tape drives.

We have a heterogeneous environment when different software applications access the library, in which case, there is no master control. Therefore, the library needs to be logically partitioned or have its own in-built library manager such as in the IBM 3494. Table 2-1 shows the relationship between homogeneous and heterogeneous applications with respect to library and drive sharing.

Table 2-1   Homogeneous versus heterogeneous

	Tape library sharing	**Tape drive sharing**
Homogeneous application sharing	Solved by backup application (ARCserve, Tivoli Storage Manager) or by tape library hardware partitioning (IBM 3584 or 3494)	Solved by backup application (such as CA ARCserve or Tivoli Storage Manager)

	Tape library sharing	Tape drive sharing
Heterogeneous application sharing	Solved by Library Management middleware OR by tape library hardware partitioning (IBM 3584 or 3494)	Solved by Library Management middleware (such as Veritas Media Librarian, or Legato SmartMedia)

2.2 Future environment

Try to forecast the backup environment as much as three years ahead, both in terms of computer systems and considering data amounts. Combine the historical information for the last few years with the general trends in data growth.

The considerations discussed in the present environment are valid for the future environment as well, but there will most probably also be a new focus on new and advanced functionality such as more online database backups and an ever increasing usage of NAS and SAN storage functions.

Why rely on tape for backup?

With the rise of electronic commerce, data repositories and other data-intensive applications, more data must be backed up and stored ever more quickly:

► Tape is still the top performer in terms of cost and capacity for data storage, playing a crucial role in corporate data protection strategies.

► No other technology offers the low cost and high capacity advantages of tape.

2.2.1 Hardware

What will the computer systems look like in three years? How do you anticipate the growth, consolidation, and trends towards new operating systems such as Linux; perhaps consolidation into IBM @server , zSeries, Linux, or consolidated disk and tape storage on a SAN? Consider whether this consolidation may take place in a single location, or whether it may be corporate-wide.

You will need to consider the following:

► Estimate of computer systems and data capacity
► Possible move towards SAN for disk and tape solutions
► Local or corporate consolidation
► Compatibility and interchange of tape systems
► Move to dedicated backup servers
► Move to Disaster Recovery routines
► Look at trends in tape systems, and growth potentials

- General situation for corporate location
- General situation for branch offices

2.2.2 Software

Similarly, consider the selection of backup software requirements to cope with hardware and data. Consider the use of Tivoli Storage Manager for backup in locations without an installed backup solution, or as an advanced solution to consolidate different backup systems already in use. The Disaster Recovery Manager feature of Tivoli Storage Manager is more and more becoming a must for any backup solution:

- Tape backup server software that can cope with backup requirements
- Local or corporate consolidation
- General situation for corporate location
- General situation for branch offices

2.2.3 Data environment

Especially look for changes in the type of backup data — more, larger, and other databases; more emphasis on online backup routines for databases as well as another mix of files. Consider the move towards SAN for tape and disk sharing, and the possibility of introducing LAN-free backup or even server-free backup:

- Files, and mix of file sizes:

  Look for the mix of files in your environment. Do you have a lot of small files, large files, or a mix of file sizes?

- Databases, type of database, and online or offline backup:

  Also, consider the database size and if full backup, incremental backup, or more probably a mix of these are to be used.

- Tape library sharing, locally or across a SAN:

  Are several backup servers sharing one library, or is one backup server allowing tape access from other backup users?

- Dedicated backup server or servers:

  What does your server structure look like? Do you have dedicated servers for backup and restore, or are you using one system for multiple proposes?

- Also, consider LAN-free or server-free backup:

  Do you have a SAN infrastructure, or are you planning to implement one? Do you plan to reduce LAN traffic by implementing a LAN-free backup solution in your SAN environment? Or, to offload also the backup server with server-free backups?

- Disaster Recovery Management across a SAN/WAN or with manual tape handling:

  Disaster Recovery Management across WAN will require a good infrastructure. A 100 Mbit link can transmit a maximum of approximately 36 GB/hr, but typically less.

- WORM data:

  Nonalterable, nonrewritable tape media for long term records retention.

2.3 Backup

What are the data amounts for backup today, and which trends are foreseen such as keeping more or less data for a longer or shorter time? Contrast the differences between these types of backups: *Incremental* (new or changed files since last backup), *differential* (new or changed files since last full backup), and *full* (backups of all files), as well as combinations of these. You should consider the storage effects of keeping many versions and relate this to the point-in-time restore possibilities. What are the backup requirements for accessing "old" data?

Especially for databases, there will be a preferred backup window, or even a single possible backup window. However, also for backups in general, there will be a window of less than 24 hours. If the backup window is short, or the number of backup tapes are high, Tivoli Storage Manager with its *incremental always* concept is a way to reduce backup time and amount of data.

With the growth in regulatory requirements for data security and data retention, Media types and formats need to be considered. The new 3592 tape cartridge that is designed to work in conjunction with the IBM 3592 Tape Drive to provide WORM capability. This is intended to provide a cost-effective solution for non-rewritable, non-erasable long term records retention.

2.3.1 Current backup environment

What are the backup specifications currently implemented?

- Total amount of data to be backed up:

  Consider the total backup for the file systems, and the daily rate of change for incremental backup. What part of the total data is for databases? Identify some brackets, for example:

  - Daily backup less than 50 GB
  - Daily backup between 50 GB and 500 GB
  - Daily backup greater than 500 GB

- Amount of tapes in use:

How much data is presently backed up and kept on tape either in libraries or on the shelves? Are there more than one type of backup tape systems in use such as 4mm, 8mm, DLT, or other? Consider the following:

– Total amount of backup data at present

– Total amount of tapes in use

– Number of tapes not stored in libraries, both for Disaster Recovery Management and especially for primary backup data

– Different tape systems in use, single tapes, and libraries

► Media handling considerations

Any manual tape shuffling must be identified, whether used with single tape readers, filled-up libraries, or disaster recovery procedures. Other considerations that need to be thought about are:

– Staff time
– Transport costs (offsite storage)
– Checkin/checkout procedures
– Lost and/or damaged media

► Tape conversions needed:

Conversion from DLT is especially important as IBM 3584 provided the ability to mix LTO and DLT drives and tapes. This feature in not available after April 2003, although installed systems will continue to be supported.

Also, Tivoli Storage Manager provides the possibility to move data between storage pools, that is backup data on DLT cartridges may be easily and automatically moved to LTO.

► Requirements for "historical" data; backup versions that are really needed:

What are the requirements to be able to restore "old" data? Are the routines, as implemented, really covering the business need? Are more or less versions actually needed?

– Number of versions of data in backup at present, incremental or full
– Versions required according to business need

► Method of database backup, online or offline:

Online backup will allow stretching of the backup window for the databases, and sometimes can be the only possible way to secure a daily backup. Using database APIs, it may be possible to have database incremental backup too.

► Use of *incremental always* backup, or full+incremental, or full+differential:

Tivoli Storage Manager provides an *incremental always* backup philosophy. Compared to combinations of full and differential/incremental, Tivoli Storage Manager will be backing up much less data, and therefore using fewer tapes and a shorter backup window. This can be a reason for selecting Tivoli Storage Manager as a new or replacement backup system.

► Any specific reason for type of backup (full, incremental, and so on):

The organization may have specific reasons for choosing the type of backup in use. Quite often, however, this is just historical, and the Tivoli Storage Manager concept of *incremental always* may be a better solution.

► Archiving required or in use:

Archiving may be a filing requirement, or it may be a method to keep a full backup also in an *incremental always* layout.

2.3.2 Predicted trends

Look for changes to the backup data. Growth of volume, requirements regarding number of versions, and changes to databases. Use the same three-year planning time frame for the hardware and for the software:

► New estimated total amount of data:

Do you know the amount and the increase of data you backup currently? Did you keep track of your changing backup and restore volumes over the years? What is your outlook for the years to come? How much data will you back up?

► Amount of tapes needed, depending on type of media:

Envision the number of tapes required with the present backup parameters and type of hardware, and compare that with new high capacity tape systems such as LTO or 3590 class. What will be the total capacity of present tape libraries, compared to the high capacity libraries.

► Changes to number of backup versions:

The number of backup versions, and the period backup versions are stored, will have a significant impact on amount of data. Make sure that no backup data is kept any longer than what business needs dictate. On the other hand, also make sure you can restore any versions required.

► Changes in backup strategy; going *incremental always*:

Identify the changing storage requirements from a change in storage philosophy. What will be the effect of having no more periodic full backups?

► Databases moving towards all online, and using full or incremental database backup:

Online or offline database backup primarily influences the backup window. The use of database incremental backup can significantly influence the amount of data stored.

► Grouping data in "backup sets", image backup, or archives:

Special complete backups can be used to achieve faster restore for systems with many small files. But this will simulate the occasional full backup schema, and therefore increase storage requirement.

► Move away from manual tape handling:

The necessary manual tape handling should be reduced to the minimum required for Disaster Recovery Management. All current backup data should be available in the library.

► SAN and LAN-free backup:

Do you have a SAN infrastructure, or are you planning to implement one? Do you plan to reduce LAN traffic by implementing a LAN-free backup in your SAN environment?

► NAS caches and point-in-time image backup with Persistent Storage Manager:

Are you using NAS technology with instant point-in-time backups? Are you using Persistent Storage Manager (PSM) for servers where no downtime is acceptable?

► Shared tape devices local attached or on a SAN:

This allows for consolidation of several backup servers into one tape system.

► Disaster Recovery Management solutions across SAN/WAN:

With Disaster Recovery Management across the network, no manual tape handling will be required.

2.3.3 WORM data

The IBM TotalStorage Enterprise Tape Cartridge 3592 WORM data cartridges provide nonalterable, nonrewritable tape media for long-term records retention. When the 3592 Model J1A Tape drive detects a WORM cartridge, the tape drive will prevent overwrite or changes to existing customer data. New data can be appended to existing data until the cartridge capacity is reached. WORM cartridges are available in two sizes: 300 GB or 60 GB native capacity. These new media types are reported to the host by 3592 Model J1A Tape drives and controllers. WORM and standard tape cartridges can be intermixed within the same IBM TotalStorage Enterprise Automated Tape Library 3494, IBM TotalStorage Ultra scalable Tape Library 3584, or StorageTek Automated Cartridge System (ACS) solutions.

2.4 Restore

Time to restore is generally the crucial parameter. Data should be kept *collocated* for faster restore, but this may to some extent mean that more tapes are used. Also, remember that one large file can be restored faster than many small ones. Therefore, backup schemes including backup sets or logical file system *image* backup might be considered.

Some tape systems are optimized for data streaming (DLT or LTO); others can handle small files and start/stop efficiently (3590 class).

2.4.1 Current restore environment

Are there any special considerations about the restore time at present? Are any restore windows defined? And can the normal restore processes coexist with daily backup? What is the experience with restore? Are there time consuming manual processes to find and mount tapes? Or, are the automated backup and restore systems "just too slow"?

► Is restore performing as required? What restore performance has been seen?

Identify if the present restore routines require manual tape handling. What is perceived as the major limitation to performance? Does automated backup/restore work as expected?

► What restore bottlenecks are presently designated?

Manual tape handling may be one bottleneck. Time to load tapes and scan for data may be another.

► Are multiple restore paths being used?

Is backup data available in a way to allow multiple restores in parallel? Collocated tapes would allow parallel restore of different systems or logical volumes.

► Database restore with multiple paths:

When a database is backed up using parallel backup of its different files, it may also be restored in parallel. The database files must reside on different disks for parallel backup/restore to be of any benefit.

► Disaster Recovery restore routines:

Disaster Recovery routines may not be implemented. This functionality should always be included with the Tivoli Storage Manager application, and should be implemented and in use.

2.4.2 Predicted trends

Present bottlenecks should be alleviated. A shorter time to restore is always requested, although the amount of data is growing. You should always stay away from any manual tape handling, except possibly for Disaster Recovery Management routines:

► Use of "data groups": Backup sets, logical volume backups, image backup, or others:

All backup systems have reduced speed in handling many small files, especially for restore. Grouping such data will increase the backup data requirements, but can be much more efficient in restore. Using large storage caches like those provided by VTS can be another way to improve this.

► Increased parallelism, especially for databases:

As databases grow, time to backup and time to restore may require the use of parallelism. The backup APIs may provide automatic parallel backup of the different database files, and therefore also provides parallel restore.

► Use of SAN, LAN-free, tape pools:

Use of these features may influence capacity.

► Disaster Recovery Management restore through SAN/WAN:

This will reduce or eliminate the manual tape handling, but you do need a high speed network structure.

2.5 Financial considerations

Look at the present budget concerning backup. Predict the budget for the next three years as necessary to implement backup/restore trends and requirements. Consider system upgrades as well as replacements. Corporate plans and decisions for consolidation and standardization must also be included in the considerations.

There is presently a significant price difference between the streaming tape products like DLT and LTO, and the 3590 and 3592 products. The advantages of the different systems concerning high data volumes, small file environments, total data security, automatic failover, partitioning, and dynamic load balancing, should be considered in evaluating this cost difference.

2.5.1 Budget timetable

You should look at two distinct timetables: the present immediate requirement and budget and the three-year predictions:

► How much is available to spend at this time?

This study can even be used to show the need for earlier-than-planned investments and increased budgets. Generally, however, look for systems solutions that can fit in the present budget, but which have the growth potential for the three-year time frame.

► Which investments are planned for the next three years at present plans?

Some system development plans may exist already. They should be contrasted to the recommendations of this study, and be included in the updated budgets.

► What is reasonable to plan for the next three years, based on this survey?

Establish a plan based on your future needs. You need to define your future growth in storage, and estimate based on your current experience what storage solutions need to be implemented within the next three years. This study should help you get started with that task.

► How does this relate to known corporate plans and requirements?

In a corporate setting, this local situation must be related to possible corporate consolidation and standardization plans and requirements. This study can even be the trigger for such plans.

► What is the media cost for the different solutions?

Media cost is not insignificant. However, for the high capacity systems like LTO and the 3590 class, the media cost per GB stored is relatively equal. For large amounts of data, it is still a significant cost to be budgeted.

2.6 Importance of data

Some data may be necessary for the backup/restore, but may not be needed right away. Other data has an immediate need, and time to restore is crucial.

A fire or earthquake may destroy the backup system and the backup data tapes. For such situations, a Disaster Recovery solution is needed. Copies of all backup tapes should be kept at a different location, and routines must exist to be able to restore this data quickly. This will basically double the amount of data stored, and may require efficient routines for tape handling like checking-in and checking-out of the library. Alternatively, this will require a high speed SAN/WAN connection to another tape library and backup system.

2.6.1 Disaster Recovery considerations

A Disaster Recovery backup is an extra backup copy of all data. This may be stored on separate tapes that are removed from the library and stored in an offsite location. Or, the backup copy can be generated through a high speed LAN/SAN/WAN to tapes in a different system in a remote location. A 100 Mbit network may transfer 36 GB/hr at the most, so a network copy is very dependent on the infrastructure available:

► Is any Disaster Recovery Management in operation presently?

If none is implemented, the Disaster Recovery Manager feature of Tivoli Storage Manager should be considered and implemented as soon as possible.

► Will a Disaster Recovery Management solution be implemented in the three-year time frame?

If you have none, and you are not planning to implement a Disaster Recovery Management solution, your business is at risk.

► Does making a backup copy involve manually moving tapes, or is there an automatic network copy?

You can move to a fully automated solution, where no manual action is required.

► Are any personnel resources available for Disaster Recovery Management — local, corporate, or contractor?

Disaster Recovery Management is only of value if it is implemented as designed. Therefore, there must be personnel allocated to handle this. The more manual tape handling there is, the more personnel resources are involved.

► Disaster Recovery Management interfacing to corporate structures:

Make sure that you understand the business model of your company. You should be able to distinguish between critical and not-so-critical parts. In case of a disaster, the most critical parts of your company need to be up and running first. Your Disaster Recovery Management strategy should supplement your company business requirements.

2.6.2 Time to restore: Requirements

Identify types and amount of data that has to be immediately available. Restore requirements should reflect this need. You may have experienced restore processing taking much longer than anticipated, and may have put forth requirements for the future. The backup system sizing must reflect this, but you must also consider that these requirements have a cost:

- ► What is the acceptable time to restore the different types of data?
- ► Which data are the most important and requires the fastest restore?
- ► Which data are dependent on each other and must be restored together?
- ► How can the present or proposed solution fulfill these requirements?

2.7 Other considerations

Do you run the backup operation yourselves, or is it outsourced? Will there be any changes to this for the three-year period? Can the present tape backup systems cope with the growth in data and backup functionality, or will tape and data formats have to be converted during the term? Consolidation and growth may be a good reason to consider the Tivoli Storage Manager application.

2.7.1 Support structure

Primarily, look at the site support structure now and in the three-year time frame. Are resources available locally, will corporate support be possible, or is outsourcing the road to go?

- ► Support organization locally:

  With a small support organization, or when the support organization prioritizes other tasks, who will secure the backup operations?

- ► Corporate support organization available:

  Does your company already provide a support structure? Will there be major changes within the next few years?

- ► Known plans for the three-year time frame:

  Do you have plans to establish, change, or improve your support structure within the next three-year time frame?

2.7.2 Conversions

With growing amounts of data, the single drive 4mm, 8mm, and QIC tapes may not be the answer, nor will the small capacity libraries. DLT is a quite common tape system, and may store large amounts of data, but also has a number of restrictions. These tape formats may be considered for low end servers or special usage. However, as total data backup requirements grow to several hundred gigabytes and even terabytes, the LTO and 359x class tape libraries should be preferred.

When converting to LTO tape systems, a format conversion will be needed. Existing tape solutions must be available until all the data they contain has been expired, or until there is sufficiently new backups available. With Tivoli Storage Manager, it is also possible to move the data from one storage pool to another, that is, from one type of storage device to another. This means you can convert the data from DLT to LTO by a scheduled process, and you do not need to wait for expiration of several backup versions.

With the original IBM 3584 LTO library, DLT tapes could coexist with the LTO tapes, therefore, also protecting the present investment in DLT technology. This feature is no longer available after April 2003. Installed systems will continue to be supported.

The 359x class tape system with the VTS subsystem emulates the former 3480/3490 tape format onto the new 3590 tapes, and this is transparent to the user and to the operating system. The VTS subsystem can also be used to provide a large cache between client resources and the backup tape system.

Here are some conversions to consider:

► Existing tape systems that will be phased out
► Solutions requiring co-existence of several formats
► Mainframe operations emulating 3480/3490 tape formats
► Migration from DLT tape systems
► Regulatory requirement for WORM Media

3

Data collection process

This chapter contains questions for you to cover when determining your backup needs, and a selection direction based on the information collected. The questions are divided into the following sections:

► Business and operational environment
► Current computer environment
► Backup and restore environment

Each section has several major questions to cover, and any number of supporting or descriptive type material to help further define the information.

3.1 Business and operational questions

Defining and understanding the business and operational characteristics of your backup environment is key in pursuing a backup strategy. Begin with these types of questions. This section does not dictate any one particular tape selection.

What type of business does your company do?
Types of examples include manufacturing, research, retail, government, medical, educational.

What is your typical business pattern?
Examples include 7x24, 5x9, Internet-based, based on trends.

Describe the company's historical and predicted growth.
Gather as much information on overall growth trends and patterns as possible, including income, personnel, and infrastructure.

What are your perceptions of the current needs addressing backup?
Developing a list of pain points or areas of immediate concern regarding the issues related to backup.

What are the budgetary considerations?
Establish budget amount, purchasing timetable, and approval ladder.

3.2 Computing and IT environment questions

Use the following set of questions to begin getting a feeling of what the possible selections are.

> **Note:** Be sure to look at all notes referring to suggested solutions as you read the questions.

What hardware platforms are you running?
Examples include UNIX, Linux, Intel, S/390 zSeries, AS400, Windows NT, and Windows 2000. Revision levels of the operating systems are important to record.

> **Note:** If the platforms included involve any mainframes, the selection criteria will primarily involve 3590 class products including 3590, 3494, and VTS.

Describe the physical make-up of your environment:
- ► Number and type of servers
- ► Network infrastructure
- ► Components of storage
- ► Current backup hardware

What are the applications involved in your environment?
This includes crucial information needed in the areas of databases, groupware, support infrastructure applications, backup applications, file systems.

Can you detail data amounts involved in your environment?
Some areas include size of databases, home directories, and total disk space.

> **Note:** This is a good time to tie in together the current data storage needs with the information obtained from the predicted business growth question. Use this to develop an anticipated data growth amount.

Where does this environment fit into your organizational structure?
Is this a single department, multiples, or is it for the entire company.

What is the admin/support structure of your IT environment?
Examples include network administrators, backup administrators, help desk, system administrators. Not only are positions important to define, but also the number of positions and the reporting chain are important.

3.3 Backup and restore questions

These questions address the need for further development into the specific nature of the current backup and restore environment. This is a key area of understanding, and with the information collected from the computing environment section, it will provide great benefit in coming up with the right type of solution. Keep in mind that this section of questions will help develop the area of sizing the proper solution.

What types of backup do you currently perform?
Examples include manual or centralized backups; number of full, incremental, differential, or combination backups; current jobs running; off site copies, concurrent copies, HSM, and WORM versus re-writable.

What is the scheduling pattern?
How often and when are backups performed.

Describe the use and length of the backup window.

Information needed: nightly timetable, weekends. Are jobs fitting into the window?

What are the usages of restores in your environment?

How often do they occur, length of restore time, administrative overhead, asset overhead.

3.4 Summary of questions

After you have collected enough information to feel comfortable that you know the operating and business environment, you can proceed to finding the product that fits.

The most accurate way of using the remainder of this guide is to position the information you have gained using the matrix in Table 4-1 on page 41. Using the information collected with the relevant rows of this table will help you determine the proper IBM technology.

Further explanation of why the products fit where they do is covered in the remainder of this chapter. It is important to understand why and how each tape product fits, instead of just putting in model numbers. Not only will you gain the added confidence that you are proposing the right tape solution, but you will be reassured that you are investing in the best solution, and will gain confidence in your skills.

3.5 Total backup solution offerings

There will be a number of situations where you should be considering the complete backup solution, and where IBM has an appropriate and sound solution to offer:

- ► No backup system solution is in place, only disjointed backup operations
- ► A backup system solution is installed, but it is not working according to requirements.
- ► A backup system is installed for part of the environment, and a consolidated solution is requested.

The response to all of these cases are backup system solutions based upon Tivoli Storage Manager (TSM).

If you are satisfied with the existing backup system and want to keep it, you should concentrate on determining the best tape system recommendations.

3.5.1 Tivoli Storage Manager

Tivoli Storage Manager is the recommended backup software solution. It is ideal for both backup environments that are needing consolidated backup operations, as well as for environments that want to add flexibility and functions to the solutions that are already in place.

Tivoli Storage Manager will provide backup of almost any computer system, and can be installed as a backup server in the major open systems environments. It will work with most tape systems available, and fully utilizes the advantages of the tape systems discussed in this book.

Any computing environment with no backup system software installed, or those that need added functionality, should consider Tivoli Storage Manager and the benefits of the Disaster Recovery Manager module.

3.5.2 Other backup system software

In the scope of this book, we are looking at coming up with the best tape solution. Therefore, for any existing and well functioning backup system in place, your question will be:

How does this software interface with the tape offerings?

Generally, all the major backup systems applications will support the tape systems discussed here. If in doubt, look up the Internet support links provided in the manufacturer documentation.

4

Finding the solution

This chapter provides a quick reference section for product positioning through a series of tables, matrices, and URL references.

The information is organized in the following sections:

► Entry Level and LTO solutions
► Enterprise tape solutions
► Finding the tape solution
► Tape storage URLs

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4.1 Entry Level and LTO Solutions

Of the tape library solutions discussed here, the primary ones are the IBM LTO Ultrium 358x family, and the IBM TotalStorage Enterprise Tape family. These should be the open systems tape libraries of choice. However, in some cases, the direct attachable entry level tape drives may be suitable for those small, departmental environments.

This section discusses the characteristics of the different models of IBM tapes, in order to better understand their positioning when looking for a tape solution.

4.1.1 IBM TotalStorage entry level products family

There will be instances where the proper solution will call for small requirements for tape, and IBM offers products that fit within this category. These products generally consist of a single drive, single cartridge combination, and are tailored for individual system attachment where volumes of capacity are in the range of a few gigabytes to a couple of hundred.

Products in this family include the following:

► **IBM model 7206/7332**: Single 4 mm DAT drive, and autoloader version
► **IBM model 7208**: Single 8 mm DAT tape drive
► **IBM model 7205**: Single DLT tape drive

4.1.2 IBM TotalStorage Ultrium Tape products family

From a price and performance standpoint, and in a high capacity data streaming environment, the open systems tape library of choice should be LTO. It spans the entire data volume range from 100 GB up through 496 TB (native). The 3583 and 3584 libraries allows you to mix Ultrium 1 and Ultrium 2 tape drives and tape cartridges, thus protecting the investment in first generation Ultrium 1 products, and providing an easy migration path (see Figure 4-1). This is supported in TSM V5.2, and the Ultrium 1 cartridges can be read/written by any of the Ultrium 1 or Ultrium 2 drives.

LTO greatly surpasses other tape systems like 4 mm, 8 mm, or DLT in terms of capacity and speed in a streaming environment. The Digital Speed Matching feature of the Ultrium 2 drive will perform dynamic speed matching between the tape drive and the host data rate. This will greatly reduce the number of backhitch repositions, and improve the throughput performance also in small file environments.

The differentiator between the LTO tape systems will be mostly by storage volume, but library partitioning and total future data potential will also be important. However, there is no upgrade path between the different LTO libraries, so the growth path must be taken into consideration, and a larger library may be selected based on total future need. The published LTO roadmap indicates there will be important growth in data capacity with each new tape and cartridge generation. Thus, the functionality of the library is a main differentiator.
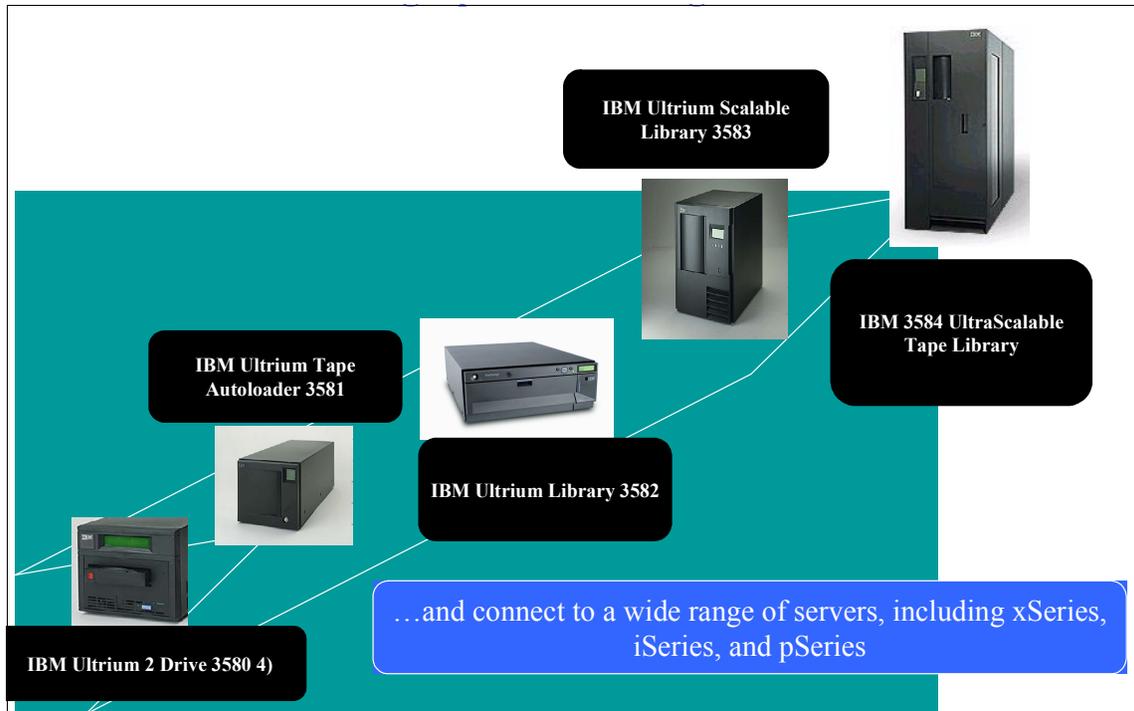

Figure 4-1   IBM LTO Ultrium offerings

IBM TotalStorage Ultrium 2 Tape Drive 3580

Figure 4-2   BM TotalStorage Ultrium Tape Drive 3580

The IBM TotalStorage Ultrium 2 Tape Drive 3580 (see Figure 4-2) is a single tape drive, single slot external device intended for direct system attachment. The Ultrium 2 model has a transfer rate of 35 MB per second (native), and a native storage capacity of 200 GB per cartridge. It includes the same features as all IBM Ultrium drives such as a 64 MB buffer, speed matching feature, and Statistical Analysis Reporting System (SARS) capability. It attaches through either an LVD or HVD SCSI interface.

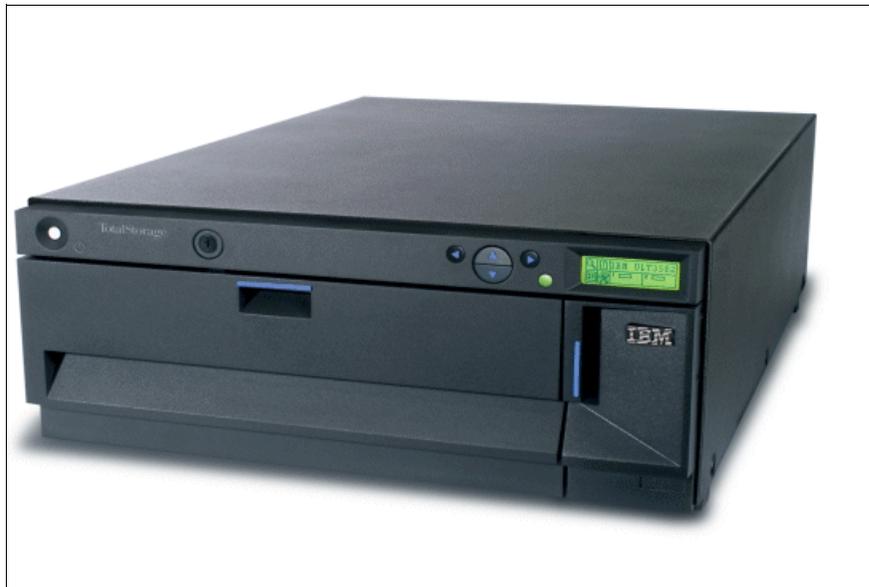### IBM TotalStorage Ultrium Tape 2U Autoloader 3581

Figure 4-3   IBM TotalStorage Ultrium Tape 2U Autoloader 3581

The IBM TotalStorage Ultrium Tape 2U Autoloader 3581 models L28 and F28 offer high capacity, performance, and technology designed for the midrange open systems environment. These models incorporate a single Linear Tape-Open (LTO) Ultrium 2 Tape Drive. With a 1.6 TB native capacity this eight-slot carrousel autoloader is the natural entry choice for small data volume environments.

The IBM TotalStorage Ultrium Tape 2U Autoloader 3581 (see Figure 4-3) is a desktop or rack-mountable unit (requiring two rack units, thus "2U") that operates in automatic, sequential, or random mode, and comes equipped with a robotic interface that moves tape cartridges to and from the drive and cartridge carousel.

Optional features include an HVD Converter, a Remote Management Unit (RMU), and a Bar Code Reader (BCR). The Model L28 comes with an LVD Ultra160 SCSI attachment, and the Model F28 comes with a native Switch Fabric Fibre Channel attachment. For users requiring a HVD-SCSI interface an optional HVD Converter is available. This HVD-SCSI Converter is plugged on the back of the Autoloader.

IBM TotalStorage Ultrium Entry Tape Library 3582

Figure 4-4   IBM TotalStorage Ultrium Tape Library 3582

The IBM TotalStorage Scalable Tape Library 3582 (see Figure 4-4) is a full fledged library that reduces manual intervention. It has 24 tape slots and two drives, with a maximum of 4.8 TB native data capacity. The library can attach to native fibre or a SAN, and can be partitioned into two logical libraries.

This is the library of choice for the fully automated small backup volume environment. The two drives accommodate automatic TSM reclamation. The Ultrium 2 drives can read and write Ultrium 1 cartridges, thus protecting the investments made in LTO technology.

IBM TotalStorage Ultrium Scalable Tape Library 3583

Figure 4-5   BM TotalStorage Ultrium Scalable Tape Library 3583

Although it is a physically small library (see Figure 4-5), the IBM TotalStorage Ultrium Scalable Tape Library 3583 still handles high data volume and data transfers. A fully configured library has a 14.4 TB native data capacity. This is the system of choice for the backup range up to 10 TB, but may also be considered for higher capacities too.

For many current backup infrastructures with DLT tapes, this LTO system will offer great speed and capacity enhancements. The high capacity available should reduce any need for manual tape interaction, and the speed matching feature is a great advantage above the DLT streaming backup. In the medium backup data volume environment, this library will have many advantages for consolidation and standardization. The library has built-in partitioning, which allows simultaneous connections to different servers and applications.

The Ultrium 2 drives can read and write Ultrium 1 cartridges, thus protecting the investments made in LTO technology.

IBM TotalStorage UltraScalable Tape Library 3584

Figure 4-6   IBM TotalStorage UltraScalable Tape Library 3584

The IBM TotalStorage UltraScalable Tape Library 3584 (see Figure 4-6) is the high-end LTO library accommodating any backup data requirements upwards to 496 TB native. The price and performance targets this library from upwards of 10 TB, but it may also be the system of choice for the smaller data volumes.

Important features are the library partitioning that allows a number of heterogeneous systems to attach simultaneously. Also, in an AIX and TSM environment, this library supports increased availability with Control Path Failover.

The IBM TotalStorage UltraScalable Tape Library 3584 is part of the family of tape library storage solutions designed for the large, unattended storage requirements from today's midrange systems up to high-end open systems. Each aspect of the subsystem is designed to optimize access to data and reliability.

The IBM 3584 tape library supports the Ultrium 2 Tape Drive, in addition to the Ultrium 1 Tape Drive, and the IBM TotalStorage Enterprise Tape Drive 3592.

IBM LTO Ultrium tape drives are compact storage devices that support the highly intensive read and write operations required by today's open system servers. The IBM LTO Ultrium 2 Tape Drive is the second generation of LTO Ultrium tape drives in the IBM TotalStorage LTO Ultrium family of products. The IBM 3592 Tape Drives are designed to provide high levels of performance, functionality, and cartridge capacity supporting the 3592 tape format, including Write Once Read Many (WORM) media support.

The IBM 3584 library models L32 and D32 can be equipped with LTO Ultrium 1 or 2 tape drives; the models L52 and D52 with LTO Ultrium Fibre Channel tape drives; and the models L22 and D22 with the IBM 3592 tape drives.

This library provides up to 1377 TB native capacity using LTO Ultrium technology, and up to 1878 TB native capacity using 3592 technology. As there is no upgrade path between the different LTO libraries, the IBM 3584 should be considered starting at a few TB, if anticipated growth and possible future consolidation calls for it.

As you compare competitive tape solutions, consider:

► Scalability: 1 to 16 frames, 1 to 192 tape drives, 58 to 6,887 cartridge slots
► Capacity, performance, and library management requirements
► Data integrity, reliability, and availability
► Storage usage and application requirements
► Affordability
► Loyalty to legacy or existing tape formats, including LTO and 3592 drive technology
► Server attachment and operating system support

For more information on the 3584 Library, refer to "IBM TotalStorage UltraScalable Tape Library 3584" on page 70.

4.1.3 Entry level and LTO tape drives positioning matrix

Table 4-1 is designed to help you position the various IBM entry level tape products.

Table 4-1   Entry level tape product utilization up to 2 TB

	7206	7332	7208	7205	7207	3580 Ultrium 2	3581 Ultrium 1
Product type	4 mm	4 mm stacker	8mm	DLT	QIC	LTO Ultrium 2	LTO Ultrium 1
Single Tape Native Capacity -GB	12/20/ 80	48/120 4/6 slots	20/60	40	4	200	100
UNIX (RISC,MIPS etc)	X	X	X	X	X-	X	X
Intel (Linux, Windows, SCO, etc)						X	X
Less than 50 GB	X+	X+	X+	X+	X-	X	X
50 GB – 200 GB	X	X+	X-	X-		X	X+
200 GB – 1 TB		X- (6 slots)				X	X+
1 TB –2 TB							X-
HSM		X-					X
Native fibre tape							
SAN attach through SDG						X	X
Legend: **X** = will work **X+** = best or strong fit **X-** = will work, but not recommended							

This chart covers tape products that cover the entry level attachment requirements. All are single drives and available in SCSI attachment only. All drives use a 2:1 compression ratio.

Table summary

At first glance this table may present an overwhelming amount of information and seem hard to navigate. Here is some summary information to assist in the use of the table.

Using the legend

In portions of the table where you find just a X, this basically means the product will work, provides some benefit, but may not necessarily be the best fit.

Where you find the symbol X+, this indicates that the product has the most beneficial value and is best suited for that particular selection criteria. For example, for small file backups the best candidate proves to be the 3590 family, due to the fast start/stop capabilities, even considering the speed matching feature of the Ultrium 2 drives.

In areas where X– is indicated, this is to point out that the product is a weak fit at best, but combined with other areas where it fits, it may still prove to be the best choice. For example, the 3584 is costly and a weak fit in the less then 5 TB range, but if fast data growth is anticipated, along with partitioning requirements, it may still prove to be the most cost effective fit.

Sometimes the product may technically be a good fit, but at a high cost. Note that in general terms, 3590, and the associated libraries are approximately twice the price of LTO.

Summary
The intent for a table such as this is to provide a centralized reference point. Direction and selection, as well as differentiation, is obtained through viewing the table as a general guideline, and then supported through supplemental information.

Some of that supplemental information is given in the following sections.

4.2 IBM TotalStorage Enterprise Tape Solutions

The IBM TotalStorage Enterprise tape products deliver features that facilitate their use in a broad range of applications and environments. To meet the need of increased storage and processing requirements, IBM's Enterprise Tape Drive is able to integrate into IBM's 3494 family of linear tape libraries, providing reliable, scalable tape automation.

4.2.1 IBM TotalStorage Enterprise Tape Drive 3592-J1A

Figure 4-7   IBM TotalStorage Enterprise Tape Drive 3592

The IBM TotalStorage Enterprise Tape Drive 3592 offers a design focused on high capacity and performance, and high reliability for storing mission critical data (see Figure 4-7). Whether configured as a stand-alone drive or part of an automated tape library, the 3592 is designed to offer both fast access to data and high capacity in a single drive, helping to reduce the complexity your tape infrastructure.

Here are some of the key features of the IBM 3592 tape drive, which make it a true enterprise tape drive in both performance and reliability:

► 40 MB/sec. native streaming data rate

► Media designed for fast access and capacity.

► Dual coat, advanced particle media

► Virtual backhitch or Nonvolatile Caching: Optimum adaptive formats and algorithms designed for improved start/stop write synchronize performance

► High resolution tape directory support to help improve file search times

► 128 MB data buffer

► Streaming Lossless Data Compression (SLDC) data compression algorithm

► Dual active FC-2 ports to support enterprise environments that use dual paths for failover or load balancing

► High performance and robust dual microprocessor architecture. One microprocessor operates the host attachment interface (running what is essentially proven 3590 host attach microcode, while the other is allowed to focus strictly on writing data to, and reading data from, tape). Each is designed to reset the other to act as a fail safe.

► A new cartridge design featuring 3590-style geometry to support both the existing storage cells and grippers of the 3494 and StorageTek libraries. The cartridge shell is thicker, and the cartridge assembly is strengthened between

top and bottom. Together, these features help create a substantially stronger and more durable cartridge.

► Enhanced scaling and segmentation

► Write Once Read Many (WORM) functionality when operating on one of the two WORM cartridge types

For more information on the IBM 3592-J1A tape drive, refer to "IBM TotalStorage Enterprise Tape System 3592" on page 74.

4.2.2 IBM TotalStorage Enterprise Tape Drive 3590

Figure 4-8   IBM TotalStorage Enterprise Tape Drive 3590

The IBM TotalStorage Enterprise Tape System 3590 (see Figure 4-8) provides high levels of performance and reliability, and exemplifies IBM's continued leadership in storage products. Since its first shipment in September 1995, it has met with wide marketplace acceptance.

The IBM 3590 tape drive provides a native data rate of up to 14MB/sec. With Ultra SCSI attachment, the 3590 models E and H are capable of reaching sustained data rates of up to 34MB/sec with 3:1 compression. With native Fibre Channel attachment, the sustained data rate is 42MB/sec (with 3:1 compression).

The IBM 3590 tape drive is designed for mission-critical data storage. Error Correction Codes (ECC) and servo tracks written on each tape cartridge help

promote data integrity. Resident diagnostics dynamically monitor drive and media performance to detect.

The IBM 3590 Tape Drive uses a bidirectional longitudinal serpentine recording technique and a magneto-resistive head, which concurrently reads and writes 16 data tracks. This means that 384 tracks of data can be reliably written onto 3590 media with the 3590 model H tape drive. In addition, a digital channel technology helps further increase data integrity.

For more information on the 3590 drive refer to "3590 Models" on page 76.

4.2.3 IBM TotalStorage Enterprise Tape Controller 3592-J70
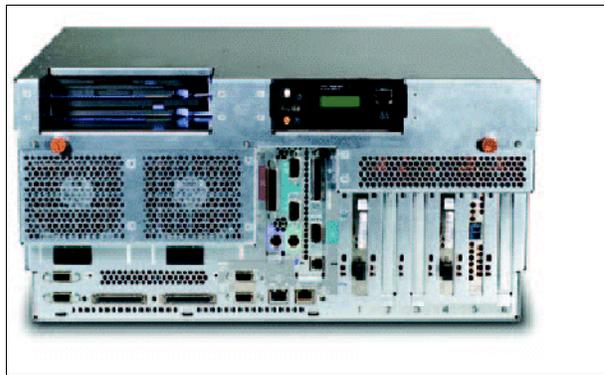
Figure 4-9   IBM TotalStorage Enterprise Tape Controller 3592 Model J70

The IBM TotalStorage Enterprise Tape Controller 3592 Model J70 (see Figure 4-9) is designed to offer ESCON and FICON attachment of either 3592 or 3590 tape drives in an IBM 3494 tape library, a StorageTek ACS, or in a stand-alone environment. The Model J70 is designed to exploit the performance and function of the IBM 3592 tape drive including the high capacity 300GB, the economy 60GB fast access, in either re-writable or WORM tape formats.

Tape drives can be shared among FICON and ESCON hosts, allowing effective drive utilization, and to help reduce hardware switching and fabric infrastructure requirements. The J70 controller is built from IBM components including the IBM pSeries, AIX operating system, and PCI-X bus architecture. Redundant, hot-swappable power supplies and cooling components with automatic failover help provide high availability for the controller.

4.2.4 IBM TotalStorage Enterprise Tape Library 3494

Figure 4-10   IBM TotalStorage Enterprise Tape Library 3494

The IBM TotalStorage Enterprise Tape Library 3494 consists of individual frames that can be configured to help address a variety of user requirements. This flexible design enables organizations to install a solution that helps address current capacity requirements, and to add capacity when required. Configurations include a library base frame, drive frames, storage frames, and up to two IBM TotalStorage Virtual Tape Servers. A high availability model and a dual active accessor feature are available. The modular linear approach to tape automation is the perfect vehicle for the latest technology in storage.

Integration of the IBM TotalStorage Enterprise Tape Drive 3592 and media into the library provides scalability with up to five Petabytes of information storage. The IBM 3494 tape library supports multiple generations of tape drives, tape controllers, and virtual tape servers. The versatility of its design supports the increasing demands of today's storage growth.

Figure 4-10 illustrates the modular flexibility of the library. In addition, a tape library can be shared across multiple platforms such as the IBM zSeries, IBM pSeries, IBM iSeries, and IBM xSeries servers, as well as various non-IBM platforms. The IBM 3494 tape library has a small footprint, starting at 2.5 feet wide by 5 feet deep. This size allows it to fit in many environments and makes it suitable for vaults. It can also provide a significant saving in floor space.

4.2.5 IBM TotalStorage Virtual Tape Server 3494-Bxx

Figure 4-11   IBM TotalStorage Virtual Tape Server

The IBM TotalStorage Virtual Tape Server (VTS) illustrated in Figure 4-11 is an enterprise tape solution designed to enhance performance and provide the capacity required for today's backup requirements. The adoption of this solution can help reduce batch processing time, total cost of ownership, and management cost.

The VTS initially creates a *virtual volume* in a buffer known as the Tape Volume Cache (TVC), which is a RAID-5 disk array. If the host needs to reference these virtual volumes again, they are accessed in most instances from the TVC, helping to eliminate many of the physical delays associated with tape I/O, and improving the performance of the tape process. The virtual volume is also written to an attached tape drive as a *logical volume*. A copy of the virtual volume remains in the cache, which may provide fast access to critical data.

A VTS Peer-to-Peer (PtP) configuration can provide redundancy for greater disaster tolerance with features like remote dual copy for use with Geographically Dispersed Parallel Sysplex (GDPS), disaster backup and recovery, and remote tape vault. Advanced policy management allows selective dual copy for noncritical data. The IBM Virtual Tape Server and the new configurations can be installed at extended distances. These enhancements also address planned outages such as maintenance and upgrades, as well as unplanned outages by eliminating single points of failure.

4.2.6 Selection criteria summary

The selection criteria for the 359x/3494 and VTS product line can be summarized as follows:

- ► Mainframe-only environment, non Linux environments (S/390 zSeries)
- ► Mixed environment where backup system software is running on mainframe
- ► Any environment where there is already a high investment in 3590
- ► STK silos environment, especially with 3590 tape drives already attached
- ► High data volume and maximum data access speed required
- ► Many small files and non-data streaming operation
- ► High data volume and maximum data security required
- ► High availability environment
- ► HSM in a high data volume environment

4.3 Finding the tape solution

This section provides information, figures, tables, and charts, which help further focus on where IBM tape products fit best, and offer comparisons between them.

4.3.1 The LTO tapes subsystems

The summary below highlights some of the LTO tape subsystem capacities to allow for easy comparison and analysis:

3580: Stores several hundred gigabytes of on a single cartridge while co-existing on a desktop with your other systems

3581: Can segment the data by cartridge, perhaps by day, assigning 1 cartridge per day, or one cartridge by user. The total amount of data will typically not exceed the capacity of eight cartridges, or it may be conveniently segmented into eight cartridges (such as one dedicated cartridge per day). Users will be able to store up to 1.6 Terabytes (native) in this configuration.

3582: Can store up to 5 TB (native) of information and would like to do in limited rack space. This configuration is also attractive to ISPs who have dedicated racks of midrange disk by customers that need to be backed-up, racking the tape and the disk together to maintain affinity.

3583: Can to store from 3.4 TB in a minimum slot configuration to 14.4TB (native) in a maximum slot configuration, transferring at speeds from 126 GB/hr to up to 756 GB/hr information, and would like to do in a small footprint deskside (14u) library. Typically, this data growth is in the 60%+ per year, and they are using tape for backup and restores on a daily basis.

3584: Can store from 1.3 to 1.8 Petabytes through heterogeneous backup servers using Ultrium 2, or 3592 tape technology respectively. Bandwidth and SAN connectivity is a key enabler for this type of library. The bandwidth of the total tape subsystem is also a critical element. On a per frame basis, the user can grow bandwidth from 126GB/Hr to 1.5TB/hr.

Open formats benefit customers by offering them multiple sources of product and media, and by providing a means to enable compatibility between products from different vendors. The competitive environment fostered by multiple sources of product also leads to faster paced innovation and enhancements, and provides for data compatibility and investment protection well into the future (see Figure 4-12).

LTO Ultrium Road Map

	Generation 1	Generation 2	Generation 3	Generation 4
Capacity (Native)	100GB	200GB	400GB	800GB
Transfer Rate (Native)	10-20MB/s	20-40MB/s	40-80MB/s	80-160MB/s
Media	Metal Particle	Metal Particle	Metal Particle	Thin Film

Figure 4-12   LTO Ultrium capacity road map

4.3.2 The Enterprise Tape Subsystems

Within the 359x/3494 enterprise class of tape subsystems, the IBM 3592 tape drive surpasses the capabilities of its predecessors by providing up to five times the capacity, and two-and-a half times the data transfer rates of the IBM 3590 series.

The IBM 3592 tape drive uses cartridges with up to 300 GB physical capacity (up to 900 GB with 3:1 compression), allowing more data to be stored on fewer tapes, which can help reduce total cost of ownership TCO), as well as

floor-space requirements and cartridge handling time. In automated tape systems, the cartridge handling time can translate to improved automation slot utilization.

Some of the key characteristics of the IBM 3592 tape drives are the following:

► Up to 300 GB native cartridge capacity
► 40 MB/s native data rate
► Enhanced write performance of synchronized data
► Enhanced Locate performance for data retrieval
► Basis for a new extensible product family
► New levels of reliability and durability in drive and cartridge
► Enhanced automation footprint allowing more drives per library
► Helps protect the customer investment in current automation hardware
► non-alterable, non-rewritable media, Write Once Read Many (WORM)

Figure 4-13 illustrates the functionality of WORM.

WORM Requirement	Provided by	Notes
Non-alterable, non-erasable	✓WORM Tape	New function
Longevity	✓WORM Tape	Up to 10 yr. Shelf lifetime
Data Verify during Write	✓WORM Tape	Embedded function.
Access time	–WORM Tape	60GB version of WORM Tape (approx. 45 sec 3592 in 3494)
Serialization and Time stamp	Application	Application tracks information.
Audit Trail	Application	Application keeps track of all activities
Periodic Migration	Application	As new technology becomes available.
Timely disposition	Application	Discard indexes to records on tape.
Protected Indexes	Application	Indexes facilitate access to data.
Duplicate Copy	Application	Copy Function

Figure 4-13   WORM functionality

4.3.3 Integration of components in tape solutions

Tape systems are composed of integrated components (refer to Figure 4-14). Each component must be considered when selecting a tape technology. The integration of the 3592 tape drive into both IBM 3494 and 358x tape library's has bridged the technology gap between capacity, performance, and reliability. The

evolutionary progression of tape technology can now benefit a broader range of computing environments.
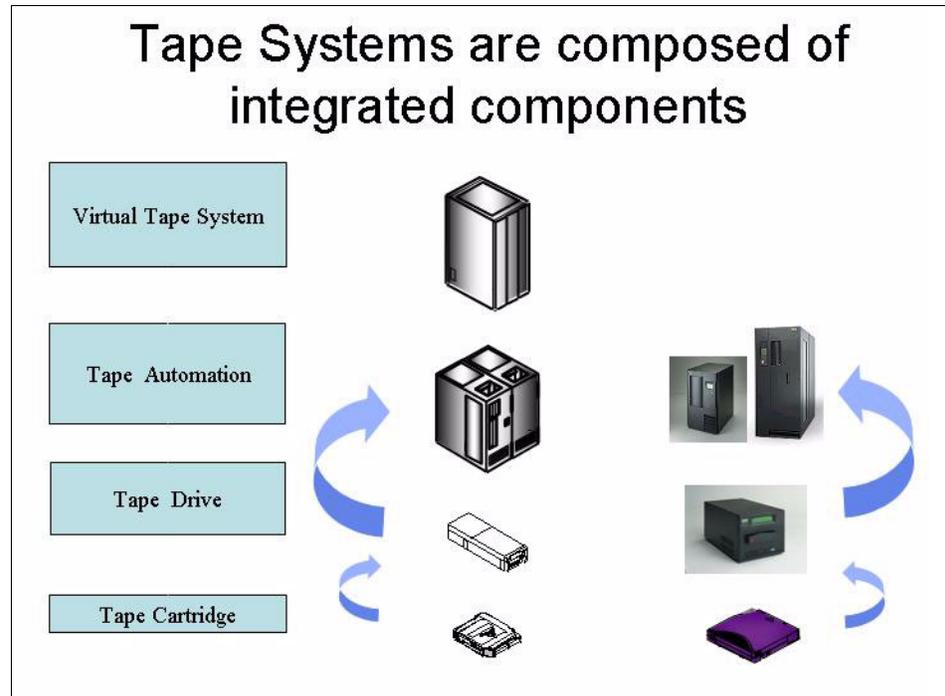

Figure 4-14   Tape system components

4.3.4 Decision summary and positioning scenarios

This section presents two positioning scenarios, and a graphical decision summary chart that exemplifies a tape selection decision process.

Figure 4-15 provides a simplified look at the typical positioning scenario for the 359x class tape products.
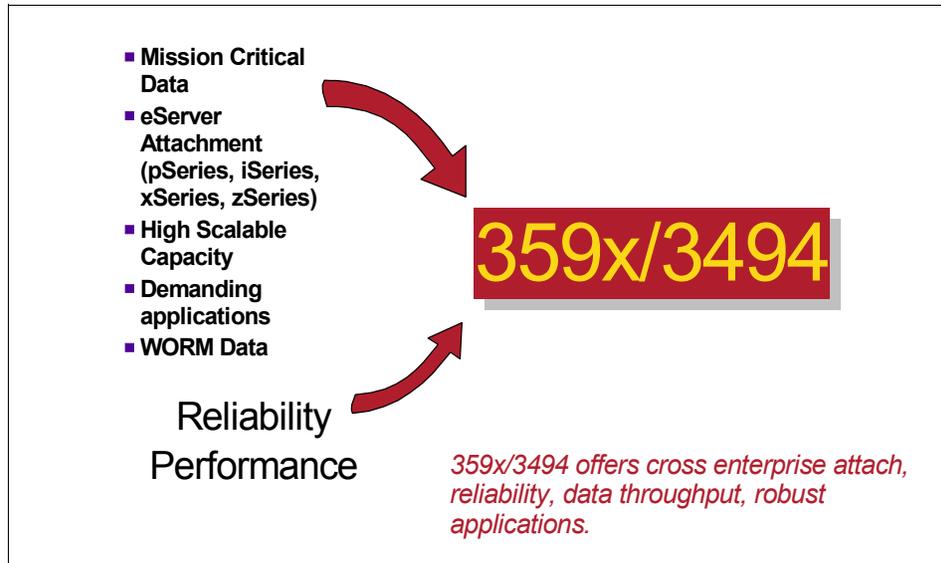
Figure 4-15   Positioning scenario for the 3590 enterprise class tape products

Figure 4-16 provides a simplified look at the typical positioning scenario for the LTO class tape products.
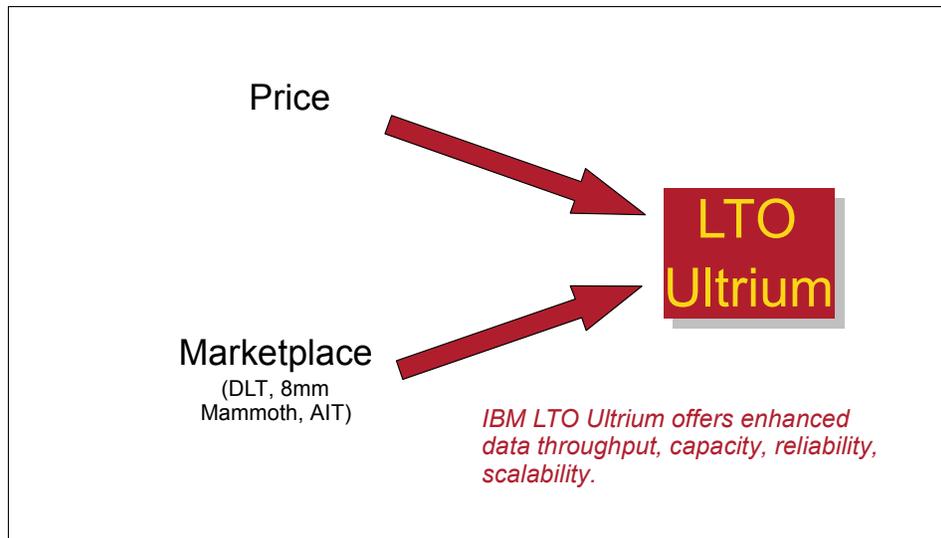
Figure 4-16   Positioning scenario for the LTO tape products

Figure 4-17 provides a quick reference and decision tree for tape technology selection.
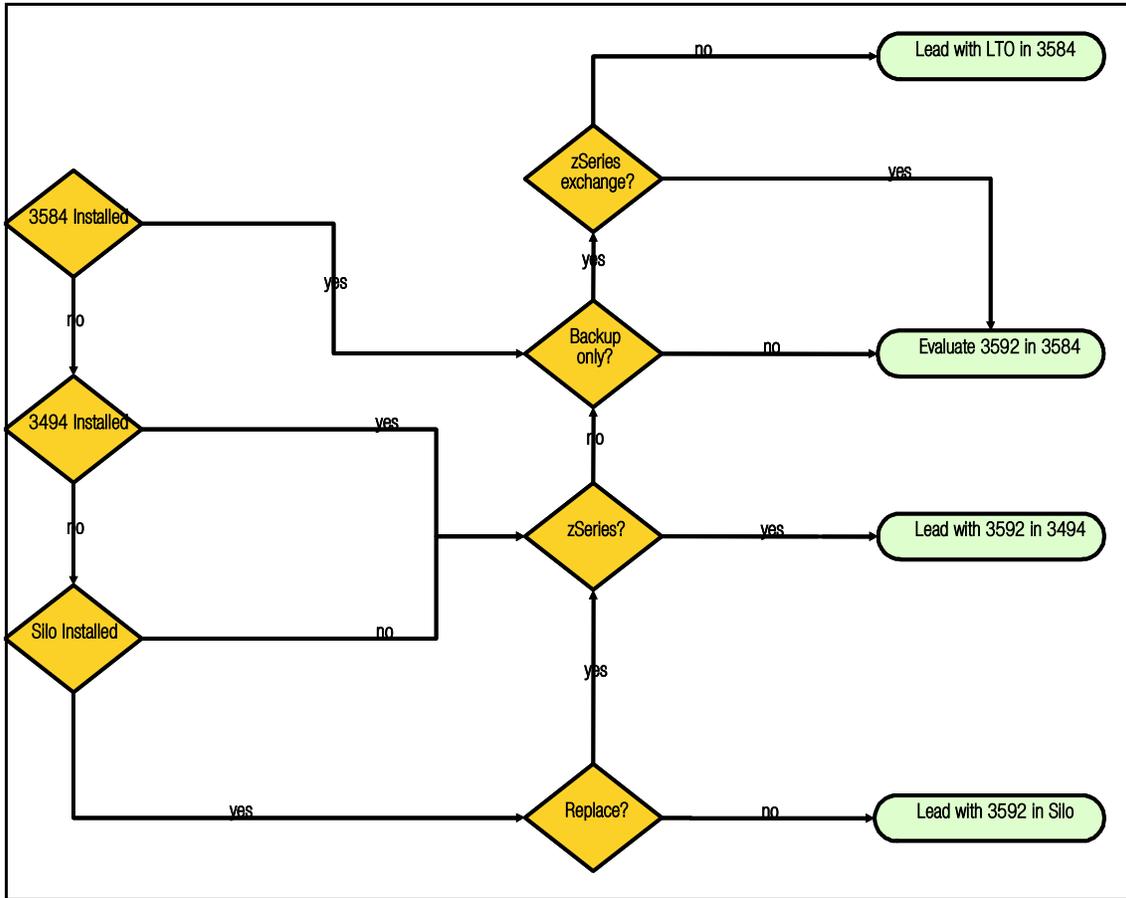
Figure 4-17   Tape technology selection

4.3.5 Tape drives comparison

This section illustrates some basic characteristics and specific features that help further differentiate and position the different tape technologies.

Figure 4-18 differentiates the areas where the 359x and 3580 tape drives are stronger fits as per their basic design characteristics.
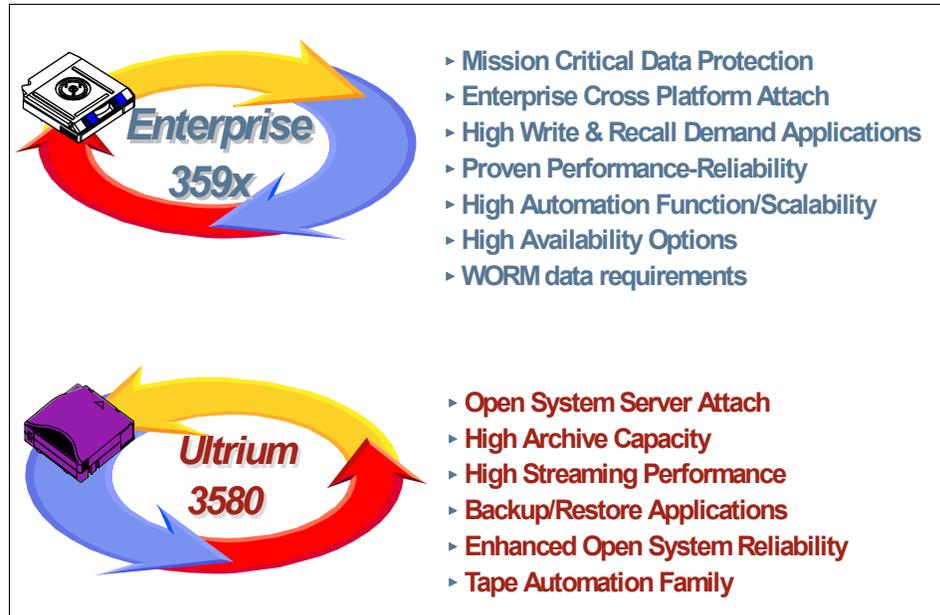
Figure 4-18   Enterprise 359x versus Ultrium 3580 best fits

Figure 4-19 shows a comparison of some basic features that further differentiate the tape technologies.

.

Parameter	Specifications of the 3592 J1A Drive	Specifications of the Ultrium 2 Drive	Specifications of the 3590 Model H drive
Capacity (native) without capacity scaling.	300 GB using a JA Media Type cartridge	200 GB using an Ultrium 2 Type cartridge	60 GB using a K Media Type cartridge 30 GB using a J Media Type cartridge
Device data rate – maximum sustained (native)	40 MB/sec	35 MB/sec	14.5 MB/sec
Device data rate – maximum sustained with maximally compressible data	110 MB/sec (FC-2) write 120 MB/sec (FC-2) read	110 MB/sec (FC-2) write 120 MB/sec (FC-2) read	85 MB/sec (FC-1)
Host attachment interface	Dual active ports of FC-2 with short wave optical LC duplex connectors, N and NL Port support with auto-negotiate	Single Port of Ultra-160 SCSI LVD or FC-2 with a short wave optical LC duplex connector , N and NL Port support with auto-negotiate	Dual active ports of Ultra-1 SCSI HVD or FC-1 with short wave optical SC duplex connectors NL support only
Interface burst transfer rate –maximum	200 MB/sec (FC-2)	160 MB/sec (SCSI) or 200 MB/sec (FC-2)	40 MB/sec (SCSI) or 100 MB/sec (FC-1)
Tape Speed Write/Read, max.	4.74 m/s	6.22 m/s average for Ultrium 2 media	3.14 m/s average
Speed Matching, sub-speeds supported	4.147 m/s @ 35.0 MB/s 3.629 m/s @ 30.6 MB/s	@ 4/8, 5/8, 6/8, & 7/8 of full speed (6.22 m/s)	Not Supported
Tape Speed – locate / rewind	8 m/s max, middle of tape	8 m/s max, middle of tape	5.2 m/s constant
Rewind time, maximum	<76 sec using JA cartridge	<60 sec using an Ultrium 2 cartridge	<120 sec, K media cartridge < 60 sec, J media cartridge
Media type	Dual coat advanced particle	Dual coat metal particle	PEN substrate MP particle
Number of data tracks	512	512	384
Number of servo regions	5	5	5
Number of data tracks recorded / read simultaneously	8	8	16
Data buffer size	128 MB	64 MB	16 MB
Weight, without cartridge (drive only)	3.2 kg estimated drive only 5.7Kg measured canister	3.0 kg	40.0 kg *includes power supply

Figure 4-19   Comparison between tape drive products

4.3.6 IBM 3494 and 3584 tape libraries comparison

This section contains a comparison of the IBM 3494 and 3584 tape libraries (refer to Table 4-2 for a summary).

Table 4-2   Comparison between the IBM 3494 and 3584 tape libraries

	3494	**3584**
Product	1/2" Cartridge Tape Library	LTO Ultrium Ultra Scalable Tape Library
Machine model	3494 (Frames) L12, L14, L22 - Library D12, D14, D22, D24 - Library Frame S10 - Storage Frame HA1 - High Availability	3584 D22, D52 LTO Frames L22, L52 Enterprise 3592 Frames
Technology	Modular Linear	Modular Linear
Max number of cartridges	6,240 (*2*)	6,881 (*2*)
Cartridge capacity native/ compressed (*1*)	Drive Dependent HX: 60/180GB JA: 300/900GB	Drive Dependent Ultrium 1: 100/200GB Ultrium 2: 100/400GB JA: 300:/900GB
Max library capacity compressed (*1*)	HX: 1.2PB JA: 5.6PB	Ultrium 1: 496TB Ultrium 2: 2.75PB JA: 5.6PB
Interface	SCSI F/W, Diff PCI, Ultra SCSI, FC, ESCON, FICON, 2BG FICON	FC fabric, LVD, HVD
Supported platforms (*5*)	iSeries, AS/400, pSeries, RS/6000, zSeries, S/390, Linux, Windows NT, Windows 2000, Sun, HP	iSeries, AS/400, pSeries, RS/6000, zSeries, S/390, Linux, Windows NT, Windows 2000, Sun, HP

F/W = Fast/Wide, Diff = Differential, N/A = Not Applicable, FC = Fibre Channel, X= Extended length cartridge, IOE = IBM Onsite Exchange, CRU = Customer Replaceable Unit

NOTES 1: Compressed data rates are estimates and are data-, application- and processor-dependent. User results may vary. 2: Max number of cartridges decreases as tape drives are added.
3: AIX 4.1.5 or later. 4: Load and search only. 5: Server platforms with SAN-ready attachability, model- and feature-dependent. 6: Depends on virtual cartridge configuration. 7: The latest ISV support can be found in the connectivity section at storage.ibm.com/hardsoft/tape/conntrix. 8: The latest ISV support can be found in the connectivity section at storage.ibm.com/hardsoft/tape/3590/infor.html.

Always check the Web for the latest in support. The following links will provide you with the latest in platform and independent software vendor support for the tape libraries:

For the IBM 3494 tape library refer to:

http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3494l12.html

For the IBM 3584 tape library refer to:

http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3584.html

3494 highlights

The IBM TotalStorage Enterprise Automated Tape Library 3494 is enhanced to support the IBM TotalStorage Master Console (TSMC), which integrates service monitoring of the 3494 library. Remote data monitoring of devices attached to the master console may assist in determining if the 3494 is working properly and providing rapid diagnostic support.

Some of the basic characteristics of the IBM 3494 tape library are:

- ► Provide an adaptive scalable solution
- ► Linear library design to provide scalability
- ► Modular design provides configuration flexibility
- ► Frame design supports future tape generations
- ► Outboard library manager design allows incorporation of new function
- ► Provide a highly available solution
- ► Outboard library manager to remove host dependencies
- ► Dual library managers provide redundant host connections
- ► Dual accessors enable concurrent library maintenance
- ► Modular design and upgrades support physical resource additions
- ► Outboard design allows virtualization of drives and volumes
- ► Support Storage Resource Management
- ► zSeries® provided through DFSMS™ Advanced Policy Management

Figure 4-20 shows an example of an IBM 3494 tape library configuration.

The figure shows:

> ➢ Up to 32 open system attached 3592 tape drives
> ➢ Up to 100 zSeries or S/390 attached 3592 tape drives
>   • 108 if only 24 open system tape drives are included
>   • 116 if only 12 open system tape drives are included
>   • 120 if only 4 open system tape drives are included

Library frames labeled: L22, D24, D24, D24, D24, D24, D24, D24, D24, D24, D24, D24, D24, D22, D22, D22

zSeries / S/390 — open system
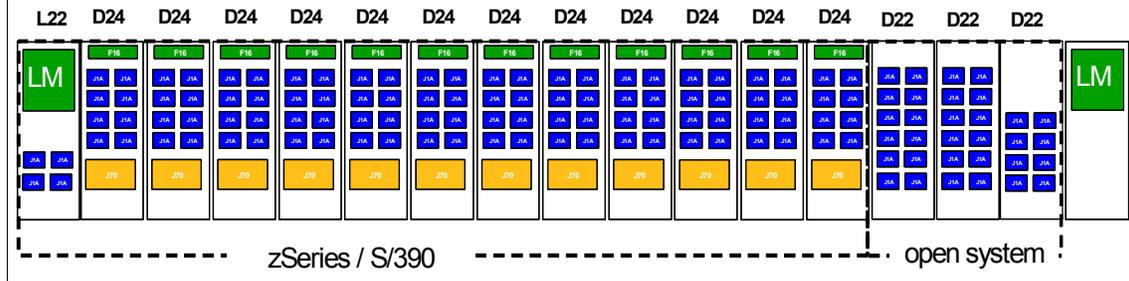
Figure 4-20   3494 sample configuration

The ability to put a second robotic unit and a second library manager (LM) in the IBM 3494 tape library gives it a high availability feature (see Figure 4-20).

3584 highlights

Designed for automated tape handling, the IBM TotalStorage UltraScalable Tape Library 3584 is illustrated in Figure 4-21. Every aspect of the subsystem is designed to optimize data access and reliability.

The IBM 3584 supports IBM LTO Ultrium 1, IBM Ultrium 2 drives and IBM Enterprise Tape Drive 3592. IBM LTO Ultrium tape drives are compact, high-performance storage devices that support the operations required by today's network and e-business servers. Some key characteristics of the IBM 3584 tape library are:

Integrated
Remote management capabilities designed to simplify data management for the open systems environment including pSeries, iSeries, xSeries, HP, Sun, and other Intel platforms

Open
Based on the open LTO standard established by IBM, HP, and Seagate, LTO

tape technology remains the only format widely available from multiple vendors, helping to lower costs and bringing new generations to the marketplace faster.

Virtualized
Exclusive Multi-Path architecture allows a single physical LTO library to easily be partitioned into multiple logical libraries used by heterogeneous servers, facilitating storage consolidation.

Autonomic
Control path failover and data path failover features in LTO libraries enable self-healing capabilities that help support continuous operation for key data protection activities.

Load balancing features in LTO libraries support self-optimizing capabilities to help maximize library utilization and return on investment.
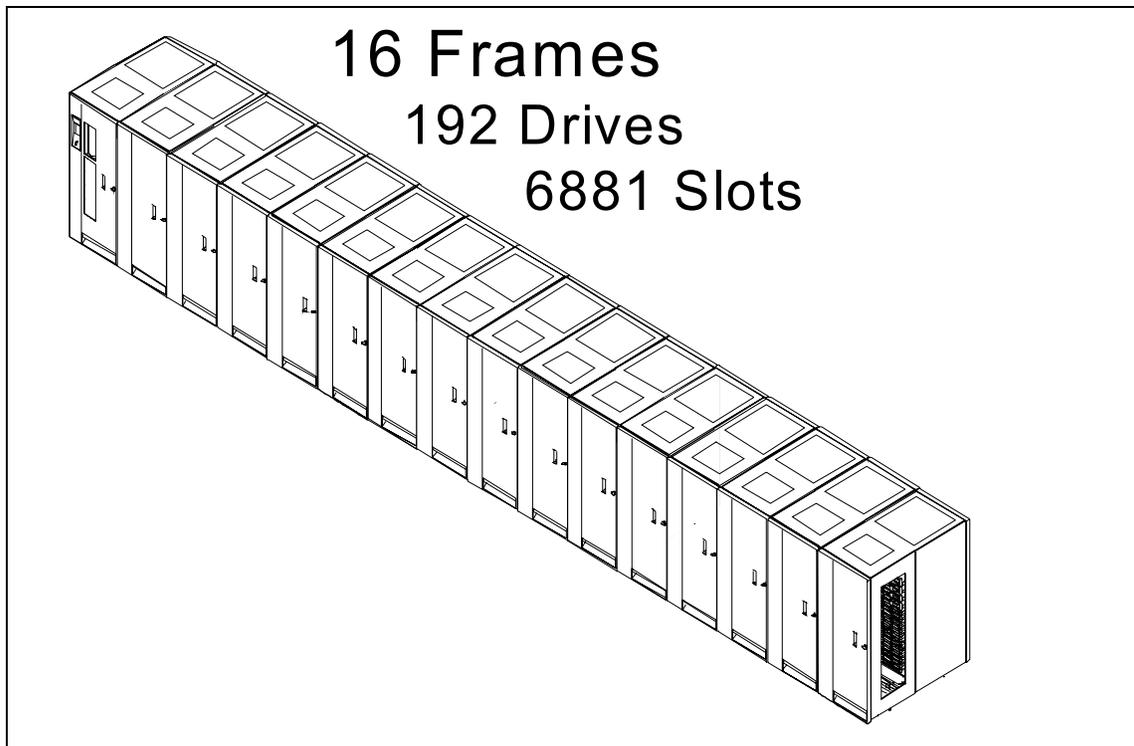
Figure 4-21   3584 library frames

> Note: The new L52 and D52 frames offer a 20% floor space reduction, and substantial storage density increase (a total of > 35TB/sq.ft.) over the L32/D32 when using 3592 drives.

4.4 Tape technical information URL

IBM provides extensive technical information for all of its tape products. This includes product overviews, specification sheets, technical documentation, and white papers.

Go to the standard IBM storage page and search for the IBM TotalStorage Enterprise Tape System 3590, or the IBM Ultrium LTO systems; or go directly to the tape storage URL:

`http://www.storage.ibm.com/hardsoft/tape/index.html`

Overview of IBM TotalStorage tape offerings

This appendix gives additional information on the IBM TotalStorage tape and backup products:

- ► Entry level tape storage
- ► IBM TotalStorage Ultrium 2
- ► IBM TotalStorage Ultrium Tape 2U 3581
- ► IBM TotalStorage Ultrium Tape Libraries
- ► IBM TotalStorage Enterprise Tape System
- ► IBM TotalStorage Virtual Tape Server

IBM has several other tape products that are primarily the focus of different brands or groups within IBM, and are not considered in the TotalStorage product set. For more information regarding these, reference the URL below as a starting point:

http://www.storage.ibm.com/hardsoft/tape/index.html

Entry level tape storage

This section lists IBM TotalStorage products available in the 4 mm, 8 mm, and DLT product lines.They are all based on streaming data transfers. Generally, there is a high amount of manual involvement changing tapes regularly.

IBM 7206 / 7332 4mm DDS

The IBM 7206 4 mm single drive, or the IBM 7332 4 mm autoloader are designed for the entry level server market, and are ideal for backup and interchange of low volumes of data (in the range of 10s of Gigabytes).

Highlights
These are the main features of this product:

► **Capacity 7206:** 24/40 GB (2:1 compression) per DDS3/DDS4 cartridge
► **Capacity 7206-VX2:** 160 GB (2:1 compression) per cartridge
► **Capacity 7332:** 96/240 GB (2:1 compression)
► **Performance:** 2/6 MB/sec (optimal compression)

Technical and driver support
Refer to the URLs below for the latest information about the 4 mm tape product set:

http://www.storage.ibm.com/hardsoft/tape/7206/index.html
http://www.storage.ibm.com/hardsoft/tape/7332/index.html

IBM 7208 8mm DAT drive

The IBM 7208 8 mm single drive also addresses the entry level server market, serving backup and interchange of low volumes of data.

Highlights
These are the main features of this product:

► **Capacity:** 40/150 GB (2:1/2.5:1 compression) per cartridge
► **Performance:** 6/30 MB/sec (optimal compression)

Technical and driver support
Refer to the URL below for the latest information about the 8 mm tape product set:

http://www.storage.ibm.com/hardsoft/tape/7208/index.html

IBM 7205 DLT drive

The IBM 7205 DLT single drive also addresses the entry level server market, serving backup and interchange of low volumes of data.

Highlights
These are the main features of this product:

- ▶ **Capacity:** 80 GB (2:1 compression) per cartridge
- ▶ **Performance:** 12 MB/sec (optimal compression)

Technical and driver support information
Refer to the URL below for the latest information about the DLT tape product set:

http://www.storage.ibm.com/hardsoft/tape/7205/index.html

IBM TotalStorage Ultrium

This section describes the current products available from IBM in the TotalStorage Ultrium family of products. They are also known as the Linear Tape Open (LTO) product set (Figure A-1). The initial series of LTO products is now in limited availability, and the second generation series is known as Ultrium 2.

The digital speed matching feature of the Ultrium 2 drives provides a better matching between the tape and the host data transmission speeds, thus reducing the backhitch requirements, and greatly improving the performance in small file backup. Also, the buffer size has been doubled to 64 MB to further assist in reducing backhitch and improve streaming.

> **Note:** All models are currently available as Ultrium 2 drives, but the Ultrium 1 drives will continue to be supported, and Ultrium 2 drives may be installed together with Ultrium 1 drives in earlier versions of the 3583 and 3584 libraries. The Ultrium 2 drive can read and write the Ultrium 1 cartridges, thus protecting the investment in LTO technology.

Figure A-1   IBM TotalStorage Ultrium Tape family

IBM TotalStorage Ultrium Tape Drive 3580

The IBM TotalStorage 3580 Ultrium Tape Drive (abbreviated to 3580) is an external, stand-alone, SCSI-attached tape drive that attaches to iSeries, pSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, Linux, and Microsoft Windows NT/2000 open systems using a suitable SCSI adapter.

The IBM TotalStorage 3580 Ultrium Tape Drive can also connect to Fibre Channel server host bus adapters through the IBM SAN Data Gateway Routers models 2108-R03 or 2108-G07.

The IBM TotalStorage Ultrium 3580 is available as separate model types, depending on the SCSI interface:

- ► IBM TotalStorage Ultrium 2 3580 -L23 has a LVD Ultra160 SCSI attachment and a three year warranty
- ► IBM TotalStorage Ultrium 2 3580 -H23 has a HVD Ultra SCSI attachment and a three year warranty

Refer to the URL below for the latest information about the Ultrium 3580:

http://www.storage.ibm.com/hardsoft/tape/3580/index.html

LTO Ultrium: key attributes

Figure A-2 summarizes the strong points of the IBM LTO Ultrium 2 technology.

- **Open Standards**
  - LTO specifications developed and maintained by IBM, HP and Seagate
  - LTO cartridge interchangability
  - Multi-generation roadmap available, Ultrium 2 now available
  - LTO drives and media available from multiple vendors
- **High Capacity**
  - up to 200GB / cartridge (uncompressed)
- **Price / Value**
  - Priced to compete in the open systems space; 5 year media warranty
- **Data Rate**
  - Up to 35MB/second (DLT 8000 6MB/s; Mammoth-2 12MB/s; uncompressed)
- **Read/Write Compatibility**
  - Ultrium 2 drive can read and write the Ultrium 1 cartridges
- **Enhanced Reliability**
  - Servo bands, MR Heads
  - Advanced ECC
  - Media-Subsystem health monitoring - SARS reporting of permanent errors as well as tracking last 9 tape mounts
- **Open Systems Automation Solutions**
  - Autoloader and Scalable library solutions; Over 130,000 drives shipped
  - Over 9,000 libraries shipped

Figure A-2   Key attributes of the IBM Ultrium LTO technology

IBM TotalStorage Ultrium Tape 2U 3581

The IBM TotalStorage Ultrium Tape Autoloader 3581 2U is a desktop or rack-mountable unit (requiring two rack units, thus "2U") that operates in automatic, sequential, or random mode and comes equipped with a robotic interface that moves tape cartridges to and from the drive and cartridge carousel. The IBM TotalStorage Ultrium Tape 2U Autoloader 3581 attaches initially to pSeries, RS/6000, Sun, HP, iSeries, AS/400, xSeries, and other Intel-based servers supporting IBM AIX, Microsoft Windows 2000, Microsoft Windows 2003, Sun Solaris, HP-UX, OS/400, and Linux using SCSI or Fibre Channel attachment.

The IBM TotalStorage Ultrium Tape 2U Autoloader 3581 uses the IBM ULtrium 2 drives only for fast data transfer and reliability in automated library services. The Ultrium 2 cartridge has a native capacity of 200 GB.

The IBM TotalStorage Ultrium tape 2U Autoloader 3581 has a eight cartridges capacity, provides an native media capacity of 1.6 TB (3.2 TB with 2:1 compression), and a sustained data rate up to 35 MB/sec (uncompressed).

The Autoloader's robotic system includes an I/O door, a cartridge carousel with eight cartridge slots, and a cartridge loader. The I/O door allows importing or exporting a single cartridge to or from the Autoloader. The cartridge carousel encircles the Ultrium 2 Tape Drive, and positions the specified cartridge slot in front of the tape drive. A robotic cartridge loader moves the cartridges between the cartridge slots and the tape drive.

Three different interfaces are available for the IBM TotalStorage Ultrium Tape 2U Autoloader 3581:

► The IBM Totalstorage Ultrium Tape 2U Autoloader 3581 model L28

  Model L28 has a Low-Voltage Differential (LVD) Ultra 160 SCSI attachment that connects to LVD fast/wide adapters.

► The IBM Totalstorage Ultrium Tape 2U Autoloader 3581 model L28 with an optional High-Voltage Differential (HVD) converter (feature #3104)

  The HVD Converter is a SCSI LVD to HVD converter/expander. It converts the Autoloader's low voltage differential (LVD) to wide high voltage differential (HVD).

► The IBM TotalStorage Ultrium tape 2U Autoloader 3581 model F28

  Model F28 has a 2 GB Native Switched Fabric Fibre Channel attachment.

  The Remote Management Unit (RMU) is optional with the IBM TotalStorage Ultrium Tape 2U Autoloader 3581 (feature #1660). The RMU provides an Ethernet port, so that the library can be configured as a TCP/IP device on the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps. The IBM Ultrium Tape Library Specialist enables network access (through a Web browser) to the library for more detailed status and for updating the firmware of the library. All library operator panel functions can be accessed using the IBM Ultrium Tape Library Specialist.

IBM TotalStorage Ultrium Tape Library 3582

The 3582 Ultrium Entry Library (abbreviated to 3582) is an external, stand-alone or rack-mounted library that incorporates two IBM Ultrium 2 Tape Drives. It attaches to iSeries, pSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, SunSolaris, HP-UX, Linux, and Microsoft Windows 2000/NT open systems using a suitable SCSI or Fibre Channel adapter.

> **Note:** It should be noted that native Fibre Channel Ultrium tape drives provide the ability to log in as fabric-aware devices, not just as FC-AL as in previous generations of the drive, thus eliminating the need for protocol conversion.

The 3582 Ultrium Tape Library capacity is 24 tape cartridges, providing a media capacity of up to 4.8 TB (9.6 TB with 2:1 compression) data storage per library and a sustained data rate per drive of up to 35 MB per second (native). The Ultrium 2 drives may read and write the Ultrium 1 cartridges, thus protecting the investment in LTO technology. This model also has the ability to partition into two smaller libraries if desired.

The IBM TotalStorage Ultrium 3582 can be ordered using the model designation 3582-L23 and has a standard three year exchange warranty. Feature codes are added to the model to designate the following Ultrium 2 drives:

► LVD - SCSI Ultra160 interface
► HVD - Ultrawide SCSI interface
► FC - 2 GB fabric Fibre Channel interface

Refer to the URL below for the latest information about the 3582:

http://www.storage.ibm.com/hardsoft/tape/3582/index.html

IBM TotalStorage Ultrium Scalable Tape Library 3583

The IBM TotalStorage 3583 Ultrium Scalable Tape Library is a high-performance, reliable, scalable tape subsystem. Designed for tape automation, the 3583 can be attached to iSeries, pSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, Linux, and Microsoft Windows 2000/NT open systems using SCSI attachment or Fibre Channel attachment.

The library uses the IBM Ultrium 2 Tape Drives for faster data transfer and reliability in automated library service. Each aspect of the library subsystem has been designed for repeated, reliable unattended tape handling. Tape capacity is 200 GB per cartridge in native format, and using (2:1) compression is 400 GB. The Ultrium drives have maximum sustained data rates of 35 MB/sec native and 70 MB/sec at 2:1 compression. Of course, the real achieved performance depends on many other system variables.

The tape library is designed for easy expansion. It can accommodate from one to six tape drives, and from 18 to 72 cartridges. There are three library models: L18, L36, and L72. The cartridge capacity of the Model L18 is 18 cartridges, the Model L36 is 36 cartridges, and the Model 72 is 72 cartridges. Models 18 and 36 can be field upgraded to hold 72 cartridges. Cartridge expansion is in increments of 18 cartridges.

One IBM Ultrium 2 drive is required, and five additional drives are available for factory or field installation. Upgrade features are modular units that are easy to install. Drives can be a mixture of native Fibre Channel, LVD SCSI, or HVD SCSI.

The Ultrium 2 drives may field install in the existing Ultrium 1 libraries to any mix of Ultrium 1 and Ultrium 2, when supported by TSM V5.2. A chargeable feature known as the *multipath upgrade feature* is required when upgrading existing 3583 libraries with Ultrium 2 tape drives. The Ultrium 2 drives may read and write the Ultrium 1 cartridges, thus protecting the investment in LTO technology.

The tape library input/output (I/O) station enables cartridges to be inserted and removed without disrupting library operation. There are two I/O station options: a single slot option and a 12 slot option. The 12 slot I/O station is required to achieve the 72 cartridge maximum library configuration. With the 12 slot I/O station feature, the library can be configured as 72 storage slots or 60 storage slots and 12 I/O slots.

The Remote Management Unit (RMU) comes standard in every library shipped after July 27, 2001. The unit can be added to pre-existing libraries by ordering the chargeable upgrade Feature Code 1660. The RMU provides an Ethernet port so that the library can be configured as a TCP/IP device on the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps.

The StorWatch Specialist enables network access (through the Web browser) to the RMU for library status and control. All library front panel operator functions can be accessed using the StorWatch Specialist. The SAN Data Gateway Integrated Module is an additional chargeable feature. The gateway provides the ability for SCSI devices in the library to connect into a SAN infrastructure. This feature is integrated into the existing physical library structure.

> **Note** It should be noted that native Fibre Channel Ultrium tape drives provides the ability to log in as fabric aware devices, not just as FC-AL as in previous generations of the drive, thus eliminating the need for protocol conversion.

Library partitioning for the new Ultrium 2 library is supported with the latest version of TSM, as well as other backup applications. The library has the ability to be logically partitioned up to three times. Another advantage of partitioning is the ability to use the 3583 in heterogeneous computing environments. Refer to the URL below for the latest information about the 3583:

http://www.storage.ibm.com/hardsoft/tape/3583/index.html

Since April 2003, the AIX LTO device driver supports control path failover. There must be pre-configured redundant paths, but the capability allows AIX to have adapter and control path failures without losing connectivity to the library and aborting current jobs in progress. The support for this function is in the AIX Atape device driver.

The patented Multi-Path feature of the Ultrium Tape Library 3583 supports sharing of the library robotics. This is accomplished by partitioning the library into up to three multiple logical libraries, and providing each logical library its own separate and distinct drives, storage slots, and control paths. Input/output (I/O) slots are shared on a first-come-first-served basis. This type of partitioning allows heterogeneous applications to share the library robotics independent of each other. Cartridges under library control are not shared between logical libraries, nor allowed to be moved between logical libraries. An example of heterogeneous sharing is a Microsoft Windows 2000 application using the drive and storage slots of one logical library, while a UNIX application uses the drive and slots of another logical library.

Logical libraries can also be used for separating Ultrium 1 Tape Drives and cartridges from Ultrium 2 Tape Drives and cartridges for applications that do not support mixing the drives in the same logical library. Go to the following Web sites to get the latest library and drive updates:

http://www-1.ibm.com/servers/storage/support/lto/

ftp://ftp.software.ibm.com/storage/358x/

For enhanced availability you may use Control Path Failover. This optional feature provides automatic control path failover to a preconfigured redundant control path in the event of a loss of a host adapter or control path drive, without aborting the current job in progress. Control path fail over is supported on AIX for Fibre Channel attachments, and requires usage of the IBM device driver.

The Remote Management Unit (RMU) comes standard in every library. The RMU provides an Ethernet port, so that the library can be configured as a TCP/IP device on the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps. The TotalStorage Ultrium Specialist enables network access (through the Web browser) to the library for more detailed status and control. All library operator panel functions can be accessed using the IBM Ultrium Tape Library Specialist.

IBM TotalStorage UltraScalable Tape Library 3584

In today's business environment, the number of clients and servers continues to grow almost exponentially. From midrange systems to large-scale server-based operations, the IBM TotalStorage UltraScalable Tape Library is designed to handle backup, archive, and disaster recovery data storage needs with ease.

The IBM TotalStorage UltraScalable Tape Library 3584 supports the IBM TotalStorage Ultrium 2 Tape Drive, and the new IBM TotalStorage LTO Ultrium 200GB Data Cartridge. It more than doubles tape drive performance over the first generation LTO Ultrium Tape Drive, and is designed to support up to 35 MB/sec native data transfer rates (70 MB/sec with 2:1 compression).

IBM TotalStorage Ultrium 2 Tape Drives can read and write original LTO Ultrium data cartridges at first generation Ultrium 1 capacities with improved performance. The Ultrium 2 tape drives and cartridges can be resident in the same 3584 Library frame with first generation original Ultrium tape drives and cartridges. The UltraScalable Tape Library is designed with a variety of advanced features. The multi-path architecture is designed to simultaneously attach heterogeneous servers and applications to LTO logical library partitions, including mixed Ultrium drives and media.

Note: It should be noted that native Fibre Channel Ultrium tape drives provide the ability to log in as fabric aware devices, not just as FC-AL as in previous generations of the drive, thus eliminating the need for protocol conversion.

Remote management capabilities using a Web browser provides library control and configuration. Simple Network Management Protocol (SNMP) functionality is also included. LTO I/O expansion capability is available with a 20-cartridge option, which can be added to the standard 10 cartridge feature. Hot swap drives and redundant power offer enhanced availability. Control path failover for AIX with TSM V5.2, and 110 volt power options are also available.

The IBM TotalStorage UltraScalable Tape Library 3584 is part of the family of tape library storage solutions designed for the large, unattended storage requirements from today's midrange systems up to high-end open systems.

Each aspect of the subsystem is designed to optimize access to data and reliability. The UltraScalable Tape Library 3584 supports the IBM TotalStorage LTO Ultrium 2 Tape Drive, in addition to the Ultrium 1 Tape Drive; and the IBM TotalStorage Enterprise Tape Drive 3592. IBM LTO Ultrium tape drives are compact storage devices that support the highly intensive read and write operations required by today's open system servers. The IBM LTO Ultrium 2 Tape Drive is the second generation of LTO Ultrium tape drives in the IBM TotalStorage LTO Ultrium family of products. The 3592 Tape Drives are designed to provide high levels of performance, functionality, and cartridge capacity supporting the 3592 tape format, including Write Once Read Many (WORM) media support.

The 3584 Library Models L32 and D32 can be equipped with IBM TotalStorage LTO Ultrium 1 or 2 Tape Drives, the Models L52 and D52 with IBM TotalStorage LTO Ultrium Fibre Channel Tape Drives, and the Models L22 and D22 with the IBM TotalStorage Enterprise Tape Drive 3592. The 3584 Models D22, D52, L22, and L52 have a smaller footprint than the Models D32 or L32, so they take up less floor space. The Ultrium 2 Tape Drives and data cartridges can be resident in the same UltraScalable Tape Library 3584 frame with original Ultrium 1 Tape Drives and data cartridges, and adjacent frames can have 3592 Tape Drives and data cartridges. The 3584 supports mixed media in the same library (by frame), intermix of the Models D22, D32, and D52 within a 3584 library is supported. Input/Output (I/O) stations are located on the Models L22, L32, or L52 to facilitate tape loading and unloading.

Model L22 (Base Frame)

The 3584 Model L22 Base Frame is designed for holding IBM 3592 tape drives and 3592 data cartridges. The Model L22 Base Frame has 58 to 260 cartridge slots, and support for up to 12 tape drives with an incremental reduction of storage slots for more than four drives or with the additional I/O station installed. This model has a smaller footprint than the Model L32. The 3584 Model L22 is designed with an optimized gripper for use with LTO or 3592 tape cartridges. Up to 12 logical libraries (one per tape drive) can be configured for each frame.

Each Model L22 library has a standard 16-slot cartridge I/O station for importing or exporting 3592 tape cartridges from the library without requiring a re-inventory. An additional 16-slot cartridge I/O is optionally available for either LTO or 3592 data cartridges. Libraries containing a mixture of LTO and 3592 drive technologies must have one LTO I/O station and one 3592 I/O station. For bulk loading of tape cartridges, the library door can be opened. Each time the library door is closed, a bar code reader mounted on the autochanger scans the cartridge labels enabling a reinventory of the cartridges in the library frame in typically less than 60 seconds. A door lock is included to restrict physical access to cartridges in the library.

Model L52 (Base Frame)

The 3584 Model L52 Base Frame is designed for holding IBM LTO Ultrium Fibre Channel tape drives and LTO data cartridges. The Model L52 Base Frame has 64 to 287 cartridge slots, and support for up to 12 tape drives with an incremental reduction of storage slots for more than four drives or with the additional I/O station installed. This model has a smaller footprint than the Model L32. The 3584 Model L52 is designed with an optimized gripper for use with LTO or 3592 tape cartridges. Data capacity for the Model L52 depends on the types of cartridges, up to 115 TB (at 2:1 compression) using LTO-DC with Ultrium 2 data cartridges. Up to 12 logical libraries (one per tape drive) can be configured for each frame.

Each Model L52 library has a standard 16-slot cartridge I/O station for importing or exporting LTO tape cartridges from the library without requiring a re-inventory. An additional 16-slot cartridge I/O is optionally available for either LTO or 3592 data cartridges. Libraries containing a mixture of LTO and 3592 drive technologies must have one LTO I/O station and one 3592 I/O station. For bulk loading of tape cartridges, the library door can be opened. Each time the library door is closed, a bar code reader mounted on the autochanger scans the cartridge labels enabling a re-inventory of the cartridges in the library frame in typically less than 60 seconds. A door lock is included to restrict physical access to cartridges in the library.

Model D22 (Expansion Frame)

The 3584 Model D22 Expansion Frame is designed for holding IBM 3592 tape drives and 3592 data cartridges. Up to 15 Model D22 Expansion Frames may be added to the 3584 Model L22, L32, or L52 Base Frame to increase 3592 cartridge storage or drive capacity. Each Model D22 supports up to 400 3592 cartridge slots and up to 12 3592 Tape Drives, with an incremental reduction of storage slots for each set of four tape drives installed. Each frame can have up to 12 logical libraries or 12 control paths (one per tape drive).

Model D52 (Expansion Frame)

The 3584 Model D52 Expansion Frame is designed for holding IBM LTO Ultrium Fibre Channel tape drives and LTO data cartridges. Up to 15 Model D52 Expansion Frames may be added to the 3584 Model L22, L32, or L52 Base Frame to increase LTO cartridge storage or drive capacity. Each Model D52 supports up to 440 LTO cartridge slots and up to 12 IBM LTO Ultrium 2 Tape Drives, with an incremental reduction of storage slots for each set of four tape drives installed. Each frame can have up to 12 logical libraries or 12 control paths (one per tape drive).

Model L32 (Base Frame)

The IBM TotalStorage 3584 base library, the Model L32, has 141 to 281 cartridge slots, and support for up to twelve IBM LTO Ultrium tape drives. You can add Ultrium 2 drives to an existing Ultrium 1 library, and mix Ultrium 1 and Ultrium 2 cartridges within the same frame, thus protecting the investments in LTO technology. There is an incremental reduction of storage slots for more than four drives. Data capacity for the Model L32 is 28 TB to 56.2TB native, and 56 TB to 112.4 TB using LTO-DC (LTO Data Compression) (2:1) compression. Users can expand library capacity and number of drives to meet their changing needs.

Up to twelve logical libraries and up to twelve control paths can be configured for each L32 frame.

Each 3584-L32 library has a standard 10 slot, and optionally an additional 20 slot, cartridge input/output station for importing or exporting cartridges from the library with no need for re-inventory. For bulk-loading of IBM LTO Ultrium tape cartridges, the library door can be opened and cartridges loaded manually. When the library door is closed, the bar code reader mounted on the autochanger re-inventories the cartridges in the library frame. This usually takes less than 60 seconds. A door lock is included to restrict physical access to cartridges in the library. The base 3584-L32 can be expanded by adding up to five additional frames - D32.

Model D32 (Expansion Frame)

Up to five expansion frames, 3584 model D32, may be added to the base frame (Model 3584-L32) in order to add storage and drive capacity. Each 3584-D32 frame supports up to 440 storage slots and up to twelve drives, with incremental reduction of storage slots for each set of four drives installed.

A fully configured 3584 with one Model L32 frame and five Model D32 frames will support up to seventy-two drives with an aggregate data rate of 18.1 TB per hour (2:1 compression using Ultrium 2 drives and media), or up to 2481 storage slots with a total capacity of 496.2 TB native or 992.4 TB with 2:1 compression and using Ultrium 2 drives and media.

Each frame can have up to 12 logical libraries and 12 control paths due to the multipath capability of the 3584.

Model D42 DLT Expansion Frame (withdrawn from marketing)

The previous 3584 Model D42 expansion frame allowed both LTO and DLT libraries to co-exist in the same physical structure. This frame is no longer available since April 2003. Existing configurations will continue to be supported.

Refer to the URL for the latest information about the 3584:

http://www.storage.ibm.com/hardsoft/tape/3584/index.html

Platform and ISV compatibility

The following are Web links within IBM to determine hardware platform compatibility within the LTO family of products:

► http://www.storage.ibm.com/hardsoft/tape/3580/3580opn.html

► http://www.storage.ibm.com/hardsoft/tape/3581/3581opn.html

► http://www.storage.ibm.com/hardsoft/tape/3582/3582opn.html

► http://www.storage.ibm.com/hardsoft/tape/3583/3583opn.html

► http://www.storage.ibm.com/hardsoft/tape/3584/3584opn.html

IBM publishes information about ISV storage management applications, which are certified with LTO Ultrium devices and operating system platforms. Use this URL:

http://www.storage.ibm.com/hardsoft/tape/conntrix/pdf/lto_isv_matrix.pdf

IBM TotalStorage Enterprise Tape Systems

This section describes products available in the IBM TotalStorage Enterprise Tape System 359x product line.

IBM TotalStorage Enterprise Tape System 3592

The 3592 Tape Drives are designed for environments that require reliable, high performance tape support for backup, restore, archive, and data interchange.

The 3592 Model J1A Tape Drive has a native data rate of up to 40 MB/sec. With the use of the IBM TotalStorage Enterprise Tape Cartridge 3592, it provides a native cartridge capacity of up to 300 GB (900 GB with 3:1 compression). It uses an optimal dynamic compression method called *byte level compression scheme swapping,* which is designed to achieve maximum data compression, and unlike other tape drive compression methods, it is designed to prevent data expansion. The 3592 Model J1A Tape Drive is designed for automation and uses a tape cartridge with a form factor similar to the 3590 and 3480 tape cartridges. The 3592 will also use a new, unique Write Once Read Many (WORM) IBM 3592 Tape Cartridge with two capacities: 60 GB and 300 GB

The 3592 Model J1A Tape Drive has dual-ported 2 Gbps native switched fabric Fibre Channel interfaces. This offers attachment flexibility in an open systems environment. The drives can be directly attached to open systems servers with Fibre Channel attachments. The 3592 Model J1A uses SARS to assist in isolating failures between media and hardware. It is designed to use the cartridge performance history saved in the cartridge and drive performance history kept in the drive to determine the more likely cause of failure. It is designed to cause the drive to mark the media as degraded, and to indicate that the hardware has degraded.

The 3592 Model J1A also has additional enhancements that may help improve performance, capacity, and availability including:

► Large 128 MB internal data buffer
► Digital speed matching to adjust the drive's native data rate to the net host data rate (after data compressibility has been factored out) throughput performance.
► Channel calibration which is designed to allow for customization of each read/write data channel for optimum performance
► High resolution tape directory plus enhanced search speed to improve nominal and average access times.
► Streaming Lossless Data Compression (SLDC) algorithm which is designed to offer an improvement over previous IBM lossless compression algorithms

3592 Tape Cartridge

The 3592 Model J1A uses the IBM TotalStorage Enterprise Tape Cartridge 3592, which contains an advanced metal particle tape specifically optimized for the enterprise tape environment, providing a native cartridge capacity of up to 300 GB (or up to 900 GB with 3:1 compression). This can be very beneficial in space savings and economy of data storage since it can help lower the cost of storage per megabyte. For applications that fill current data cartridges, this can help reduce the number of tape cartridges required. The reduced number of cartridges may also help free up floor space for other requirements.

The robust 3590-style cartridge shell is designed to sustain a 1 meter drop. The cartridge has a similar form factor as the 3590 and 3490 tape cartridges. It contains cartridge memory that is a passive, contactless silicon storage device. It is used to hold information about the specific cartridge, including the VOLSER, the media in the cartridge, and the drive.

Economy cartridges with a native cartridge capacity of up to 60 GB (or up to 180 GB with 3:1 compression) are available. In addition, WORM cartridges in both sizes are available.WORM data cartridges provide non-alterable, non-rewritable tape media for long term records retention.

IBM TotalStorage Enterprise Tape System 3590

The 3590 Models B1A,E1A and H1A are designed for automated tape libraries like the IBM TotalStorage Enterprise Automated Tape Library 3494; IBM TotalStorage Virtual Tape Server; and StorageTek silos.

The 3590 Model B1A supports up to 20 GB per cartridge and 9 MB/second data rate native. Model E1A supports up to 40 GB per cartridge and 14 MB/second data rate native. Model H1A supports up to 60 GB per cartridge and 14 MB/second data rate.

3590 Models

The 3590 models B11, E11, and H11 are rack-mounted (see Figure A-3) tape drives with an Automatic Cartridge Facility (ACF). The 10 cartridge ACF allows the drives to be used as a mini-library with access of up to 1.8 TB of data (compressed 3:1). The 3590 B11/ E11/H11 can be converted to a B1A/E1A/H1A for use in a fully automated library system.

Figure A-3   IBM TotalStorage Enterprise Tape Drive 3590 in a rack

Rack model highlights

These are the main features of the 3590 rack models:

► A 10-slot cartridge auto loader for sequential or random access to up to 1.8 TB of compressed data

> ► Integrated operator/service display showing device status, activities, error conditions and messages

Platform and ISV support

Following are URLs linking to current support matrices for the 3590 family of products:

- ► http://www.storage.ibm.com/hardsoft/tape/3590/3590opn.html
- ► http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3590_h.pdf
- ► http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3590_e.html
- ► http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3590.html
- ► http://www.storage.ibm.com/tape/conntrix/pdf/3592_isv_matrix.pdf

IBM 3590: Key attributes

Figure A-4 shows a summary of the 3590 characteristics.

■ **Drive Robustness / Durability / Availability**
  - Designed for the most demanding applications
    - High number of tape mounts
    - High stop/start characteristics
  - Write / Read Applications
  - High duty cycle

■ **Highest Data Integrity / Availability**
  - "Hole" in the tape RAID-like performance
  - Media-Subsystem health monitoring - SARS reporting of permanent and temporary errors as well as tracking last 100 tape mounts

■ **Performance / Throughput Leader**
  - Up to 42MB/s (Fibre compressed)

■ **Virtual Tape Backstore**
  - Over 8,500 drives in use with VTS

■ **Price/Value**
  - High end street prices commensurate with competition; 10 year media warranty

■ **Investment Protection / Asset Sharing-Reuse**
  - Dual Ultra-SCSI, 2-8 ESCON, 1-2 FICON
  - Can attach SCSI or attach SCSI drive to 3590 Controller for ESCON/FICON server support
  - Field Upgrades (Fibre, FICON, B to E,E to H, Extended Capacity Tape)

■ **Broad Application - Connectivity**
  - SCSI-2, Ultra-SCSI-Fibre via SAN Data Gateway
  - ESCON-FICON Bridge, Native FICON
  - Fibre Switches, Hubs
  - ACF, 3494, VTS, Silo-Compatible Attach

■ **Market Acceptance - Proven Standard**
  - Over 100,000 drives shipped to all major industries worldwide
  - ANSI, ECMA, ISO Standards Certification

Figure A-4   Key attributes of the IBM TotalStorage Enterprise Tape System 3590

The 3590 has one additional feature which differs from other tape drives. The Alternate Pathing Support allows Automatic Failover and Dynamic Load Balancing.

IBM TotalStorage Enterprise Tape Library 3494

These are the main components of the IBM TotalStorage Enterprise Tape Library 3494:

► Library control frame unit
► Drive unit frame
► Storage unit frame
► High availability model

Library control frame unit

The library control frame unit is a central and important component of the IBM 3494 tape library. Each control frame unit contains:

► Tape subsystem (IBM 3490E/H, and 3592-J1A tape drives)
► Library manager (LM)
► Cartridge accessor with single or optional high-performance dual gripper
► Optional convenience I/O station
► Cartridge storage cells

Drive unit frames

Drive unit frames are designed to provide additional tape drives and tape cartridge storage. There are three models of the drive frame to give you flexibility in choosing the correct tape drive technology to fit your server platform.

Storage unit frames

Storage unit frames are designed to provide additional tape cartridge storage capacity. Each storage unit allows for the attachment of up to 400 additional tape cartridges.

High availability model

The high availability model provides a second library manager (LM) and a second cartridge accessor. In the unlikely event of a failure of either of these components, they can be switched over to replace the failed unit. In addition, there is a dual active accessor feature that will allow both cartridge accessors to operate simultaneously.

IBM TotalStorage Virtual Tape Server

IBM is leading the way in e-business computing with their third generation Virtual Tape solution, two new IBM TotalStorage Virtual Tape Server (VTS) models, the B10 and B20 (Figure A-5). These models are the first tape storage products to utilize IBM's innovative copper chip technology. In addition, the copper microprocessors used by the VTS models were pioneered by IBM researchers, and are more reliable and cost-effective. The B10 and B20 bring together many benefits that enable companies to automate more data storage, as well as improve performance and lower cost of ownership.

By combining with the various models of the 3494, you can create an automated tape library of up to 16 library frames that can contain over 6000 tape cartridges and up to 748 TB (compressed) of stored data. The 3494 was designed to be highly reliable and highly flexible to meet the most demanding tape storage business needs.

Figure A-5   IBM TotalStorage Virtual Tape Server

Platform and connectivity support
The following URL will allow you to get the latest information on operating system support, as well as ISV support:

http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3494l12.html

Abbreviations and acronyms

ACF	Automatic cartridge facility	**IBM**	International Business Machines Corporation
AIT	Advanced intelligence tapes	**ISO**	International Organization for Standardization
AIX	Advanced interactive executive	**ISV**	independent software vendor
ALDC	Adaptive lossless data compression	**ITSO**	International Technical Support Organization
ANSI	The American National Standards Institute	**LAN**	Local area network
ATL	Automated tape library	**LPAR**	Logical partition
ATM	Asynchronous transfer mode	**LTO**	Linear Tape Open
CD	Compact disc	**LUN**	Logical unit number
CM	Cartridge memory	**LVD**	Low voltage differential
DLT	Digital linear tape	**MR**	Magneto resistive
DRM	Disaster Recovery Manager	**MVS**	Multiple Virtual Storage
ECC	Error Checking and Correcting	**NDMP**	Network Data Management Protocol
ECMA	European Association for Standardizing Information and Communication Systems	**NSM**	Network Storage Manager
		NVC	Non Volatile Cache
		PB	Petabyte
ESCON	Enterprise System Connection	**PTF**	Program temporary fix
FC	Fiber Channel	**PtP**	Peer to Peer
FC-AL	Fiber Channel arbitrated loop	**RCON**	Remote console
FCP	Fiber Channel protocol	**RISC**	Reduced instruction set computer
FDDI	Fiber Distributed Data Interface	**RMU**	Remote management unit
FICON	Fiber Connection	**SAN**	Storage Area Network
GB	Gigabyte	**SARS**	Statistical Analysis and Reporting System
GBIC	Gigabit Interface Converter	**SCSI**	Small computer systems interface
HBA	Host bus adapter		
HSM	Hierarchical storage management	**SLDC**	Streamless losses data compression
HVD	High voltage differential	**SMIT**	System management interface tool

SNMP	Simple network management protocol	FC	Fiber Channel
TB	Terabyte	FC-AL	Fiber Channel arbitrated loop
TCP/IP	Transmission Control Protocol/Internet Protocol	FCP	Fiber Channel protocol
		FDDI	Fiber Distributed Data Interface
TSM	Tivoli Storage Manager	FICON	Fiber Connection
URL	Universal Resource Locator	GB	Gigabyte
VHDCI	Very High Density Cable Interconnect	GBIC	Gigabit Interface Converter
		HBA	Host bus adapter
VTS	Virtual tape server	HSM	Hierarchical storage management
WAN	Wide area network		
WORM	Write once read many	HVD	High voltage differential
WWN	World wide name	IBM	International Business Machines Corporation
WWPN	World wide port name		
7x24	Seven days a week, twenty-four hours a day	ISO	International Organization for Standardization
5x9	Five days a week, nine hours a day	ISV	independent software vendor
		ITSO	International Technical Support Organization
ACF	Automatic cartridge facility		
AIT	Advanced intelligence tapes	LAN	Local area network
AIX	Advanced interactive executive	LPAR	Logical partition
		LTO	Linear Tape Open
ALDC	Adaptive lossless data compression	LUN	Logical unit number
		LVD	Low voltage differential
ANSI	The American National Standards Institute	MR	Magneto resistive
		MVS	Multiple Virtual Storage
ATL	Automated tape library		
ATM	Asynchronous transfer mode		
CD	Compact disc		
CM	Cartridge memory		
DLT	Digital linear tape		
DRM	Disaster Recovery Manager		
ECC	Error Checking and Correcting		
ECMA	European Association for Standardizing Information and Communication Systems		
ESCON	Enterprise System Connection		

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

IBM Redbooks

For information on ordering these publications, see "How to get IBM Redbooks" on page 84. Note that some of the documents referenced here may be available in softcopy only.

► *The IBM TotalStorage Solutions Handbook*, SG24-5250

► *The LTO Ultrium Primer for IBM iSeries Customers*, REDP3580

► I*BM TotalStorage Virtual Tape Server Planning, Implementing and Monitoring*, SG24-2229

► *IBM Tape Solutions for Storage Area Networks and FICON*, SG24-5474

► *Magstar Peer-to-Peer Virtual Tape Server Planning and Implementation Guide*, SG24-6115

► *The IBM LTO Ultrium Tape Libraries Guide*, SG24-5946

► *Implementing IBM LTO in Linux and Windows environments*, SG24-6268

► *Using IBM LTO Ultrium with Open Systems*, SG24-6502

► *Tivoli Storage Management Concepts*, SG24-4877

► *Tivoli Storage Manager Version 4.2: Technical Guide*, SG24-6277

► *Tivoli Storage Manager Version 3.7.3 & 4.1: Technical Guide*, SG24-6110

► *IBM Magstar Tape Products Family: A Practical Guide*, SG24-4632

► *Magstar MP 3575 Tape Library Dataserver: Multiplatform Implementation*, SG24-4983

► *Magstar and IBM 3590 High Performance Tape Subsystem Technical Guide*, SG24-2506

► *Guide to Sharing and Partitioning IBM Tape Library Data*, SG24-4409

► *Magstar and IBM 3590 High Performance Tape Subsystem: Multiplatform Implementation,* SG24-2594

► *The IBM Magstar Virtual Tape Server and Enhancements to Magstar: New Era in Tape*, SG24-4917

Other publications

These publications are also relevant as further information sources:

► *IBM Magstar 3590 Tape Subsystem Introduction and Planning Guide*, GA32-0329

► *IBM TotalStorage Enterprise Automated Tape Library 3494 Introduction and Planning Guide*, GA32-0448

► *3583 Ultrium Scalable Tape Library Setup and Operator Guide*, GA32-0411

► *3584 UltraScalable Tape Library Planning and Operator Guide*, GA32-0408

► *3466 Network Storage Manager Introduction and Planning Guide for C01*, GA32-0427

Online resources

These Web sites and URLs are also relevant as further information sources:

► Tape and Optical Storage home page

  http://www.storage.ibm.com/hardsoft/tape/

► IBM Tape Storage Publications

  http://www.storage.ibm.com/hardsoft/tape/pubs/prodpubs.html

► Tivoli Storage Manager home page

  http://www-3.ibm.com/software/tivoli/solutions/storage/

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Index

(0.1"spine)
0.1" <-->0.169"
53<-->89 pages

IBM TotalStorage Tape Selection and Differentiation Guide

Understand your tape and backup requirements

See which tape product meets your business needs

Define your tape strategy

This IBM Redbook will help users to select the appropriate tape solution for various backup scenarios found in open systems environments. This redbook is a tape product selection and differentiation guide that is designed to assist users in finding all the information needed to select the best tape solution for the designated backup environment.

This guide describes the information gathering process and product selection criteria to differentiate among the available IBM tape offerings. It provides a basis for tape differentiation. It is not, however, intended as a tape system sizing guide. For this purpose, users should use the sizing tools provided by each product family.

This guide focuses primarily on identifying backup environments for the IBM 358x Ultrium product family (LTO) and the environments for the IBM TotalStorage Enterprise Tape System 3590 and 3592. Single user or departmental type backup environments are also addressed through providing information on the entry level tape product lines such as 4mm or 8 mm, and so on. Total backup solution offerings are supported by the Tivoli Storage Manager, as well as other backup applications offered by various vendors.