IBM United States Hardware Announcement
114-072, dated May 19, 2014

IBM TS4500 tape library models deliver higher storage density, integrated storage management, and improved ease of use

Table of contents

At a glance

The IBM® TS4500 tape library combines IBM tape and automation reliability at open systems prices. New models expand capacity and function, and are designed to deliver the following enhancements:

- Storage for up to 2.2 PB of data in a single frame library, up to 3.4 times improvement over the previous generation of IBM tape libraries
- Improved storage density with expansion frame capacity increase of up to 2.4 times and support for 33 percent more tape drives
- Dynamic storage management through the Advanced Library Management System (ALMS) which is now standard in the TS4500
- Improved business continuity and disaster recovery with automatic control path and data path failover
- Data security and regulatory compliance through support for tape drive encryption and WORM media

---

- Support LTO™ Ultrium™ 6, LTO Ultrium 5, and IBM TS1140 HD2-compatible tape drives

For ordering, contact your IBM representative, an IBM Business Partner, or IBM Americas Call Centers at 800-IBM-CALL (Reference: YE001).

Overview

The IBM TS4500 tape library is a next-generation storage solution designed to help midsize and large enterprises respond to storage challenges. Some of these challenges include high data volume, growth in data centers, increasing cost of data center storage footprints, difficulty migrating data across vendor platforms, and increased complexity of IT training and management as staff resources shrink.

The TS4500 delivers the density needed for current and future business data growth with the cost efficiency and manageability to preserve existing investments in IBM tape library products. Now organizations can achieve both low cost per terabyte (TB) and a high TB density per square foot. The TS4500 can support up to 2.2 PB of native storage capacity in a single 10 square foot library frame, up to 3.4 times more capacity than the IBM TS3500.

The TS4500 offers deeper integration of tape drive and media management for a seamless, single pane of glass user experience. The TS4500 GUI is based on the IBM Storage Unified UI. The GUI is designed to lead the user directly to task completion and includes persistent, at-a-glance library utilization and health status indicators.

TS4500 features such as capacity on demand, automatic control-path and data-path failover, and support for tape drive encryption and WORM media are carried over from previous generations of industry-leading IBM tape libraries.

Automates solutions for open environments

TS4500 is an industry leader in tape drive integration with features such as a persistent worldwide name, multipath architecture, drive and media exception reporting, remote drive/media management, and host-based path failover. TS4500 L25, D25, and S25 frames support the TS1140 tape drive, and L55, D55, and S55 frames support LTO Ultrium 6 and 5 tape drives. L-frame and D-frame models support improved hot-swappable drive packaging. All of the frames include high-density (HD) slot technology that can significantly increase a library's total capacity.

Delivering more flexibility in the use of data center floor space than previous versions, the new frame models can be placed in any active position so that the library can grow from both the right and the left side of the first L frame. The previous library allowed the addition of frames only to the right.

Available with top rack (Model TR1) option

The optional top rack offering can reduce the storage footprint and simplify cabling by providing 10U of rack space on top of the library for Fibre Channel switches, tape data movers, or LTFS nodes.

Delivers capacity on demand

The TS4500 library frame provides a more flexible upgrade path for users wanting to expand their tape storage as their needs grow. Capacity-on-demand configurations for TS4500 L-frame models include an *entry-level* configuration, an *intermediate* configuration, and a *base-capacity* configuration. All models also support HD capacity-on-demand configurations.

Includes advanced features

TS4500 is designed with a number of advanced features to deliver cutting-edge performance and long-term value. The ALMS feature supports dynamic storage management, enabling users to dynamically create and change logical libraries

and configure any drive into any logical library. The TS4500 also offers automatic control-path and data-path failover to support improved business continuity and disaster recovery.

Centralizes management of tape resources

IBM offers a wide range of management software options for TS4500.

IBM TS4500 command line interface (CLI): Enables users to interact with the TS4500 with automated scripts to perform specific tasks.

IBM Tape System Reporter: Enables administrators to monitor and report on the performance, utilization, and health of their tape library.

IBM Tape System Library Manager: Enables clients to manage large tape environments that span multiple libraries as a single system.

IBM Security Key Lifecycle Manager: Simplifies encryption key management with an intuitive user interface.

Product preview

IBM intends to introduce IBM Linear Tape File System™ (LTFS) Library Edition (LE), Storage Manager, and Enterprise Edition (EE) support to the IBM TS4500 tape libraries in the third quarter of 2014.

IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion. Information regarding potential future products is intended to outline our general product direction and it should not be relied on in making a purchasing decision. The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code, or functionality. Information about potential future products may not be incorporated into any contract. The development, release, and timing of any future features or functionality described for our products remains at our sole discretion.

Key prerequisites

Prerequisites for using encryption

Certain hardware and software prerequisites must be met before using encryption with the TS4500 tape library.

With the TS4500 tape library, encryption is managed at the logical library level. All encryption-enabled drives that are assigned to a logical library use the same method of encryption. The rules for setting up encryption differ based on whether the library is installed with 3592 or LTO tape drives, and whether you use Library-Managed Encryption (LME) or Application-Managed Encryption (AME). If the library contains 3592 tape drives, the following prerequisites apply:

- IBM Security Key Lifecycle Manager (formerly Tivoli® Key Lifecycle Manager) must be attached to the TS4500 and configured for LME.
- Tape drives must be enabled for encryption from the Logical Libraries page of the TS4500 management GUI.

If the library contains LTO tape drives, the following prerequisites apply:

- Tape drives must be enabled for encryption from the Logical Libraries page of the TS4500 management GUI.
- Feature code 1604, Transparent LTO Encryption, is required for LTO tape drives if using LME.
- IBM Security Key Lifecycle Manager is required as the key manager when using LME with LTO.

Planned availability date

June 13, 2014

Description

IBM TS4500 is a highly scalable, stand-alone device that delivers high-density tape storage and high-performance, automated tape handling for open systems environments. IBM TS4500 tape library consists of a high-density base frame with up to three high-density expansion frames.

The TS4500 tape library is built from a single frame model, called the base frame. The scalability of the library allows an increase in capacity by adding up to three additional frames, called expansion frames. The frames join side by side and can grow to the left or to the right of the base frame. All frames are supported by a single cartridge accessor.

The TS4500 tape library supports second-generation HD (HD2) frames, which like the first generation HD frames, offer increased capacity without increasing frame size or required floor space by using high-density storage slots for tape cartridges. In addition, HD2 frames provide the following enhancements:

- HD2 expansion frames can be installed in the leftmost position of the library (frame number 1)
- Drive-capable HD2 frames support up to 16 HD2-compatible tape drives when positioned at frame number 2 or higher

Note: Non-HD2 frames cannot be upgraded to HD2 frames.

The L25 and L55 (Lx5) frames and D25 and D55 (Dx5) frames are HD2, drive-capable frames, meaning they contain HD cartridge storage slots, as well as slots to house up to sixteen tape drives. The S25 and S55 (Sx5) frames are HD2, storage-only frames, meaning they contain HD cartridge storage slots, but no tape drives. All HD frames provide internal LED lighting.

Note: The LED lighting in the HD frames is specifically designed for use only in the TS4500 tape library and is not suitable for other applications.

The TS4500 tape library supports IBM TS1060 LTO Ultrium 6, TS1050 LTO Ultrium 5, and IBM TS1140 Tape Drives. I/O stations are located on Model L25 or L55 to facilitate tape loading and unloading.

The TS4500 tape library is designed to deliver an excellent network data backup/archive solution. With the granularity and scalability to follow your requirements from a few servers to hundreds of clients, from gigabytes to terabytes, this powerful pairing can grow with you, helping to protect your investment.

HD technology

The TS4500 tape library offers HD, drive-capable, and storage-only frame models that are designed to greatly increase storage capacity without increasing frame size or required floor space.

HD slots contain tape cartridges in a tiered architecture. The cartridge immediately accessible in the HD slot is a Tier 1 cartridge. Behind that is Tier 2, and so on. The maximum tier in an LTO HD slot is Tier 5. The maximum tier in a 3592 HD slot is Tier 4 because the 3592 tape cartridge is slightly longer than the LTO cartridge. The single-deep slots on the door side of HD frames are referred to as Tier 0 slots.

HD2 frames can be installed in the leftmost library position (frame position 1) and offer drive-capable models that support up to 16 HD2-compatible tape drives when in frame position 2 or higher.

Note: Non-HD2 frames cannot be upgraded to HD2 frames.

TS4500 tape library delivers high performance

The IBM TS1060 LTO Ultrium, IBM TS1050 LTO Ultrium Tape Drives, and TS1140 Tape Drives are designed for high performance in a streaming mode of operation. Automatic data caching, using an expanded cache memory and read/write buffering, helps enhance performance even further. The TS4500 tape library is designed for high data transfer performance.

Cartridge move time within the TS4500 tape library can be as fast as 3.0 seconds or less in a single-frame library. The dual-gripper accessor is designed to retrieve the next cartridge to be mounted, unload the current cartridge, and load the next cartridge, helping provide the following potential benefits as compared to a single gripper:

- Save complete move operations
- Improve overall library performance
- Increase redundancy and reliability

TS4500 tape library defines high reliability

Leading-edge technology positions the TS1140, TS1060 LTO Ultrium, and TS1050 LTO Ultrium Tape Drives among the top leaders of the industry. Highly accurate recording is supported by an exclusive thin-film write module designed by IBM with read-after-write data verification. Data read is managed by IBM Magneto Resistive (MR) heads, designed for accuracy, high reliability, and durability. The TS4500 drives and library robotics are TapeAlert-compatible, and are designed to provide tape drive and library errors, and diagnostic reporting. Drive cleaning is an automatic function that can be performed by the library when required by the drive, without requiring operator intervention.

High granularity in library configurations

Features and capacities are designed to address a wide variety of customer requirements. You can attach up to three Model D25 or D55 expansion frames to a Model L25 or L55 base frame to tailor the library to match your system capacity and performance needs. This provides a cartridge capacity with Ultrium 6 data cartridges of up to 4,690 cartridges with up to 11.7 PB of physical capacity per library (up to 29.3 PB with 2.5:1 compression), or with 3592 data cartridges of up to 3,550 cartridges with up to 14.2 PB of physical capacity per library (up to 42.6 PB with 3:1 compression).

Model L25 (base frame)

TS4500 tape library Model L25 is a base frame designed for TS1140 or 3592 Tape Drives and 3592 data cartridges. The Model L25 base frame has up to 660 cartridge slots (up to 550 in frame 1) and support for up to 16 tape drives (up to 12 in frame 1). Up to 16 logical libraries (one per tape drive) can be configured for each frame.

Each Model L25 library has two standard 16-slot cartridge I/O stations for importing or exporting 3592 tape cartridges from the library without requiring a re-inventory. 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 is designed to scan the cartridge labels enabling a re-inventory of the cartridges in the library frame in as little as 60 seconds. A door lock is included to restrict physical access to cartridges in the library.

Model L55 (base frame)

TS4500 tape library Model L55 is a base frame designed for IBM TS1060 LTO Ultrium Fibre Channel, IBM TS1050 LTO Ultrium Fibre Channel Tape Drives, and LTO data cartridges. The Model L55 base frame has up to 882 cartridge slots (up to 730 in frame 1) and support for up to 16 tape drives (up to 12 in frame 1). Up to 16 logical libraries (one per tape drive) can be configured for each frame.

Each Model L55 library has two standard 18-slot cartridge I/O stations for importing or exporting LTO tape cartridges from the library without requiring a re-inventory. 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 is designed to scan the cartridge labels enabling a re-inventory of the cartridges in the library frame in as little as 60 seconds. A door lock is included to restrict physical access to cartridges in the library.

Model D25 (expansion frame)

The TS4500 tape library Model D25 expansion frame is designed for TS1140 or 3592 Tape Drives and 3592 data cartridges. Up to three Model D25 expansion frames may be added to the TS4500 Model L25 base frame to increase 3592 cartridge storage or drive capacity. Each Model D25 supports up to 740 3592 cartridge slots (up to 590 in frame 1) and up to 16 3592 Tape Drives (up to 12 in frame 1). Each frame can have up to 16 logical libraries or 16 control paths (one per tape drive).

Model D55 (expansion frame)

The TS4500 tape library Model D55 expansion frame is designed for IBM TS1060 LTO Ultrium Fibre Channel, IBM TS1050 LTO Ultrium Fibre Channel Tape Drives, and LTO data cartridges. Up to three Model D55 expansion frames may be added to the TS4500 tape library Model L55 base frame to increase LTO cartridge storage or drive capacity. Each Model D55 supports up to 970 LTO cartridge slots (up to 774 in frame 1) and up to 16 IBM LTO Ultrium 6 or 5 Tape Drives (up to 12 in frame 1). Each frame can have up to 16 logical libraries or 16 control paths (one per tape drive).

Designed for availability

If you are looking to maximize availability with minimum downtime for service-related activities, you will appreciate that the library is designed to preserve tape drive configuration settings, such as Fibre Channel World Wide Node Names (WWNN), when a tape drive is replaced. This helps to ensure that the replacement drive has the same WWNN as the original drive and may help avoid the need to re-IPL or reconfigure host systems. Fibre Channel drives require only a quiesce of the individual drive. Redundant hot-swap library and drive power supplies can also be replaced while avoiding impact to host systems.

The TS4500 tape library includes an enhanced power architecture and frame control assembly. This enhanced power architecture has fewer parts and is designed with hot-swappable 2N power supplies and line cords. The enhanced frame control assembly includes features that were previously ordered separately from the 3584 frame control assembly, including dual ac power, a Fibre Channel patch panel, additional redundant power supplies, and additional 10/100 Ethernet support.

Multi-Path support

The Multi-Path Architecture of the TS4500 tape library is designed to provide the capability for sharing of the library robotics. This is accomplished by partitioning the library into up to 60 multiple logical libraries (up to the number of drives installed), and providing each logical library its own separate and distinct drives, storage slots, and control paths. I/O slots are shared on a first-come, first-served basis. This type of partitioning is designed to allow 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™ 2003 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 6 Tape Drives and cartridges from Ultrium 5 Tape Drives and cartridges, or TS1140 or 3592 Tape Drives and cartridges, for applications which do not support mixing the drives in the same logical library.

Advanced Library Management System (ALMS)

ALMS virtualizes the locations of cartridges in the TS4500 tape library and is an extension of patented IBM Multi-Path Architecture. With ALMS, the TS4500 tape library is able to virtualize the locations of cartridges (called SCSI element addresses) while maintaining native SAN attachment for the tape drives. ALMS enables logical libraries to consist of unique drives and ranges of volume serial (VOLSER) numbers instead of fixed locations.

The TS4500 tape library comes with ALMS so that you can immediately start assigning tape drives to any logical library by using the TS4500 management GUI. Logical libraries can also be added, deleted, or easily changed without disruption. Storage capacity can be changed without impact to host applications.

ALMS offers dynamic management of cartridges, cartridge storage slots, tape drives, and logical libraries. It enables the TS4500 tape library to achieve unprecedented levels of integration for functionality through dynamic partitioning, storage slot pooling, and flexible drive assignment. ALMS eliminates downtime when you add Capacity On Demand (CoD) or High Density Capacity on Demand (HD CoD) storage, add or remove logical libraries, or change logical library storage allocation. ALMS also reduces downtime when you add expansion frames, add or remove tape drives, or change logical drive allocation.

ALMS provides the following capabilities:

- Dynamic partitioning through storage slot pooling and flexible drive assignment
- The transparent ability to add or remove storage capacity to any host application
- The ability to configure drives or to configure storage capacity without taking the library offline
- Continuously enabled virtual I/O slots to automatically manage the movement of cartridges between I/O slots and storage slots

Control path failover, data path failover, and load balancing

The path failover feature of the TS4500 tape library ensures the use of a redundant path in the event that communication over the primary path fails.

Command failures and time-outs are costly. You want your library to run smoothly and efficiently. To ensure continued processing, libraries that are equipped with Fibre Channel LTO and 3592 tape drives offer path failover and load balancing capabilities that enable the IBM device driver to resend a command to an alternate path. The alternate path can include another host bus adapter (HBA), Storage Area Network (SAN), or library control path drive. The device driver initiates error recovery and continues the operation on the alternate path without interrupting the application. Path failover and load balancing are built-in features that are enabled by using a purchased license key.

There are two types of path failover capabilities exist: control path failover (CPF) and data path failover (DPF). Control refers to the command set that controls the library (the SCSI Medium Changer command set on LUN 1 of the tape drives). Data refers to the command set that carries the customer data to and from the tape drives (the SCSI-3 Stream Commands (SSC) device on LUN 0 of the tape drives). Path failover refers to when there is redundancy in the path from the application to the intended target (the library accessor or the drive mechanism, respectively), the device driver transparently fails over to another path in response to a break in the active path.

Both types of failover include host-side failover when configured with multiple HBA ports into a switch, but CPF includes target-side failover through the control paths that are enabled on more than one tape drive. DPF includes target-side failover for the dual-ported tape drives that are supported by the TS4500 tape library.

DPF includes load balancing of the HBAs because the channel is a data-intensive path. This means that the control path carries very little data and load balancing is not an issue. Dynamic load balancing support optimizes resources for devices

---

that have physical connections to multiple HBAs in the same machine. When an application opens a device that has multiple HBA paths configured, the device driver determines which path has the HBA with the lowest usage and assigns that path to the application. When another application opens a different device with multiple HBA paths, the device driver again determines the path with the lowest HBA usage and assigns that path to the second application. The device driver updates the usage on the HBA assigned to the application when the device is closed. Dynamic load balancing uses all HBAs whenever possible and balances the load between them to optimize the resources in the machine.

Fibre Channel connectivity

Tape drives in TS4500 tape library Models D25, D55, L25, and L55 are designed to connect to host systems using Fibre Channel interfaces. An LTO Ultrium Tape Drive with a Fibre Channel interface or 3592 Tape Drive can be selected for attachment to host systems and servers utilizing Fibre Channel adapters. Fibre Channel connection distances up to 500 meters are possible. By utilizing selected Fibre Channel switches, it is possible to exceed 500 meter distances.

Storage-only expansion frame

TS4500 tape library Models S55 and S25 are driveless, storage-only expansion frames, with Model S55 designed to contain up to 1,320 Ultrium (LTO) tape cartridges and Model S25 designed to contain up to 1,000 3592 tape cartridges. Model S55 offers a 3 to 1 increase in slot capacity over Model D55, and Model S25 delivers a 2.5 to 1 increase in slot capacity over Model D25.

The TS4500 Model S55 can be attached to installed Model D55 and L55 with IBM TS1060, TS1050, or LTO Ultrium Tape Drives. The TS4500 Model S25 can be attached to Model D25 and L25 with Enterprise or 3592 Tape Drives.

The TS4500 Models S25 and S55 incorporate patented IBM HD slot technology, which allows multiple cartridges to be stored in a tiered architecture. The depth of a cartridge location in a high-density slot is known as a tier. Previous model frames supported only one cartridge per storage slot. HD slots are designed to contain multiple cartridges in Tiers 1 through 4 (Model S25) or Tiers 1 through 5 (Model S55).

The TS4500 tape library frames support HD CoD features (#1645 or #1646) that provide a license key to nondisruptively increase licensed capacity in the library. These advancements reduce automation floor space requirements, enhance library management, and provide flexibility, growth, and a foundation for automation across an enterprise or business installation.

The TS4500 tape library (machine type 3584) is part of the family of tape library storage solutions designed for the large, unattended storage requirements in today's midrange to high-end systems. Each aspect of the subsystem is designed to optimize access to data and reliability. The TS4500 tape library supports the IBM LTO Ultrium and Enterprise Tape Drives.

The TS4500 tape library includes support for HD2 expansion frames, Models S55 and S25, which are compatible with current TS4500 library frames. Models S55 and S25, are driveless, storage-only expansion frames, with Model S55 designed to contain up to 1,320 Ultrium (LTO) tape cartridges and Model S25 designed to contain up to 1,000 3592 tape cartridges. Model S55 offers a 3 to 1 increase in slot capacity over Model D55, and Model S25 delivers a 2.5 to 1 increase in slot capacity over Model D25.

The TS4500 tape library is designed to provide an excellent network data backup/ archive solution. With the granularity and scalability to follow your requirements from a few servers to hundreds of clients, from gigabytes to petabytes, this powerful pairing can grow with you, helping to protect your investment.

Model S25

TS4500 tape library Model S25 is a high-density, storage-only expansion frame that can contain up to 1,000 3592 tape cartridges, compared to 740 3592 cartridges in Model D25. The base capacity for a Model S25 frame consists of up to 600 storage slots available in Tiers 0, 1, and 2. In order to use the additional high-density capacity of up to 400 storage slots in Tiers 3 and 4, the CoD feature #1645 for Model S25 is required. ALMS and an enhanced gripper assembly are required for any library with a Model S25 frame.

Model S55

TS4500 tape library Model S55 is a high-density, storage-only expansion frame that can contain up to 1,320 LTO Ultrium cartridges, compared to 970 LTO cartridges in Model D55. The base capacity for a Model S55 frame consists of up to 660 storage slots available in Tiers 0, 1, and 2. In order to use the additional high-density capacity of up to 660 storage slots in Tiers 3, 4, and 5, the CoD feature #1646 for Model S55. ALMS and an enhanced gripper assembly are required for any library with a Model S55 frame.

New Top Rack Option Model 3584-TR1

The 3584 TS4500 tape library also offers an optional top rack to provide an additional 10U of rack space on any frame in a library without requiring any additional floor space. A top rack is installed by an IBM service representative on one or more frames in a TS4500 tape library. Top rack end covers, feature number 1750, are required for both ends of one or more adjacent top racks. A power distribution unit, feature number 1751, can optionally be ordered for any top rack.

TS1060 Model F6C Ultrium 6 Tape drive

IBM TS1060 Model F6C is an IBM LTO Ultrium 6 Tape Drive designed for the heavy demands of backup and archive tape storage. The TS1060 Model F6C is designed to mount in a TS4500 tape library and has an 8 Gbps Fibre Channel dual-ported interface for attachment to a wide range of environments, including select IBM Power Systems™, IBM System i®, IBM System p®, IBM System x®, IBM System z® (zLinux), other servers running Linux™, Oracle Solaris, and Microsoft Windows operating system environments.

TS1060 Model F6C incorporates sixth-generation IBM LTO Ultrium technology. It offers the following significant improvements over prior generations:

- **Increased performance:** Maximum tape drive throughput native data rate performance is up to 160 MB/sec. Data tracks are written 16 at a time. IBM LTO6 Tape Drives can read and write LTO Ultrium 5 Data Cartridges at Ultrium 5 capacities and rates, and read LTO Ultrium 4 Data Cartridges at Ultrium 4 capacities and rates.

  Note: Although the Ultrium 6 Tape Drive provides the capability for excellent tape performance, other components of the system may limit the actual performance achieved. Although the compression technology used in the tape drive can typically double the amount of data that can be stored on the media, the actual degree of compression achieved is highly sensitive to the characteristics of the data being compressed.
- **Increased tape cartridge capacity:** The LTO Generation 6 media specification tape cartridge physical capacity is up to 6.25 TB compressed physical capacity, more than double that of the Ultrium 4 and 5 Data Cartridge. This is achieved by increasing the linear density, track density, and media length. The IBM Ultrium 6 tape itself is an advanced Barium Ferrite tape developed to help provide durability and increased capacity.
- **Encryption:** The IBM TS1060 LTO Ultrium 6 Tape Drive supports data encryption on the base drive with Ultrium 6 or Ultrium 5 media. System Managed and Library Managed Encryption and associated IBM Security Key Lifecycle Manager access are all available as a chargeable licensed key (feature 1604, Transparent

LTO Encryption) under the TS4500 Tape Library L-frames. IBM Security Key Lifecycle Manager is required with this feature.

- **Attachment options:** The TS1060 Tape Drive comes with 8 Gbps Fibre Channel dual-ported attachment models for connection to a wide spectrum of open system servers. They are supported on a wide range of environments including select IBM Power Systems, IBM System i, IBM System p, IBM System x, IBM System z (zLinux), other servers running Linux, Oracle Solaris, and Microsoft Windows operating system environments.

- **WORM media support:** LTO Generation 6 with media specification provides up to 2.5 TB native capacity, up to 6.25 TB in compressed mode, and up to 160 Mbps native data rate. IBM 3589 Ultrium 6 WORM Tape Cartridges are designed for archiving and data retention applications, as well as those applications requiring an audit trail. These cartridges work with the IBM LTO Ultrium 6 Tape Drive to help prevent the alteration or deletion of user data. IBM LTO 6 WORM Tape Cartridges can be ordered as unique 3589 models with the following features:

  - Prelabeling with the ability to specify a starting volume serial and color coding

  - Packaging in individual jewel cases or in bulk

  - Cartridge memory, built into every cartridge, enhances functionality and media reliability by storing access history and media performance information for use by the tape drive every time the cartridge is accessed

  - Half-inch particle tape with up to 6.25 TB WORM compressed capacity in a single cartridge

- **Larger internal data buffer:** There is a 1 GB internal data buffer in the Ultrium 6 Tape Drive.

- **Digital speed matching:** The Ultrium 6 Tape Drive is designed to perform dynamic speed matching (at one of fourteen speeds: 160.0, 150.8, 141.5, 132.3, 123.1, 113.8, 104.6, 95.4, 86.2, 76.9, 67.7, 58.5, 49.2 or 40.0 MB/s) to adjust the drive's native data rate as closely as possible to the net host data rate (after data compressibility has been factored out). This helps reduce the number of backhitch repositions and improve throughput performance. Speed matching on Ultrium 6 ranges from 40 to 160 MB/sec versus 40 to 140 MB/sec on Ultrium 5.

- **Giant Magneto Resistive (GMR) head design:** Use of flat lap head technology in GMR heads from our Enterprise Tape Drives for Ultrium 6 helps minimize contact, edge damage, debris accumulation, and wear on the tape as it moves over the read/write heads.

- **Dual-stage 16-channel head skew actuator:** The actuator is designed to provide precision head alignment to help support higher track density and improved data integrity. Track following skew actuator supports flangeless tape guide rollers and dynamic skew to enable the head to follow skew tape motion and improve linear actuation.

- **Power management:** The Ultrium 6 Tape Drive power management function is designed to control the drive electronics to be either completely turned off or in a low-power mode when the circuit functions are not needed for drive operation. Improvements specifically in idle mode are improved over Ultrium 5.

- **IBM LTFS partitioning support:** The principal function of the media partitioning is to allow for faster data access by splitting the cartridge into two media partitions. LTFS media partitioning is supported in the TS1060 Tape Drive, and LTFS LE, LTFS EE, and LTFS Storage Manager will be supported in the TS4500 Tape Library. WORM media cannot be partitioned.

IBM LTFS software leverages LTO6 tape partitioning. It is designed to enable a self-describing tape file format and to deliver an easy tape storage and distribution solution without the use of additional database applications. Customers of IBM LTFS software are those who require a standard tape cartridge format at a low cost and will use standalone IBM LTO6 tape drives. IBM LTFS is the perfect solution for those in the media and entertainment industry, and other fields that need massive data storage on tape for long retention periods, such as banking, scientific research, and government sectors. For further information and list of supported operating systems, refer to the following website

http://www.ibm.com/tape/ltfs

IBM maintains the latest levels of tape drive and library device drivers and documentation on the Internet. Utilize the Fix Central download portal by accessing the following website

   http://www.ibm.com/support/fixcentral

There are several menus to navigate to the correct download as follows:

1. On the first menu item Click **Select Product** > **Product Group** > *System Storage®*
2. Expand **Select from System Storage** > *Tape Systems*
3. Expand **Select from Tape systems** > *Tape drivers and software*
4. Expand **Select from Tape drivers and software** > *user product*
5. Expand **Platform** > *user operating system*
6. Click **Continue** to view what drivers are available

The IBM Tape Device Drivers Installation and User's Guide can be found at

   http://www-01.ibm.com/support/docview.wss?rs=577&uid=ssg1S7002972

IBM LTO Ultrium features enhanced in the IBM LTO Ultrium 6 Tape Drive include:

- **Independent tape loader and threader motors and positive pin retention:** These are designed to help improve the reliability of loading and unloading a cartridge, and to retain the pin even if tension is dropped. An independent loader motor, coupled with positive pin retention, is designed to thread the tape with a higher level of reliability.
- **Graceful dynamic braking:** In the event of power failure, reel motors are designed to maintain tension and gradually decelerate instead of stopping abruptly, helping reduce tape breakage, stretching, or loose tape wraps during a sudden power outage.
- **Servo and track layout technology:** There are 2,176 data tracks in Ultrium 6 versus 1,280 data tracks in Ultrium 5. The high-bandwidth servo system features a low-mass servo to help more effectively track servo bands and improve data throughput with damaged media in less-than-optimal shock and vibration environments.
- **Surface Control Guiding Mechanism:** The patented Surface Control Guiding Mechanism from IBM is designed to guide the tape along the tape path in the Ultrium 6, 5, and 4 Tape Drives. This method uses the surface of the tape, rather than the edges, to control tape motion. This helps reduce tape damage (especially to the edges of the tape) and tape debris, which comes from the damaged edges and can accumulate in the head area.
- **Robust drive components optimized for automation environments:** Using some of the most robust components available, such as an all metal clutch, steel ball bearings in loader, robust leader block design, and a single circuit card, helps to enhance reliability and prolong the life of drives.
- **Adaptive read equalization:** This feature is designed to automatically compensate for dynamic changes in readback signal response.
- **Dynamic amplitude asymmetry compensation:** This feature optimizes readback signals for linear readback response from MR read head transducers.
- **Separate writing of multiple filemarks:** Separate writing of multiple filemarks is designed to cause any write command of two or more filemarks to cause a separate data set to be written containing all filemarks after the first. This feature helps improve performance if a subsequent append overwrites somewhere after the first filemark. A write of multiple filemarks typically indicates a point where an append operation might occur after the first of these filemarks, and this change helps prevent having to rewrite datasets containing customer data and the first filemark, if such an append occurs.
- **LTO Data Compression (LTO-DC):** The Ultrium 6 uses LTO-DC, which is an implementation of a Lempel-Ziv class 1 (LZ-1) data compression algorithm. LTO-DC is an extension of Adaptive Lossless Data Compression (ALDC) and an improvement over previous IBM lossless compression algorithms. Scheme-

Swapping compression, patented by IBM, is designed to look ahead at incoming data and determine the most efficient storage method (either ALDC or pass-thru mode) to help provide optimal data compression and increase data throughput. The compression ratio for LTO Ultrium 6 is 2.5 to 1.

- **LTO Cartridge Memory (LTO-CM):** Contained within the LTO Ultrium data cartridge is the LTO-CM, which is a passive, contactless silicon storage device that is a physical part of the cartridge. The LTO-CM is designed to hold information about that specific cartridge, the media in the cartridge, and the data on the media. The storage capacity of the Generation 6 LTO-CM is 16320 bytes, double the capacity of Generation 5 and 4 LTO-CM 8160 bytes. Communication between the drive and the LTO-CM is through a low-level RF field transmitted by the drive to the cartridge.

- **Statistical Analysis and Reporting System (SARS):** The Ultrium 6 Tape Drive uses SARS to help isolate failures between media and hardware. SARS uses the cartridge performance history saved in the CM module and the drive performance history kept in the drive flash EEPROM to help determine the most likely cause of failure. SARS is designed to cause the drive to request a cleaner tape, to mark the media as degraded, and to indicate that the hardware has degraded.

- **Highly integrated electronics using IBM-engineered copper technology:** This technology is designed to reduce the total number of components in the drive, help lower chip temperatures, and reduce power requirements to deliver a more reliable drive. The sixth-generation drive electronics are designed to provide error correction of soft errors in the memory arrays in data and control paths.

With support for LTO Ultrium-format tape data cartridges, TS1060 Model F6C with the TS4500 Tape Library can be a cost-effective solution for backup, save-and-restore, and archiving functions.

Ultrium 6 Data Cartridge

The LTO Generation 6 media specification tape cartridge physical compressed capacity of the LTO 6 Data Cartridge has more than doubled the capacity of the IBM Ultrium 5 Data Cartridge with a capacity of up to 6.25 TB with 2.5 to 1 compression. IBM LTO Ultrium 6 Tape Drives can read and write Ultrium 5 data cartridges, and read Ultrium 4 data cartridges. IBM LTO 6 cartridges can be resident in the same TS4500 Tape Library with the Ultrium 5 and Ultrium 4 data cartridges. IBM LTO 6 data cartridges can be ordered using IBM machine type 3589, IBM LTO Ultrium Tape Cartridges.

These cartridges have been designed to provide several enhancements over previous tape technologies. They are designed to work with tape drives that have increased tape speeds and high-density data recording. The case is specially designed for use in automated libraries and is designed for repeated, unattended handling.

TS1050 Model F5C Ultrium 5 Tape drive

IBM TS1050 Model F5C is an IBM LTO Ultrium 5 Tape Drive designed for the heavy demands of backup and archive tape storage. The TS1050 Model F5C is designed to mount in a TS4500 Tape Library and has an 8 Gbps Fibre Channel dual-ported interface for attachment to a wide range of environments, including select IBM Power Systems, IBM System i, IBM System p, IBM System x, IBM System z (zLinux), other servers running Linux, Oracle Solaris, and Microsoft Windows operating system environments.

TS1050 Model F5C incorporates fifth-generation IBM LTO Ultrium technology. It offers the following significant improvements over prior generations:

- **Increased performance:** Maximum tape drive throughput native data rate performance is up to 140 MB/sec. Data tracks are written 16 at a time. IBM LTO5 Tape Drives can read and write LTO Ultrium 4 Data Cartridges at Ultrium 4 capacities and rates, and read LTO Ultrium 3 Data Cartridges at Ultrium 3 capacities and rates.

Note: Although the Ultrium 5 Tape Drive provides the capability for excellent tape performance, other components of the system may limit the actual performance achieved. Although the compression technology used in the tape drive can typically double the amount of data that can be stored on the media, the actual degree of compression achieved is highly sensitive to the characteristics of the data being compressed.

- **Increased tape cartridge capacity:** The LTO Generation 5 media specification tape cartridge physical capacity is up to 3.0 TB compressed physical capacity, more than double that of the Ultrium 4 and 5 Data Cartridge. This is achieved by increasing the linear density, track density, and media length. The IBM Ultrium 5 tape itself is an advanced Barium Ferrite tape developed to help provide durability and increased capacity.

- **Encryption:** The IBM TS1050 LTO Ultrium 5 Tape Drive supports data encryption on the base drive with Ultrium 5 media. System Managed and Library Managed Encryption and associated IBM Security Key Lifecycle Manager access are all available as a chargeable licensed key (feature 1604, Transparent LTO Encryption) under the TS4500 Tape Library L-frames. IBM Security Key Lifecycle Manager is required with this feature.

- **Attachment options:** The TS1050 Tape Drive comes with 8 Gbps Fibre Channel dual-ported attachment models for connection to a wide spectrum of open system servers. They are supported on a wide range of environments including select IBM Power Systems, IBM System i, IBM System p, IBM System x, IBM System z (zLinux), other servers running Linux, Oracle Solaris, and Microsoft Windows operating system environments.

- **WORM media support:** LTO Generation 5 with media specification provides up to 1.5 TB native capacity, up to 3.0 TB in compressed mode, and up to 140 Mbps native data rate. IBM 3589 Ultrium 5 WORM Tape Cartridges are designed for archiving and data retention applications, as well as those applications requiring an audit trail. These cartridges work with the IBM LTO Ultrium 5 Tape Drive to help prevent the alteration or deletion of user data. IBM LTO 5 WORM Tape Cartridges can be ordered as unique 3589 models with the following features:

  - Prelabeling with the ability to specify a starting volume serial and color coding

  - Packaging in individual jewel cases or in bulk

  - Cartridge memory, built into every cartridge, enhances functionality and media reliability by storing access history and media performance information for use by the tape drive every time the cartridge is accessed

  - Half-inch particle tape with up to 3.0 TB WORM compressed capacity in a single cartridge

- **Larger internal data buffer:** There is a 512 MB internal data buffer in the Ultrium 5 Tape Drive.

- **Digital speed matching:** The Ultrium 5 Tape Drive is designed to perform dynamic speed matching to adjust the drive's native data rate as closely as possible to the net host data rate (after data compressibility has been factored out). This helps reduce the number of backhitch repositions and improve throughput performance. Speed matching is 40 to 140 MB/sec on Ultrium 5.

- **IBM LTFS partitioning support:** The principal function of the media partitioning is to allow for faster data access by splitting the cartridge into two media partitions. LTFS media partitioning is supported in the TS1050 Tape Drive, and LTFS LE, LTFS EE, and LTFS Storage Manager will be supported in the TS4500 Tape Library. WORM media cannot be partitioned.

The IBM LTFS software leverages LTO5 tape partitioning. It is designed to enable a self-describing tape file format and to deliver an easy tape storage and distribution solution without the use of additional database applications. Customers of IBM LTFS software are those who require a standard tape cartridge format at a low cost and will use standalone IBM LTO5 tape drives. IBM LTFS is the perfect solution for those in the media and entertainment industry, and other fields that need massive data storage on tape for long retention periods, such as banking, scientific research, and government sectors. For further information and a list of supported operating systems, refer to the following website

http://www.ibm.com/tape/ltfs

IBM maintains the latest levels of tape drive and library device drivers and documentation on the Internet. Utilize the Fix Central download portal by accessing the following website

  http://www.ibm.com/support/fixcentral

There are several menus to navigate to the correct download as follows:

1. On the first menu item Click **Select Product** > **Product Group** > *System Storage*
2. Expand **Select from System Storage** > *Tape Systems*
3. Expand **Select from Tape systems** > *Tape drivers and software*
4. Expand **Select from Tape drivers and software** > *user product*
5. Expand **Platform** > *user operating system*
6. Click **Continue** to view what drivers are available

The IBM Tape Device Drivers Installation and User's Guide can be found at

  http://www-01.ibm.com/support/docview.wss?rs=577&uid=ssg1S7002972

IBM LTO Ultrium features enhanced in the IBM LTO Ultrium 5 Tape Drive include:

- **Independent tape loader and threader motors and positive pin retention:** These are designed to help improve the reliability of loading and unloading a cartridge, and to retain the pin even if tension is dropped. An independent loader motor, coupled with the positive pin retention, is designed to thread the tape with a higher level of reliability.
- **Graceful dynamic braking:** In the event of power failure, reel motors are designed to maintain tension and gradually decelerate instead of stopping abruptly, helping reduce tape breakage, stretching, or loose tape wraps during a sudden power outage.
- **Servo and track layout technology:** There are 1,280 data tracks in Ultrium 5. The high-bandwidth servo system features a low-mass servo to help more effectively track servo bands and improve data throughput with damaged media in less-than-optimal shock and vibration environments.
- **Surface Control Guiding Mechanism:** The patented Surface Control Guiding Mechanism from IBM is designed to guide the tape along the tape path in the Ultrium 5 and 4 Tape Drives. This method uses the surface of the tape, rather than the edges, to control tape motion. This helps reduce tape damage (especially to the edges of the tape) and tape debris, which comes from the damaged edges and can accumulate in the head area.
- **Robust drive components optimized for automation environments:** Using some of the most robust components available, such as an all metal clutch, steel ball bearings in the loader, robust leader block design, and a single circuit card, helps to enhance reliability and prolong the life of drives.
- **Adaptive read equalization:** This feature is designed to automatically compensate for dynamic changes in readback signal response.
- **Dynamic amplitude asymmetry compensation:** This feature optimizes readback signals for linear readback response from MR read head transducers.
- **Separate writing of multiple filemarks:** Separate writing of multiple filemarks is designed to cause any write command of two or more filemarks to cause a separate data set to be written containing all filemarks after the first. This feature helps improve performance if a subsequent append overwrites somewhere after the first filemark. A write of multiple filemarks typically indicates a point where an append operation might occur after the first of these filemarks, and this change helps prevent having to rewrite datasets containing customer data and the first filemark, if such an append occurs.
- **LTO-DC:** The Ultrium 5 uses LTO-DC, which is an implementation of a Lempel-Ziv class 1 (LZ-1) data compression algorithm. LTO-DC is an extension of ALDC and an improvement over previous IBM lossless compression algorithms. Scheme-Swapping compression, patented by IBM, is designed to look ahead at incoming data and determine the most efficient storage method (either ALDC

or pass-thru mode) to help provide optimal data compression and increase data throughput. The compression ratio for LTO Ultrium 5 is 2 to 1.

- **LTO-CM:** Contained within the LTO Ultrium data cartridge is the LTO-CM, which is a passive, contactless silicon storage device that is a physical part of the cartridge. The LTO-CM is designed to hold information about that specific cartridge, the media in the cartridge, and the data on the media. The storage capacity of the Generation 5 and 4 LTO-CM is 8160 bytes. Communication between the drive and the LTO-CM is through a low-level RF field transmitted by the drive to the cartridge.
- **SARS:** The Ultrium 5 Tape Drive uses SARS to help isolate failures between media and hardware. SARS uses the cartridge performance history saved in the CM module and the drive performance history kept in the drive flash EEPROM to help determine the most likely cause of failure. SARS is designed to cause the drive to request a cleaner tape, to mark the media as degraded, and to indicate that the hardware has degraded.
- **Highly integrated electronics using IBM-engineered copper technology:** This technology is designed to reduce the total number of components in the drive, help lower chip temperatures, and reduce power requirements to deliver a more reliable drive. The fifth-generation drive electronics are designed to provide error correction of soft errors in the memory arrays in data and control paths.

With support for LTO Ultrium-format tape data cartridges, TS1050 Model F5C with the TS4500 Tape Library can be a cost-effective solution for backup, save-and-restore, and archiving functions.

Ultrium 5 Data Cartridge

The LTO Generation 5 media specification tape cartridge physical compressed capacity of the LTO 5 Data Cartridge has more than doubled the capacity of the IBM Ultrium 4 Data Cartridge with a capacity of up to 3.0 TB with 2 to 1 compression. IBM LTO Ultrium 5 Tape Drives can read and write Ultrium 4 data cartridges, and read Ultrium 3 data cartridges. IBM LTO 5 cartridges can be resident in the same TS4500 tape library with the Ultrium 4 and Ultrium 3 data cartridges. IBM LTO 5 data cartridges can be ordered using IBM machine type 3589, IBM LTO Ultrium Tape Cartridges.

These cartridges have been designed to provide several enhancements over previous tape technologies. They are designed to work with tape drives that have increased tape speeds and high-density data recording. The case is specially designed for use in automated libraries and is designed for repeated, unattended handling.

TS1060 Model F6C and TS1050 Model F5C Tape Drive supports IBM LTFS partitioning which enables data to be written individually on media without affecting data on another partition.

TS4500 features and functions

LTO tape drives

The TS4500 tape library supports LTO 5 and later LTO tape drives.

The LTO 5 and LTO 6 tape drives are dual-ported drives that facilitate 8 Gbps Fibre Channel connectivity. These drives are differentiated from other LTO drives by their machine type and model numbers. You can identify the LTO tape drives by the label at the rear of the drive's canister. The following two generations of HD2-compatible LTO drives are supported by the HD2 frames of the TS4500 tape library:

- IBM TS1060 Tape Drive (Model 3588 F6C)
- IBM TS1050 Tape Drive (Model 3588 F5C)

Note: Drive models 3588 F6A and 3588 F5A are not supported by the HD2 frames of the TS4500 tape library.

The LTO tape drives communicate with the TS4500 tape library through an internal Ethernet interface and use SARS to isolate failures between media and hardware.

LTO tape drives read and write non-WORM media, so you can load WORM-capable firmware on your tape drives and use any media that is supported by these drives. In this case, only the data that is written on WORM media is treated as WORM data. Data that is written on other types of media can be overwritten.

LTO tape drives do not read from or write to 3592 tape cartridges, and 3592 tape drives do not read or write to LTO tape cartridges.

The LTO tape drives can read tapes that were written by non-IBM LTO drives. They also write to tapes that can be read by non-IBM LTO drives.

All supported generations of LTO tape drives and cartridges can reside in the same frame.

When a cartridge is labeled according to IBM bar code label specifications, the last character of its VOLSER number indicates the generation of the medium. For example, a cartridge with a VOLSER of 000764L6 is an LTO 6 cartridge and a cartridge with a VOLSER of 000764L5 is an LTO 5 cartridge.

To enhance library performance, the LTO tape drives include speed matching, channel calibration, and power management. Speed matching dynamically adjusts the drive's native (uncompressed) data rate to the slower data rate of a server. Channel calibration customizes each read and write data channel for optimum performance. The customization enables compensation for variations in the recording channel transfer function, media characteristics, and read/write head characteristics. Power management reduces the drive's power consumption during idle power periods.

To ensure that your tape drive conforms to IBM specifications for reliability, use only IBM LTO tape cartridges.

Encryption

The LTO 5 and later LTO tape drives are encryption capable, which means they can convert data into a cipher for data security. To perform encryption, the drive must be encryption enabled by your selection of one of three methods of encryption management. Two of these methods, system-managed and library-managed encryption, require the purchase of feature number 1604 (Transparent LTO Encryption). A key is required to encrypt and decrypt the data. How a key is generated, maintained, controlled, and transmitted depends on the operating environment where the tape drive is installed. Some data management applications are capable of performing key management. For an alternative solution, IBM provides a key manager that works in conjunction with the keystore of your choice to perform all necessary key management tasks. There is no recovery for lost encryption keys. Also refer to the IBM Encryption Key Manager and IBM Security Key Lifecycle Manager (formerly Tivoli Key Lifecycle Manager) publications.

3592 tape drives

The TS4500 tape library supports the TS1140 tape drive.

The TS1140 tape drive offers a dual-port Fibre Channel host attachment interface. This feature provides flexibility in open systems environments because the drives can directly attach to Open Systems servers with Fibre Channel attachments. All TS1140 tape drives are encryption capable. The IBM TS1140 (Model 3592 EH7) HD2-compatible 3592 tape drive is supported by the HD2 frames of the TS4500 tape library.

Note: Drive model 3592 E07 is not supported by the HD2 frames of the TS4500 tape library.

The 3592 tape drive communicates with the TS4500 tape library through an internal Ethernet interface and uses the SARS to isolate failures between media and hardware.

The 3592 tape drives provide the following performance, capacity, and availability features:

- N+1 power supplies
- Speed matching
- High-resolution tape directory
- Channel calibration and dynamic adaptive equalization
- Recursive accumulating backhitchless flush
- Backhitchless backspace
- Capacity scaling
- WORM
- Capacity-based and position-based LEOT reporting
- Enhanced format for recording error-correction codes
- Drive mechanical and electrical reliability
- Data compression
- Data buffer with read ahead feature
- Offboard data string searching
- Encryption

Accessibility by people with disabilities

A US Section 508 Voluntary Product Accessibility Template (VPAT) containing details on accessibility compliance can be requested at

  http://www.ibm.com/able/product_accessibility/index.html

Product positioning

As you compare competitive tape solutions, consider:

- Library scalability, one base frame, up to 3 expansion frames, up to 16 tape drives per frame (up to 12 in frame 1) and up to 60 per library string
- 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

The TS4500 tape library and related software applications excel in addressing these requirements and can constitute a functionally rich tape storage solution incorporating LTO Ultrium and 3592 tape technology. You also gain flexibility of automated tape library management and unattended save and restore operations.

TS4500 tape library models are a smart choice for tape automation for IBM System i, IBM System p, or IBM System z products, and System x and other open systems. The TS4500 tape library utilizes the patented Multi-Path Architecture, designed to allow homogeneous or heterogeneous open systems applications to share the library robotics, with ALMS for storage slot pooling and flexible drive assignment.

The TS4500 tape library Base Frame Model L55 offers up to 882 (up to 730 in frame 1) slots for LTO Ultrium tape cartridge media and up to 16 (up to 12 in frame 1)

IBM LTO Ultrium Fibre Channel Tape Drives. It is designed to provide excellent price and performance in the open systems environments where the tape automation requirements are satisfied by 1 to 16 drives or a library native capacity of up to 11.7 PB.

The TS4500 tape library Base Frame Model L25 offers up to 660 (up to 550 in frame 1) slots for 3592 tape cartridge media and up to 16 (up to 12 in frame 1) IBM TS1140 Tape Drives, with a library native capacity of up to 14.2 PB. The TS1140 Tape Drives are designed to provide high capacity, performance, and reliability in open systems environments with tape drive flexibility to accommodate capacity, as well as fast access where these requirements are needed.

Up to 3 TS4500 tape library Expansion Frame 3584 Model D25 or D55 can be added to either Model L25 or L55. Model D25 provides up to 740 cartridge slots for 3592 media (up to 590 in frame 1), and can contain up to 16 TS1140 Tape Drives (up to 12 in frame 1). Model D55 provides up to 970 slots for LTO media (up to 774 in frame 1), and can contain up to 16 Ultrium Fibre Channel Tape Drives (up to 12 in frame 1). This can provide a total TS4500 library capacity of up to 60 IBM LTO Ultrium or TS1140 Tape Drives per library string.

The Model S25 HD frame provides storage for up to 1,000 3592 cartridges (up to 798 in frame 1), while the Model S55 HD frame provides storage for up to 1,320 LTO cartridges (up to 1054 in frame 1). This can provide a total TS4500 library capacity of up to 3,550 3592 cartridge slots holding up to 14.2 PB of native physical capacity or with up to 4,690 LTO Ultrium cartridge slots holding up to 11.7 PB of native physical capacity.

The TS4500, part of a family of IBM tape products, can be the answer to growing storage requirements and shrinking backup windows. If you require high-performance, automated tape backup, the TS4500 Tape Library constitutes an excellent tape storage solution.

If you have existing digital linear tape experience or require high-performance automated tape backup, the TS4500 tape library constitutes an excellent tape storage solution. In addition to reading and writing on LTO Ultrium-format tape cartridges, the TS4500 tape drives provide an enhanced functional alternative to DLT/SDLT, 1/4-inch, 4 mm, 8 mm, or IBM Magstar® MP 3570 tape drives.

For lower capacity requirements, a wide spectrum of tape libraries are available from the family of IBM Ultrium Tape products, depending on your storage usage and requirements. Tape automation products to choose from include the IBM TS3310 Tape Library (up to 169.6 TB compressed), IBM TS3200 Tape Library (up to 35.2 TB compressed), and IBM TS3100 Tape Library (up to 17.6 TB compressed).

Product number

Description	Machine type	Model	Feature number	Plant/Field Install
TS4500 HD2 Expansion Frame	3584	D25		
TS4500 Frame Control Assembly			1450	Both
1st Quad Drive Mounting Kit			1521	Both
2nd Quad Drive Mounting Kit			1522	Both
3rd Quad Drive Mounting Kit			1523	Both
4th Quad Drive Mounting Kit			1524	Both
Web Camera Mounting Hardware			1530	Both
HD CoD for D25			1649	Both
2 Additional I/O Stations			1652	Plant
Single Power Source Bifurcated Cable			1909	Both
Power Distribution Units			1951	Both
13 Meter LC-LC Fibre Cable			6013	Both
25 Meter LC-LC Fibre Cable			6025	Both
61 Meter LC-LC Fibre Cable			6061	Both
OEM - No IBM Logo			7703	Plant
Bull OEM Logo			7704	Plant
3592 Cleaning Cartridge			8802	Plant

Description	Machine type	Model	Feature number	Plant/Field Only Install Feature
Shipping and Handling D2x			AGG4*	Plant
Driveless Frame			9001	Both
3588/3592 Field Install			9690	Both
3592 E07/EH7 Plant Install			9692*	Plant
No Host Cables from Plant			9700	Plant
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Dual 4.3M Pwr Cord WT			9970	Both
Dual 4.3M Pwr Cord Non-WT			9972	Both
Dual 4.3M Pwr Cord Argentina			9976	Both
Dual 4.3M Pwr Cord Brazil			9977	Both
Dual 4.3M Pwr Cord Aust/NZ			9978	Both
Dual 4.3M Pwr Cord Japan			9979	Both
Dual 4.3M Pwr Cord China			9980	Both
Dual 4.3M Pwr Cord Korea			9981	Both
Dual 4.3M Pwr Cord Taiwan			9982	Both
Dual 4.3M Pwr Cord So.Africa			9983	Both
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight			9984	Both
Dual 4.3M Power Cord Russellstoll Watertight			9985	Both
Power Cord to adjacent frame PDUs			9989	Both
Shipping and Handling - No charge			AG00	Plant

Description	Machine type	Model	Feature number	Plant/Field Only Install Feature
TS4500 HD2 Expansion Frame	3584	D55		
TS4500 Frame Control Assembly			1450	Both
1st Quad Drive Mounting Kit			1521	Both
2nd Quad Drive Mounting Kit			1522	Both
3rd Quad Drive Mounting Kit			1523	Both
4th Quad Drive Mounting Kit			1524	Both
Web Camera Mounting Hardware			1530	Both
HD CoD for D55			1650	Both
2 Additional I/O Stations			1652	Plant
Single Power Source Bifurcated Cable			1909	Both
Power Distribution Units			1951	Both
13 Meter LC-LC Fibre Cable			6013	Both
25 Meter LC-LC Fibre Cable			6025	Both
61 Meter LC-LC Fibre Cable			6061	Both
Shipping and Handling D5x			AGG5*	Plant
OEM - No IBM Logo			7703	Plant
Bull OEM Logo			7704	Plant
Ultrium Cleaning Cartridge			8750	Plant
Driveless Frame			9001	Both
3588/3592 Field Install			9690	Both
3588 F5A/F5C Plant Install			9695*	Plant
3588 F6A/F6C Plant Install			9697*	Plant
No Host Cables from Plant			9700	Plant
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Dual 4.3M Pwr Cord WT			9970	Both
Dual 4.3M Pwr Cord Non-WT			9972	Both
Dual 4.3M Pwr Cord Argentina			9976	Both
Dual 4.3M Pwr Cord Brazil			9977	Both
Dual 4.3M Pwr Cord Aust/NZ			9978	Both
Dual 4.3M Pwr Cord Japan			9979	Both
Dual 4.3M Pwr Cord China			9980	Both
Dual 4.3M Pwr Cord Korea			9981	Both

Description	Machine type	Model	Feature number	Plant/Field Only Install Feature
Dual 4.3M Pwr Cord Taiwan			9982	Both
Dual 4.3M Pwr Cord So.Africa			9983	Both
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight			9984	Both
Dual 4.3M Power Cord Russellstoll Watertight			9985	Both
Power Cord to adjacent frame PDUs			9989	Both
Shipping and Handling - No charge			AG00	Plant
TS4500 HD2 Base Frame	3584	L25		
Library & Drive Code Update			0500	Field
Multi-frame Network			1460	Both
1st Quad Drive Mounting Kit			1521	Both
2nd Quad Drive Mounting Kit			1522	Both
3rd Quad Drive Mounting Kit			1523	Both
4th Quad Drive Mounting Kit			1524	Both
Web Camera Mounting Hardware			1530	Both
Intermed. Cap. On Demand			1643	Both
Base Capacity on Demand			1644*	Both
HD CoD for L25			1647	Both
Path Failover			1682	Both
1-2 Frame X-Track Cable			1802	Field
3-6 Frame X-Track Cable			1806	Field
Overhead Access Ladder			1856	Both
Single Power Source Bifurcated Cable			1909	Both
Power Distribution Units			1951	Both
IMC Non-Broadband Call Home			2735	Both
13 Meter LC-LC Fibre Cable			6013	Both
25 Meter LC-LC Fibre Cable			6025	Both
61 Meter LC-LC Fibre Cable			6061	Both
Shipping and Handling L2x			AGG2*	Plant
OEM - No IBM Logo			7703	Plant
Bull OEM Logo			7704	Plant
3592 Cleaning Cartridge			8802	Plant
Driveless Frame			9001	Both
First Expansion Frame Attch			9002	Both
Add Expansion Frame Attch			9003	Both
Attached to HP-UX System			9210	Plant
Attached to Solaris System			9211	Plant
Attached to Windows System			9212	Plant
Attached to Other Non-IBM System			9213	Plant
Attached to Linux System			9215	Plant
Attached to HPSS			9218	Plant
Attached to i5/OS™ or OS/400®			9400	Plant
Attach to AIX® System			9600	Plant
3588/3592 Field Install			9690	Both
3592 E07/EH7 Plant Install			9692*	Plant
No Host Cables from Plant			9700	Plant
IMC Broadband Call Home			9735	Both
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Dual 4.3M Pwr Cord WT			9970	Both
Dual 4.3M Pwr Cord Non-WT			9972	Both
Dual 4.3M Pwr Cord Argentina			9976	Both
Dual 4.3M Pwr Cord Brazil			9977	Both
Dual 4.3M Pwr Cord Aust/NZ			9978	Both
Dual 4.3M Pwr Cord Japan			9979	Both
Dual 4.3M Pwr Cord China			9980	Both
Dual 4.3M Pwr Cord Korea			9981	Both
Dual 4.3M Pwr Cord Taiwan			9982	Both
Dual 4.3M Pwr Cord So.Africa			9983	Both

```
Dual 4.3M Power Cord NEMA                        9984      Both
 L6-20 Non-Watertight
Dual 4.3M Power Cord                             9985      Both
 Russellstoll Watertight
Power Cord to adjacent                           9989      Both
 frame PDUs
Shipping and Handling - No charge               AG00      Plant
```

Description	Machine type	Model	Feature number	Plant/Field Only Install Feature
TS4500 HD2 Base Frame	3584	L55		
Library & Drive Code Update			0500	Field
Multi-frame network			1460	Both
1st Quad Drive Mounting Kit			1521	Both
2nd Quad Drive Mounting Kit			1522	Both
3rd Quad Drive Mounting Kit			1523	Both
4th Quad Drive Mounting Kit			1524	Both
Web Camera Mounting Hardware			1530	Both
Transparent LTO Encryption			1604	Both
Intermed. Cap. On Demand			1643	Both
Base Capacity on Demand			1644*	Both
HD CoD for L55			1648	Both
Path Failover			1682	Both
1-2 Frame X-Track Cable			1802	Field
3-6 Frame X-Track Cable			1806	Field
Overhead Access Ladder			1856	Both
Single Power Source Bifurcated Cable			1909	Both
Power Distribution Units			1951	Both
IMC Non-Broadband Call Home			2735	Both
13 Meter LC-LC Fibre Cable			6013	Both
25 Meter LC-LC Fibre Cable			6025	Both
61 Meter LC-LC Fibre Cable			6061	Both
Shipping and Handling L5x			AGG3*	Plant
OEM - No IBM Logo			7703	Plant
Bull OEM Logo			7704	Plant
Ultrium Cleaning Cartridge			8750	Plant
Driveless Frame			9001	Both
First Expansion Frame Attch			9002	Both
Add Expansion Frame Attch			9003	Both
Attached to HP-UX System			9210	Plant
Attached to Solaris System			9211	Plant
Attached to Windows System			9212	Plant
Attached to Other Non-IBM System			9213	Plant
Attached to Linux System			9215	Plant
Attached to HPSS			9218	Plant
Attached to i5/OS or OS/400			9400	Plant
Attach to AIX System			9600	Plant
3588/3592 Field Install			9690	Both
3588 F5A/F5C Plant Install			9695*	Plant
3588 F6A/F6C Plant Install			9697*	Plant
No Host Cables from Plant			9700	Plant
IMC Broadband Call Home			9735	Both
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Dual 4.3M Pwr Cord WT			9970	Both
Dual 4.3M Pwr Cord Non-WT			9972	Both
Dual 4.3M Pwr Cord Argentina			9976	Both
Dual 4.3M Pwr Cord Brazil			9977	Both
Dual 4.3M Pwr Cord Aust/NZ			9978	Both
Dual 4.3M Pwr Cord Japan			9979	Both
Dual 4.3M Pwr Cord China			9980	Both
Dual 4.3M Pwr Cord Korea			9981	Both
Dual 4.3M Pwr Cord Taiwan			9982	Both
Dual 4.3M Pwr Cord So.Africa			9983	Both
Dual 4.3M Power Cord NEMA			9984	Both

```
   L6-20 Non-Watertight
Dual 4.3M Power Cord                          9985      Both
 Russellstoll Watertight
Power Cord to adjacent                        9989      Both
 frame PDUs
Shipping and Handling - No charge             AG00      Plant
```

				Plant/Field
				Only Install
Description	Machine type	Model	Feature number	Feature
TS4500 HD2 Expansion Frame	3584	S25,S55		
Web Camera Mounting Hardware			1530	Both
HD COD for S24/S25			1645*	Both
HD COD for S54/S55			1646*	Both
Power Distribution Units			1951	Both
Shipping and Handling S2x			AGG6*	Plant
Shipping and Handling S5x			AGG7*	Plant
OEM - No IBM Logo			7703	Plant
Bull OEM Logo			7704	Plant
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Shipping and Handling - No charge			AG00	Plant

				Plant/Field
				Only Install
Description	Machine type	Model	Feature number	Feature
HD2 Frame	3584	S24,S54	9051	Plant

				Plant/Field
				Only Install
Description	Machine type	Model	Feature number	Feature
Top Rack Option	3584	TR1		
End Covers			1750	Both
Power Distribution Unit			1751	Both
Shipping and Handling SC1/TR1			AGG9*	Plant
Nema L6-30 Power Cord			9954	Both
RS 3750DP Power Cord			9955	Both
IEC 309 Power Cord			9956	Both
PDL 4.3m Power Cord			9957	Both
Korean 4.3m Power Cord			9958	Both
Unterminated Power Cord			9959	Both
Unterminated Power Cord - China			9966	Both
Shipping and Handling - No charge			AG00	Plant

* This feature was previously announced on other models, but the description has changed.

Business Partner information

If you are a Direct Reseller - System Reseller acquiring products from IBM, you may link directly to Business Partner information for this announcement. A PartnerWorld ID and password are required (use IBM ID).

https://www.ibm.com/partnerworld/mem/sla.jsp?num=114-072

Publications

The following publications are shipped with the product. Additional copies are available. To order, contact your IBM representative.

```
Title                          Order number

IBM TS4500 Lx5 Base Frame
 Installation Roadmap          SC27-5987

IBM TS4500 Product Information CD
```

The following publications will be available at

http://www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss

```
                               Order
Title                          number

IBM TS4500 Introduction        SC27-8990
 and Planning Guide
```

The following device driver publication is also available at

http://www.ibm.com/support/fixcentral

```
                               Order
Title                          number

IBM Tape Device Drivers Installation  GC27-2130
 and User's Guide
```

TS4500 Knowledge Center

http://www.ibm.com/support/knowledgecenter/STQRQ9/ts4500_kcwelcome.html

IBM Knowledge Center provides you with a single information center where you can access product documentation for IBM systems hardware, operating systems, and server software. Through a consistent framework, you can efficiently find information and personalize your access. IBM Knowledge Center is located at

http://www.ibm.com/support/knowledgecenter/

IBM Publications Center Portal

http://www.ibm.com/shop/publications/order

The Publications Center is a worldwide central repository for IBM product publications and marketing material with a catalog of 70,000 items. Extensive search facilities are provided, as well as payment options via credit card. A large number of publications are available online in various file formats, which can currently be downloaded free of charge.

Services

Global Technology Services®

IBM services include business consulting, outsourcing, hosting services, applications, and other technology management.

These services help you learn about, plan, install, manage, or optimize your IT infrastructure to be an on-demand business. They can help you integrate your high-speed networks, storage systems, application servers, wireless protocols, and an array of platforms, middleware, and communications software for IBM and many non-IBM offerings. IBM is your one-stop shop for IT support needs.

For details on available services, contact your IBM representative or visit

http://www.ibm.com/services/

For details on available IBM Business Continuity and Recovery Services, contact your IBM representative or visit

   http://www.ibm.com/services/continuity

For details on education offerings related to specific products, visit

   http://www.ibm.com/services/learning/

Select your country, and then select the product as the category.

Technical information

Specified operating environment

Physical specifications

Height and length of the frames of the library

This section provides the height of TS4500 tape library frames to help plan for shipment and installation.

Each frame of the TS4500 tape library has a set of casters and four leveling jackscrews. The casters and leveling jackscrews that attach to the TS4500 tape library affect its height.

- The nominal height from the bottom of the jackscrews to the top of the frame is 1840 mm (72.4 in). This height can vary by plus or minus 40 mm (1.6 in).
- The shipping height of the library (on its casters and with jackscrews raised and not including the pallet) is 1800 mm (70.9 in).
- The height of a frame with a top rack is 2320 mm (91.34 in).

The physical specifications by frame model provide detailed information about the height and weight of frames in various configurations. Use this information when planning for TS4500 tape library in your data storage environment.

Physical characteristics of the TS4500 tape library, Models L25 and D25

- Height of L25 and D25 frames (on casters) 1800 mm (70.9 in)
- Height of L25 and D25 frames with top rack 2320 mm (91.34 in)
- Width of L25 frame with covers 782 mm (30.8 inches)
- Width of L25 or D25 frame without covers[1] 725 mm (28.5 in)
- Depth of L25 or D25 frame (including front and rear doors) 1212 mm (47.72 in)
- Minimum weight of frame (with no tape drives or cartridges)[2] :
  - Model L25 in Position 1 (Leftmost frame) 407.8 kg (899 lb)
  - Model D25 in Position 1 (Leftmost frame) 310.7 kg (685 lb)

  - Model L25 in Position 2+ 407.8 kg (899 lb)
  - Model D25 in Position 2+ 310.7 kg (685 lb)
- Maximum weight of frame (with maximum tape drives and cartridges)[2, 3, 4] :
  - Model L25 in Position 1 (Leftmost frame) 586.5 kg (1293 lb)
  - Model D25 in Position 1 (Leftmost frame) 500 kg (1103 lb)

  - Model L25 in Position 2+ 630.5 kg (1390 lb)
  - Model D25 in Position 2+ 552.5 kg (1218 lb)
- Weight of top rack (empty)[5] 24.5 kg (54 lb)

Physical characteristics of the TS4500 tape library, Models L55 and D55

- Height of L55 and D55 frames (on casters) 1800 mm (70.9 in)
- Height of L55 and D55 frames with top rack 2320 mm (91.34 in)
- Width of L55 frame with covers 782 mm (30.8 inches)
- Width of L55 or D55 frame without covers [1] 725 mm (28.5 in)
- Depth of L55 or D55 frame (including front and rear doors) 1212 mm (47.72 in)
- Minimum weight of frame (with no tape drives or cartridges) [2] :
  - Model L55 in Position 1 (Leftmost frame) 410 kg (904 lb)
  - Model D55 in Position 1 (Leftmost frame) 316 kg (697 lb)

  - Model L55 in Position 2+ 410 kg (904 lb)
  - Model D55 in Position 2+ 316 kg (697 lb)
- Maximum weight of frame (with maximum tape drives and cartridges) [2, 3, 4] :
  - Model L55 in Position 1 (Leftmost frame) 592 kg (1305 lb)
  - Model D55 in Position 1 (Leftmost frame) 503.5 kg (1110 lb)

  - Model L55 in Position 2+ 637 kg (1404 lb)
  - Model D55 in Position 2+ 557 kg (1228 lb)
- Weight of top rack (empty) [5] 24.5 kg (54 lb)

Physical characteristics of the TS4500 tape library, Model S25

- Height of S25 frame (on casters) 1800 mm (70.9 in)
- Height of S25 frame with top rack 2320 mm (91.34 in)
- Width of S25 frame with covers 782 mm (30.8 in)
- Width of S25 frame without covers [1] 725 mm (28.5 in)
- Depth of S25 frame (including front and rear doors) 1212 mm (47.7 in)
- Minimum weight of frame (0 cartridges):
  - Model S25 in Position 1 (Leftmost frame) 299 kg (660 lb)
  - Model S25 in Position 2+ 299 kg (660 lb)
- Maximum weight of frame (with 0 drives and maximum cartridges) [3,4] :
  - Model S25 in Position 1 (Leftmost frame) 491.2 kg (1083 lb)
  - Model S25 in Position 2+ 540.2 kg (1191 lb)
- Weight of top rack (empty) [5] 24.5 kg (54 lb)

Physical characteristics of the TS4500 tape library, Model S55

- Height of S55 frame (on casters) 1800 mm (70.9 in)
- Height of S55 frame with top rack 2320 mm (91.34 in)
- Width of frame with covers 782 mm (30.8 in)
- Width of frame without covers [1] 725 mm (28.5 in)
- Depth of S55 frame (including front and rear doors) 1212 mm (47.7 in)
- Minimum weight of frame (with 0 cartridges):
  - Model S55 in Position 1 (Leftmost frame) 304 kg (670 lb)
  - Model S55 in Position 2+ 304 kg (670 lb)
- Maximum weight of frame (with 0 drives and maximum cartridges) [3,4] :
  - Model S55 in Position 1 (Leftmost frame) 509.4 kg (1123 lb)
  - Model S55 in Position 2+ 564 kg (1244 lb)
- Weight of top rack (empty) [5] 24.5 kg (54 lb)

[1]
   Frame width only. Extra inter-frame spacing of 30 mm (1.2 in) is required.

[2]

Weights listed for the Lx5 frames include the accessor, IMC, side doors and side panels. After the initial library installation, these parts can be moved to other frames within the library string, which shifts some of the weight to other frames.

[3]

The weight with drives and cartridges assumes a weight of 3.97 kg (8.75 lb) for a 3592 EH7 tape drive and 0.24 kg (0.5 lb) for a standard 3592 tape cartridge. The actual weight of the frame varies, depending on the configuration and cartridge capacity. Listed weights are plus or minus 2.3 kg (5 lb).

[4]

Frames in position 1 (the leftmost frame in a library string) can have a maximum of 12 tape drives and 550 (L25) or 590 (D25) cartridges. Frames in positions 2+ can accommodate 16 tape drives and 660 (L25) or 740 (D25) cartridges.

[5]

A top rack can optionally be installed on any HD2 frame. Side panels and PDUs are also optional. Each side panel adds 6.8 kg (15 lb). Each PDU adds 4.5 kg (10 lb).

Operating environment

- Equipment environment specifications for the IBM TS4500 tape library
  - Temperature: 15°C - 32°C (60°F - 90°F)
  - Relative humidity: 20 - 80 percent non-condensing
  - Electrical power: 5.1 amps at 200-240 V ac, 1.1 kVA (max per frame)

The TS4500 tape library is classified as a Category 1 product as defined in C-S 1-1710-006. The following table shows the maximum noise level (operating/idle) in bels (at recommended ambient temperature):

- Sound power level (LwAd):
  - Operating: 7.5 bels

For more information and documentation, refer to TS4500 Knowledge Center at

http://www.ibm.com/support/knowledgecenter/STQRQ9/ts4500_kcwelcome.html

Homologation

The TS4500 non-broadband Call Home option (#2735) are qualified for use in the following countries:

Abu Dhabi City, Afghanistan, Albania, Andorra, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Azerbaijan, Bahamas (The), Bahrain, Bangladesh, Barbados, Belarus, Belize, Bermuda, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, British Virgin Islands, Cameroon, Canada, Cayman Islands, Chile, China CCC, China NALTE, Colombia, Congo (Republic of the), Croatia, Dominica, Dominican Republic, Ecuador, EEA**, Egypt, El Salvador, Equatorial Guinea, Faroe Islands, Federated States of Micronesia, Fiji, French Polynesia, Georgia, Gibraltar, Greenland, Guatemala, Guernsey, Guinea, Guinea-Bissau, Guyana, Honduras, Hong Kong, India, Indonesia, Isle of Man, Israel, Jamaica, Japan, Jersey, Jordan, Kazakhstan, Kenya, Korea (South), Kosovo, Kuwait, Kyrgyzstan, Lebanon, Lesotho, Macedonia, Malaysia, Mauritius, Mexico, Montenegro, Monaco, Montserrat, Morocco (Western Sahara), Namibia, Netherlands Antilles, Nepal, New Caledonia, New Zealand, Nicaragua, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Russia, Saint Lucia, Saint Kitts and Nevis, Saint Pierre and Miquelon, Saint Vincent and the Grenadines, San Marino, Saudi Arabia, Serbia, Seychelles, Singapore, South Africa, Suriname, Swaziland, Taiwan, Tajikistan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Islands, UAE, Ukraine, United States, Uruguay, Uzbekistan, Vatican City, Venezuela, Vietnam, Wallis and Futuna, and Zimbabwe.

EEA = EU and EFTA: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and UK.

Oversea areas part of the European Union: Portugal: Acores, Madeira, Spain: Canarias,

France: Guyane, Guadeloupe, Martinique, Mayotte, and Reunion.

USA includes US Territories: American Samoa, Baker Island, Guam, the Commonwealth of the Northern Mariana Islands, Howland Islands, Jarvis Island, Johnson Island, Kingma Reef, Midway Islands, Navarra Islands, Palmyra, Puerto Rico, US Virgin Islands, and Wake Island.

Hardware requirements

The TS4500 tape library can be attached to select IBM Power Systems, IBM System i, IBM System p, IBM System x, and other servers running AIX, Linux, Oracle Solaris SPARC, and Microsoft Windows servers supporting Fibre Channel interfaces.

One base frame and up to three expansion frame Models D25, D55, S25, or S55 can be added as active frames to either Model L25 or L55. Model S25 is designed to provide up to 1,000 cartridge slots for 3592 media, while Model D25 provides up to 740 cartridge slots for 3592 media. Model S55 is designed to provide up to 1,320 cartridge slots for LTO media, while Model D55 provides up to 970 cartridge slots LTO media.

Model D55 and L55 can contain up to 16 IBM TS1060 or TS1050 LTO Ultrium Fibre Channel Tape Drives per frame. Model D25 and L25 can contain up to 16 of the TS1140 Tape Drives per frame. The TS1140 Model EH7 Tape Drives have an 8 Gbps dual-ported Fibre Channel interface.

The cartridge storage capacity of the TS4500 can be expanded with the HD CoD features for licensing additional library capacity or by attaching an optional expansion frame Models D25, D55, S25, or S55.

The TS4500 tape library can be attached to select IBM System i, IBM System p, or IBM System z products, and xSeries, Oracle, UNIX, Linux, and Windows servers that support Fibre Channel interfaces.

The TS4500 tape library is supported by a wide variety of servers, operating systems, and adapters. There are many ways to determine the servers and software that support the TS4500 tape library. These attachments can change throughout the lifecycle of the product. To determine the latest attachments, or to get a comprehensive list of compatible software, perform one of the following actions:

For a list of compatible software, operating systems, and servers for LTO tape drives, visit

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

1. On menu item Click **IBM TS4500 Tape Library** > *Product details*

2. Click **Learn more** > *Interoperability matrix*

3. Click **Learn more** > *Independent Software Vendor (ISV) matrix for LTO*

For a list of compatible software, operating systems, and servers for 3592 tape drives, visit

  http://www.ibm.com/servers/storage/tape/drives

1. Click *user tape drive* > *Product details*

2. Click **Learn more** > *Interoperability matrix*

3. Click **Learn more** > *Independent Software Vendor (ISV) matrix*

One First Expansion Frame Attachment feature (#9002) or one Additional Expansion Frame Attachment feature (#9003) must be added to the TS4500 Model L25 or L55 for each Model D25, D55, S25, or S55 expansion frame that is attached. This assures the proper cables are shipped and configuration records are correct. Up to three Model D25, D55, S25, or S55 expansion frames can be attached to Model L25 or L55, for a total of four frames.

The cartridge storage capacity of Model L25 or L55 can be expanded by enabling the CoD features in that frame. An Intermediate Capacity feature (#1643) is required to add a Base Capacity feature (#1644). The Base Capacity feature (#1644) is required to attach an optional expansion frame Model D25, D55, S25, or S55.

When the total number of frames in the TS4500 tape library coming from the plant is going to number three to four frames, the three- to six-frame X-track cable will be shipped with the library.

When frames are added to the library as a field upgrade, a new X-Track Cable may be required according to the following table of total installed frames:

```
Installed    New         X-Track Cable
frame qty    frame qty   feature number required

 1 - 2       3 - 6       1806
```

When frames are removed from the library, a new X-Track Cable is required according to the following:

```
Installed    New         X-Track Cable
frame qty    frame qty   feature number required

 3 - 6       1 - 2       1802
```

TS4500 tape library Models D55 and L55

The TS4500 tape library Models D55 or L55 can contain a maximum of 16 IBM TS1060 or TS1050 LTO Ultrium Fibre Channel Tape Drives per frame for a total of up to 60 per library string. The TS1060 or TS1050 Tape Drive must be ordered separately, and is designed for customer setup in the TS4500 Tape Library. One of the following features should be ordered on the library frame into which a TS1060 or TS1050 (3588) Tape Drive is installed:

- 9690 - 3588/3592 drive field install - one feature should be ordered on the library frame coming from the plant for each tape drive that will be field installed in that frame
- 9697 - 3588 F6A/F6C tape drive - plant install - one feature should be ordered on both the tape drive and library frame coming from the plant for each tape drive that will be installed in that frame by the plant
- 9695 - 3588 F5A/F5C tape drive - plant install - one feature should be ordered on both the tape drive and library frame coming from the plant for each tape drive that will be installed in that frame by the plant

If a drive mounting kit feature is not ordered on the Model D55 or L55, then #9001 Driveless Frame feature must be specified on that Model D55 or L55. A power cord feature number, if applicable, should also be specified. Labeled or bulk quantities of LTO cartridges can be ordered using machine type 3589 or purchased through distributors. Refer to the **Supplies** section for additional information.

Note: The TS4500 tape library requires that cartridges have appropriate bar code labels.

A Quad Drive Mounting Kit feature (#1521, #1523, #1523, #1524) is required for installing each set of up to four TS1060 Model F6C or TS1050 Model F5C 3588 Tape Drives in a TS4500 tape library Model L55 or D55 frame:

- 1521 - 1st TS4500 Quad Drive Mounting Kit
- 1522 - 2nd TS4500 Quad Drive Mounting Kit
- 1523 - 3rd TS4500 Quad Drive Mounting Kit
- 1524 - 4th TS4500 Quad Drive Mounting Kit

TS4500 tape library Models D25 and L25

The TS4500 tape library Models D25 or L25 can contain a maximum of 16 of the TS1140 Tape Drive Model EH7 per frame for a total of up to 60 TS1140 Tape Drives per library string. The TS1140 Tape Drive Model EH7 comes with a dual-port 8 Gbps Fibre Channel interface for redundancy.

A 3592 Quad Drive Mounting Kit feature is required for installing each set of up to four TS1140 Model EH7 in a TS4500:

- 1521 - 1st TS4500 Quad Drive Mounting Kit
- 1522 - 2nd TS4500 Quad Drive Mounting Kit
- 1523 - 3rd TS4500 Quad Drive Mounting Kit
- 1524 - 4th TS4500 Quad Drive Mounting Kit

The TS1140 Model EH7 Tape Drive must be ordered separately, and is installed in a 3584 frame with one of the following feature numbers:

- 9690 - 3588/3592 drive field install
- 9692 - 3592 E07/EH7 tape drive - plant install

If one of these drive features is not on the Model D25 or L25, then #9001 Driveless Frame feature must be specified on that Model D25 or L25. A power cord feature number should also be specified.

Labeled or initialized 3592 Tape Cartridges can be ordered using machine type 3599. Refer to the **Supplies** section for additional information.

Note: The TS4500 tape library requires that cartridges have appropriate bar code labels.

TS4500 non-broadband Call Home

The feature number 2735 is required when you do not allow broadband Call Home to be configured for the library. The IMC Non-Broadband Call Home feature provides a USB modem and optical drive for use with the Integrated Management Console (IMC).

Cables: Cables are required to attach tape drives in the TS4500 tape library to each server connection, up to the number of tape drive attachments installed. If no host attachment cables are required to be shipped with TS4500 frame from the plant, then the No Host Cables From Plant feature (#9700) should be specified on the frame. Otherwise, one or more of the following Fibre Channel cables should be specified on the frame.

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

You can establish Fibre Channel connections between Fibre Channel ports that reside in the TS4500 tape library, one or more servers, and the network interconnecting them. The network can consist of such elements as switches, hubs, bridges, and repeaters used in the interconnection.

Features available for Fibre Channel cables, and their respective lengths, are available with the following feature numbers:

- 6013 - 13 m LC-LC Fibre Channel Cable
- 6025 - 25 m LC-LC Fibre Channel Cable
- 6061 - 61 m LC-LC Fibre Channel Cable

Software requirements

LTO Ultrium or Enterprise Tape Drives in the TS4500 tape library

For the latest supported hardware interoperability configurations, refer to the Interoperation Center website

http://www.ibm.com/systems/support/storage/config/ssic/

The installation of a TS4500 or 3584 Tape Library may require code updates for supported open systems device drivers or storage management software. According to the *Solutions Assurance Product Review (SAPR) Guide,* the account team or Business Partner should ensure that the customer checks the support levels required for their particular software environment prior to the installation of the TS1140. A Solutions Assurance call is required at a minimum for the installation of the first TS1140 in an account.

Security Key Lifecycle Manager and other industry-leading compatible software offerings provide storage and tape management software for the TS4500 (machine type 3584). Supporting software and applications must be obtained separately from IBM, IBM Business Partners, or ISVs. A list of compatible software is available from your IBM representative or at

http://www-03.ibm.com/systems/storage/tape/library.html#compatibility

The *IBM Tape Device Drivers Installation and User's Guide* can be found at

http://www-01.ibm.com/support/docview.wss?rs=577&uid=ssg1S7002972

Application software

Security Key Lifecycle Manager and other industry-leading compatible software offerings provide storage and tape management software for the TS1140 Model EH7. Supporting software and applications must be obtained separately from IBM, IBM Business Partners, or independent software vendors (ISVs). For a list of compatible software and additional information, refer to the TS1140 Model EH7 ISV Matrix at

http://www.ibm.com/servers/storage/tape/3592

For a list of compatible software, operating systems, and servers for LTO tape drives, visit

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

1. On menu item Click **IBM TS4500 Tape Library** > *Product details*
2. Click **Learn more** > *Interoperability matrix*
3. Click **Learn more** > *Independent Software Vendor (ISV) matrix for LTO*

For a list of compatible software, operating systems, and servers for 3592 tape drives, visit

http://www.ibm.com/servers/storage/tape/drives

1. Click *user tape drive* > *Product details*
2. Click **Learn more** > *Interoperability matrix*
3. Click **Learn more** > *Independent Software Vendor (ISV) matrix*

For complete IBM storage interoperability information, including operating systems, servers, switches, and adapters supported by the TS4500 tape library in a SAN configuration, visit the IBM Interoperation Center (SSIC) at

http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss

Compatibility

Compatible servers and software

The TS4500 tape library is supported by a wide variety of servers, operating systems, and adapters. There are many ways to determine the servers and software that support the TS4500 tape library.

These attachments can change throughout the lifecycle of the product. To determine the latest attachments, or to get a comprehensive list of compatible software, perform one of the following actions:

For a list of compatible software, operating systems, and servers for LTO tape drives, visit

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

For a list of compatible software, operating systems, and servers for 3592 tape drives, visit

http://www.ibm.com/servers/storage/tape/drives

For complete IBM storage interoperability information, including operating systems, servers, switches, and adapters supported by the TS4500 tape library in a SAN configuration, visit the IBM System Storage Interoperation Center (SSIC) at

http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss

Contact your IBM sales representative.

Note: IBM does not provide application software with the TS4500 tape library. To order software, contact your IBM sales representative, IBM Business Partner, or an Independent Software Provider.

Note: If you attach your library to a non-IBM platform with non-IBM software, it is recommended that you contact your software vendor to obtain a matrix of compatible hardware, software, firmware revisions, and adapter cards.

Limitations

- The TS4500 tape library supports a mixture of LTO drive types in a logical library, but it does not support a mixture of LTO and 3592 tape drives in a logical library. Some ISVs support mixed drive types within logical libraries; others do not. Some ISVs that support mixed drive types do so with restrictions. For details, contact your ISV.
- For situations where the ISV support does not exist or does not meet your requirements, the TS4500 tape library provides another option to protect your investment by partitioning the tape drives into separate logical libraries. You can customize the partition to any number of slots by using menus.
- Although the compression technology can increase the amount of data stored on the media, the actual degree of compression achieved is highly sensitive to the characteristics of the data being compressed.
- Fibre Channel cable lengths are limited to 500 meters (1,650 ft).
- Although multiple systems may be attached to a tape drive, the systems cannot use the drive simultaneously.
- 3584-TR1 (Top Rack Option) cannot be ordered for frames with the shuttle Tape Library Connector Model SC1.
- Under-floor power and data connections to the 3584-TR1 cannot be routed through a single-frame TS3500 or TS4500 tape library, and overhead cable trays are strongly recommended in this case. Under-floor power and data connections to the 3584-TR1 can be routed between frames in a multi-frame TS3500 or TS4500 tape library.

Planning information

Customer responsibilities

Physical planning is a customer responsibility. Detailed planning information is in the *IBM TS4500 Introduction and Planning Guide,* SC27-8990. Current levels of the open systems device drivers should be obtained to ensure that the TS1060 or TS1050 LTO Ultrium Tape Drives or TS1140 Tape Drive are supported.

Customers are responsible for obtaining the appropriate adapters, cables, and interposers (if required) for system attachment. Customers are also responsible for ordering media.

To utilize the remote support facility, phone lines need to be installed close to the TS4500 tape library.

You are responsible for downloading or obtaining from IBM, and installing designated Machine Code (microcode, basic input/output system code (called BIOS), utility programs, device drivers, and diagnostics delivered with an IBM machine) and other software updates in a timely manner from an IBM Internet website or from other electronic media, and following the instructions that IBM provides. You may request IBM to install Machine Code changes; however, you may be charged for that service.

Cable orders

Cables are required to attach tape drives in the TS4500 tape library to each server connection, up to the number of tape drive attachments installed. If no host attachment cables are required to be shipped with 3584 frame from the plant, then the No Host Cables From Plant feature (#9700) should be specified on the frame.

Installability

Installation time for each field-installed tape drive in the TS4500 tape library is approximately 0.4 hours.

Security, auditability, and control

This product uses the security and auditability features of the host hardware, software, and application software.

The customer is responsible for evaluation, selection, and implementation of security features, administrative procedures, and appropriate controls in application systems and communications facilities.

IBM Electronic Services

Electronic Service Agent™ and the IBM Electronic Support web portal are dedicated to providing fast, exceptional support to IBM Systems customers. The IBM Electronic Service Agent tool is a no-additional-charge tool that proactively monitors and reports hardware events, such as system errors, performance issues, and inventory. The Electronic Service Agent tool can help you stay focused on your company's strategic business initiatives, save time, and spend less effort managing day-to-day IT maintenance issues. Servers enabled with this tool can be monitored remotely around the clock by IBM Support all at no additional cost to you.

Now integrated into the base operating system of AIX 5.3, AIX 6.1, and AIX 7.1, Electronic Service Agent is designed to automatically and electronically report system failures and utilization issues to IBM, which can result in faster problem resolution and increased availability. System configuration and inventory information collected by the Electronic Service Agent tool also can be viewed on the secure Electronic Support web portal, and used to improve problem determination and resolution by you and the IBM support team. To access the tool main menu, simply type "smitty esa_main", and select "Configure Electronic Service Agent." In addition, ESA now includes a powerful Web user interface, giving the administrator easy access to status, tool settings, problem information, and filters. For more information and documentation on how to configure and use Electronic Service Agent, refer to

http://www.ibm.com/support/electronic

The IBM Electronic Support portal is a single Internet entry point that replaces the multiple entry points traditionally used to access IBM Internet services and support.

This portal enables you to gain easier access to IBM resources for assistance in resolving technical problems. The My Systems and Premium Search functions make it even easier for Electronic Service Agent tool-enabled customers to track system inventory and find pertinent fixes.

Benefits

Increased uptime: The Electronic Service Agent tool is designed to enhance the Warranty or Maintenance Agreement by providing faster hardware error reporting and uploading system information to IBM Support. This can translate to less wasted time monitoring the "symptoms," diagnosing the error, and manually calling IBM Support to open a problem record. Its 24 x 7 monitoring and reporting mean no more dependence on human intervention or off-hours customer personnel when errors are encountered in the middle of the night.

Security: The Electronic Service Agent tool is designed to be secure in monitoring, reporting, and storing the data at IBM. The Electronic Service Agent tool securely transmits either via the Internet (HTTPS or VPN) or modem, and can be configured to communicate securely through gateways to provide customers a single point of exit from their site. Communication is one way. Activating Electronic Service Agent does not enable IBM to call into a customer's system. System inventory information is stored in a secure database, which is protected behind IBM firewalls. It is viewable only by the customer and IBM. The customer's business applications or business data is never transmitted to IBM.

More accurate reporting: Since system information and error logs are automatically uploaded to the IBM Support center in conjunction with the service request, customers are not required to find and send system information, decreasing the risk of misreported or misdiagnosed errors. Once inside IBM, problem error data is run through a data knowledge management system and knowledge articles are appended to the problem record.

Customized support: Using the IBM ID entered during activation, customers can view system and support information in the "My Systems" and "Premium Search" sections of the Electronic Support Web site at

http://www.ibm.com/support/electronic

My Systems provides valuable reports of installed hardware and software using information collected from the systems by Electronic Service Agent. Reports are available for any system associated with the customer's IBM ID. Premium Search combines the function of search and the value of Electronic Service Agent information, providing advanced search of the technical support knowledgebase. Using Premium Search and the Electronic Service Agent information that has been collected from your system, customers are able to see search results that apply specifically to their systems.

For more information on how to utilize the power of IBM Electronic Services, contact your IBM Systems Services Representative, or visit

http://www.ibm.com/support/electronic

Terms and conditions

Volume Orders

Contact your IBM representative.

IBM Global Financing

Yes

Products - terms and conditions

Warranty period

The TS4500 tape library: One year

IBM LTO Ultrium and 3592 media: Warranted separately

An IBM part or feature installed during the initial installation of an IBM machine is subject to a full warranty effective on the date of installation of the machine. An IBM part or feature that replaces a previously installed part or feature assumes the remainder of the warranty period for the replaced part or feature. An IBM part or feature added to a machine without replacing a previously installed part or feature is subject to a full warranty effective on its date of installation. Unless specified otherwise, the warranty period, type of warranty service, and service level of a part or feature are the same as those for the machine in which it is installed.

Warranty service

If required, IBM provides repair or exchange service depending on the types of warranty service specified for the machine. IBM will attempt to resolve your problem over the telephone, or electronically via an IBM website. Certain machines contain remote support capabilities for direct problem reporting, remote problem determination, and resolution with IBM. You must follow the problem determination and resolution procedures that IBM specifies. Following problem determination, if IBM determines on-site service is required, scheduling of service will depend upon the time of your call, machine technology and redundancy, and availability of parts. If applicable to your product, parts considered Customer Replaceable Units (CRUs) will be provided as part of the machine's standard warranty service.

Service levels are response-time objectives and are not guaranteed. The specified level of warranty service may not be available in all worldwide locations. Additional charges may apply outside IBM's normal service area. Contact your local IBM representative or your reseller for country-specific and location-specific information.

On-site Service

IBM will repair the failing machine at your location and verify its operation. You must provide a suitable working area to allow disassembly and reassembly of the IBM machine. The area must be clean, well-lit, and suitable for the purpose.

Service level is:

- 24 hours per day, 7 days a week, same day response, IBM On-site Repair

Non-IBM parts service

Warranty service

IBM is now shipping machines with selected non-IBM parts that contain an IBM field replaceable unit (FRU) part number label. These parts are to be serviced during the IBM machine warranty period. IBM is covering the service on these selected non-IBM parts as an accommodation to their customers, and normal warranty service procedures for the IBM machine apply.

Warranty service upgrades

During the warranty period, warranty service upgrades provide an enhanced level of On-site Service for an additional charge. Service levels are response-time objectives and are not guaranteed. See the Warranty services section for additional details.

IBM will attempt to resolve your problem over the telephone or electronically by access to an IBM website. Certain machines contain remote support capabilities for direct problem reporting, remote problem determination, and resolution with IBM. You must follow the problem determination and resolution procedures that

IBM specifies. Following problem determination, if IBM determines on-site service is required, scheduling of service will depend upon the time of your call, machine technology and redundancy, and availability of parts.

Maintenance service options

On-site Service

IBM will repair the failing machine at your location and verify its operation. You must provide a suitable working area to allow disassembly and reassembly of the IBM machine. The area must be clean, well lit, and suitable for the purpose. The following on-site response-time objectives are available as warranty service upgrades for your machine. Available offerings are:

- 24 hours per day, 7 days a week, 4 hour average response

Maintenance services

If required, IBM provides repair or exchange service depending on the types of maintenance service specified for the machine. IBM will attempt to resolve your problem over the telephone or electronically, via an IBM website. Certain machines contain remote support capabilities for direct problem reporting, remote problem determination, and resolution with IBM. You must follow the problem determination and resolution procedures that IBM specifies. Following problem determination, if IBM determines on-site service is required, scheduling of service will depend upon the time of your call, machine technology and redundancy, and availability of parts. Service levels are response-time objectives and are not guaranteed. The specified level of maintenance service may not be available in all worldwide locations. Additional charges may apply outside IBM's normal service area. Contact your local IBM representative or your reseller for country-specific and location-specific information. The following service selections are available as maintenance options for your machine type.

IBM will repair the failing machine at your location and verify its operation. You must provide a suitable working area to allow disassembly and reassembly of the IBM machine. The area must be clean, well lit, and suitable for the purpose.

Service levels are:

- 9 hours per day, Monday through Friday, excluding holidays, next business day response
- 9 hours per day, Monday through Friday, excluding holidays, 4 hour average response
- 24 hours per day, 7 days a week, 4 hour average response
- 24 hours per day, 7 days a week, 2 hour average response

Non-IBM parts service

Under certain conditions, IBM provides services for selected non-IBM parts at no additional charge for machines that are covered under warranty service upgrades or maintenance services.

This service includes hardware problem determination (PD) on the non-IBM parts (for example, adapter cards, PCMCIA cards, disk drives, memory) installed within IBM machines and provides the labor to replace the failing parts at no additional charge.

If IBM has a Technical Service Agreement with the manufacturer of the failing part, or if the failing part is an accommodations part (a part with an IBM FRU label), IBM may also source and replace the failing part at no additional charge. For all other non-IBM parts, customers are responsible for sourcing the parts. Installation labor is provided at no additional charge, if the machine is covered under a warranty service upgrade or a maintenance service.

Usage plan machine

No

IBM hourly service rate classification

Two

When a type of service involves the exchange of a machine part, the replacement may not be new, but will be in good working order.

General terms and conditions

Field-installable features

Yes

Model conversions

No

Machine installation

Installation is performed by IBM. IBM will install the machine in accordance with the IBM installation procedures for the machine. In the United States, contact IBM at 1-800-IBM-SERV (426-7378). In other countries, contact the local IBM office.

Some features are designated as customer setup, and customers are responsible for installation according to the instructions IBM provides with the machine. Customer requests for installation of items not covered in the installation guide may be performed at IBM's hourly service rate designated for the machine.

Graduated program license charges apply

No

Licensed internal code and licensed machine code

This product does not contain Licensed Internal Code or Licensed Machine Code.

Other installed licensed code

IBM Machine Code is licensed for use by a customer on the IBM machine for which it was provided by IBM under the terms and conditions of the IBM License Agreement for Machine Code, to enable the machine to function in accordance with its specifications, and only for the capacity authorized by IBM and acquired by the customer. You can obtain the agreement at

- http://www.ibm.com/servers/eserver/support/machine_warranties/machine_code.html

Access to Machine Code updates is conditioned on entitlement and license validation in accordance with IBM policy and practice. IBM may verify entitlement through customer number, serial number, electronic restrictions, or any other means or methods employed by IBM in its discretion.

You may also obtain updated code by contacting your IBM representative.

If the machine does not function as warranted and your problem can be resolved through your application of downloadable Machine Code, you are responsible for downloading and installing these designated Machine Code changes as IBM specifies. If you would prefer, you may request IBM to install downloadable Machine Code changes; however, you may be charged for that service.

Educational allowance

A reduced charge is available to qualified education customers. The educational allowance may not be added to any other discount or allowance.

The educational allowance is 15% for the products in this announcement.

Prices

For additional information and current prices, contact your local IBM representative.

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
TS4500 HD2 Expansion Frame	3584	D25			
TS4500 Frame Control Assembly			1450	N	N
1st Quad Drive Mounting Kit			1521	N	N
2nd Quad Drive Mounting Kit			1522	N	N
3rd Quad Drive Mounting Kit			1523	N	N
4th Quad Drive Mounting Kit			1524	N	N
Web Camera Mounting Hardware			1530	N	N
HD CoD for D25			1649	N	N
2 Additional I/O Stations			1652	N	Y
Single Power Source Bifurcated Cable			1909	N	N
Power Distribution Units			1951	N	N
13 Meter LC-LC Fibre Cable			6013	N	N
25 Meter LC-LC Fibre Cable			6025	N	N
61 Meter LC-LC Fibre Cable			6061	N	N
Shipping and Handling D2x			AGG4	N	Y
OEM - No IBM Logo			7703	N	Y
Bull OEM Logo			7704	N	Y
3592 Cleaning Cartridge			8802	N	Y
Driveless Frame			9001	N	N
3588/3592 Field Install			9690	N	N
3592 E07/EH7 Plant Install			9692	N	Y
No Host Cables from Plant			9700	N	Y
Nema L6-30 Power Cord			9954	N	N
RS 3750DP Power Cord			9955	N	N
IEC 309 Power Cord			9956	N	N
PDL 4.3m Power Cord			9957	N	N
Korean 4.3m Power Cord			9958	N	N
Unterminated Power Cord			9959	N	N
Unterminated Power Cord - China			9966	N	N
Dual 4.3M Pwr Cord WT			9970	N	N
Dual 4.3M Pwr Cord Non-WT			9972	N	N
Dual 4.3M Pwr Cord Argentina			9976	N	N
Dual 4.3M Pwr Cord Brazil			9977	N	N
Dual 4.3M Pwr Cord Aust/NZ			9978	N	N
Dual 4.3M Pwr Cord Japan			9979	N	N
Dual 4.3M Pwr Cord China			9980	N	N
Dual 4.3M Pwr Cord Korea			9981	N	N
Dual 4.3M Pwr Cord Taiwan			9982	N	N
Dual 4.3M Pwr Cord So.Africa			9983	N	N
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight			9984	N	N
Dual 4.3M Power Cord Russellstoll Watertight			9985	N	N
Power Cord to adjacent frame PDUs			9989	N	N
Shipping and Handling - No charge			AG00	N	Y

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
TS4500 HD2 Expansion Frame	3584	D55			
TS4500 Frame Control Assembly			1450	N	N
1st Quad Drive Mounting Kit			1521	N	N
2nd Quad Drive Mounting Kit			1522	N	N
3rd Quad Drive Mounting Kit			1523	N	N
4th Quad Drive Mounting Kit			1524	N	N
Web Camera Mounting Hardware			1530	N	N
HD CoD for D55			1650	N	N
2 Additional I/O Stations			1652	N	N
Single Power Source Bifurcated Cable			1909	N	N
Power Distribution Units			1951	N	N
13 Meter LC-LC Fibre Cable			6013	N	N
25 Meter LC-LC Fibre Cable			6025	N	N
61 Meter LC-LC Fibre Cable			6061	N	N
Shipping and Handling D5x			AGG5	N	Y
OEM - No IBM Logo			7703	N	Y
Bull OEM Logo			7704	N	Y
Ultrium Cleaning Cartridge			8750	N	Y
Driveless Frame			9001	N	N
3588/3592 Field Install			9690	N	N
3588 F5A/F5C Plant Install			9695	N	Y
3588 F6A/F6C Plant Install			9697	N	Y
No Host Cables from Plant			9700	N	Y
Nema L6-30 Power Cord			9954	N	N
RS 3750DP Power Cord			9955	N	N
IEC 309 Power Cord			9956	N	N
PDL 4.3m Power Cord			9957	N	N
Korean 4.3m Power Cord			9958	N	N
Unterminated Power Cord			9959	N	N
Unterminated Power Cord - China			9966	N	N
Dual 4.3M Pwr Cord WT			9970	N	N
Dual 4.3M Pwr Cord Non-WT			9972	N	N
Dual 4.3M Pwr Cord Argentina			9976	N	N
Dual 4.3M Pwr Cord Brazil			9977	N	N
Dual 4.3M Pwr Cord Aust/NZ			9978	N	N
Dual 4.3M Pwr Cord Japan			9979	N	N
Dual 4.3M Pwr Cord China			9980	N	N
Dual 4.3M Pwr Cord Korea			9981	N	N
Dual 4.3M Pwr Cord Taiwan			9982	N	N
Dual 4.3M Pwr Cord So.Africa			9983	N	N
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight			9984	N	N
Dual 4.3M Power Cord Russellstoll Watertight			9985	N	N
Power Cord to adjacent frame PDUs			9989	N	N
Shipping and Handling - No charge			AG00	N	Y

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
TS4500 HD2 Base Frame	3584	L25			
Library & Drive Code Update			0500	Y	N
Multi-frame Network			1460	N	N
1st Quad Drive Mounting Kit			1521	N	N
2nd Quad Drive Mounting Kit			1522	N	N
3rd Quad Drive Mounting Kit			1523	N	N
4th Quad Drive Mounting Kit			1524	N	N
Web Camera Mounting Hardware			1530	N	N
Intermed. Cap. On Demand			1643	N	N
Base Capacity on Demand			1644	N	N
HD CoD for L25			1647	N	N
Path Failover			1682	N	N

Description	Feature number	Field Install only	Plant Install only
1-2 Frame X-Track Cable	1802	Y	N
3-6 Frame X-Track Cable	1806	Y	N
Overhead Access Ladder	1856	N	N
Single Power Source Bifurcated Cable	1909	N	N
Power Distribution Units	1951	N	N
IMC Non-Broadband Call Home	2735	N	N
13 Meter LC-LC Fibre Cable	6013	N	N
25 Meter LC-LC Fibre Cable	6025	N	N
61 Meter LC-LC Fibre Cable	6061	N	N
Shipping and Handling L2x	AGG2	N	Y
OEM - No IBM Logo	7703	N	Y
Bull OEM Logo	7704	N	Y
3592 Cleaning Cartridge	8802	N	Y
Driveless Frame	9001	N	N
First Expansion Frame Attch	9002	N	N
Add Expansion Frame Attch	9003	N	N
Attached to HP-UX System	9210	N	Y
Attached to Solaris System	9211	N	Y
Attached to Windows System	9212	N	Y
Attached to Other Non-IBM System	9213	N	Y
Attached to Linux System	9215	N	Y
Attached to HPSS	9218	N	Y
Attached to i5/OS or OS/400	9400	N	Y
Attach to AIX System	9600	N	Y
3588/3592 Field Install	9690	N	N
3592 E07/EH7 Plant Install	9692	N	Y
No Host Cables from Plant	9700	N	Y
IMC Broadband Call Home	9735	N	N
Nema L6-30 Power Cord	9954	N	N
RS 3750DP Power Cord	9955	N	N
IEC 309 Power Cord	9956	N	N
PDL 4.3m Power Cord	9957	N	N
Korean 4.3m Power Cord	9958	N	N
Unterminated Power Cord	9959	N	N
Unterminated Power Cord - China	9966	N	N
Dual 4.3M Pwr Cord WT	9970	N	N
Dual 4.3M Pwr Cord Non-WT	9972	N	N
Dual 4.3M Pwr Cord Argentina	9976	N	N
Dual 4.3M Pwr Cord Brazil	9977	N	N
Dual 4.3M Pwr Cord Aust/NZ	9978	N	N
Dual 4.3M Pwr Cord Japan	9979	N	N
Dual 4.3M Pwr Cord China	9980	N	N
Dual 4.3M Pwr Cord Korea	9981	N	N
Dual 4.3M Pwr Cord Taiwan	9982	N	N
Dual 4.3M Pwr Cord So.Africa	9983	N	N
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight	9984	N	N
Dual 4.3M Power Cord Russellstoll Watertight	9985	N	N
Power Cord to adjacent frame PDUs	9989	N	N
Shipping and Handling - No charge	AG00	N	Y

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
TS4500 HD2 Base Frame	3584	L55			
Library & Drive Code Update			0500	Y	N
Multi-frame network			1460	N	N
1st Quad Drive Mounting Kit			1521	N	N
2nd Quad Drive Mounting Kit			1522	N	N
3rd Quad Drive Mounting Kit			1523	N	N
4th Quad Drive Mounting Kit			1524	N	N
Web Camera Mounting Hardware			1530	N	N
Transparent LTO Encryption			1604	N	N
Intermed. Cap. On Demand			1643	N	N
Base Capacity on Demand			1644	N	N
HD CoD for L55			1648	N	N
Path Failover			1682	N	N

Description	Feature number	Field Install only	Plant Install only
1-2 Frame X-Track Cable	1802	Y	N
3-6 Frame X-Track Cable	1806	Y	N
Overhead Access Ladder	1856	N	N
Single Power Source Bifurcated Cable	1909	N	N
Power Distribution Units	1951	N	N
IMC Non-Broadband Call Home	2735	N	N
13 Meter LC-LC Fibre Cable	6013	N	N
25 Meter LC-LC Fibre Cable	6025	N	N
61 Meter LC-LC Fibre Cable	6061	N	N
Shipping and Handling L5x	AGG3	N	Y
OEM - No IBM Logo	7703	N	Y
Bull OEM Logo	7704	N	Y
Ultrium Cleaning Cartridge	8750	N	Y
Driveless Frame	9001	N	N
First Expansion Frame Attch	9002	N	N
Add Expansion Frame Attch	9003	N	N
Attached to HP-UX System	9210	N	Y
Attached to Solaris System	9211	N	Y
Attached to Windows System	9212	N	Y
Attached to Other Non-IBM System	9213	N	Y
Attached to Linux System	9215	N	Y
Attached to HPSS	9218	N	Y
Attached to i5/OS or OS/400	9400	N	Y
Attach to AIX System	9600	N	Y
3588/3592 Field Install	9690	N	N
3588 F5A/F5C Plant Install	9695	N	Y
3588 F6A/F6C Plant Install	9697	N	Y
No Host Cables from Plant	9700	N	Y
IMC Broadband Call Home	9735	N	N
Nema L6-30 Power Cord	9954	N	N
RS 3750DP Power Cord	9955	N	N
IEC 309 Power Cord	9956	N	N
PDL 4.3m Power Cord	9957	N	N
Korean 4.3m Power Cord	9958	N	N
Unterminated Power Cord	9959	N	N
Unterminated Power Cord - China	9966	N	N
Dual 4.3M Pwr Cord WT	9970	N	N
Dual 4.3M Pwr Cord Non-WT	9972	N	N
Dual 4.3M Pwr Cord Argentina	9976	N	N
Dual 4.3M Pwr Cord Brazil	9977	N	N
Dual 4.3M Pwr Cord Aust/NZ	9978	N	N
Dual 4.3M Pwr Cord Japan	9979	N	N
Dual 4.3M Pwr Cord China	9980	N	N
Dual 4.3M Pwr Cord Korea	9981	N	N
Dual 4.3M Pwr Cord Taiwan	9982	N	N
Dual 4.3M Pwr Cord So.Africa	9983	N	N
Dual 4.3M Power Cord NEMA L6-20 Non-Watertight	9984	N	N
Dual 4.3M Power Cord Russellstoll Watertight	9985	N	N
Power Cord to adjacent frame PDUs	9989	N	N
Shipping and Handling - No charge	AG00	N	Y

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
TS4500 HD2 Expansion Frame	3584	S25,S55			
Web Camera Mounting Hardware			1530	N	N
HD COD for S24/S25			1645	N	N
HD COD for S54/S55			1646	N	N
Power Distribution Units			1951	N	N
Shipping and Handling S2x			AGG6	N	Y
Shipping and Handling S5x			AGG7	N	Y
OEM - No IBM Logo			7703	N	Y
Bull OEM Logo			7704	N	Y
Nema L6-30 Power Cord			9954	N	N
RS 3750DP Power Cord			9955	N	N
IEC 309 Power Cord			9956	N	N

```
PDL 4.3m Power Cord           9957    N       N
Korean 4.3m Power Cord        9958    N       N
Unterminated Power Cord       9959    N       N
Unterminated Power           9966    N       N
 Cord - China
Shipping and Handling        AG00    N       Y
 - No charge
```

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
Top Rack Option	3584	TR1			
End Covers			1750	N	N
Power Distribution Unit			1751	N	N
Shipping and Handling SC1/TR1			AGG9	N	Y
Nema L6-30 Power Cord			9954	N	N
RS 3750DP Power Cord			9955	N	N
IEC 309 Power Cord			9956	N	N
PDL 4.3m Power Cord			9957	N	N
Korean 4.3m Power Cord			9958	N	N
Unterminated Power Cord			9959	N	N
Unterminated Power Cord - China			9966	N	N
Shipping and Handling - No charge			AG00	N	Y

Description	Machine type	Model	Feature number	Field Install only	Plant Install only
HD2 Frame	3584	S24,S54	9051	N	Y

If field installed on a purchased machine, parts removed or replaced become the property of IBM and must be returned.

Model numbers	Feature number	Customer Setup	MES removal	MES removal charge
L25, L55	0500	N	N	N
D25, D55	1450	N	Y	Y
L25, L55	1460	N	Y	Y
D25, D55, L25, L55	1521	N	Y	Y
D25, D55, L25, L55	1522	N	Y	Y
D25, D55, L25, L55	1523	N	Y	Y
D25, D55, L25, L55	1524	N	Y	Y
D25, D55, L25, L55, S25, S55	1530	N	Y	Y
L55	1604	Y	Y	Y
L25, L55	1643	Y	Y	Y
L25, L55	1644	Y	Y	Y
S25	1645	Y	Y	Y
S55	1646	Y	Y	Y
L25	1647	Y	Y	Y
L55	1648	Y	Y	Y
D25	1649	Y	Y	Y
D55	1650	Y	Y	Y
D25, D55	1652	Y	Y	Y
L25, L55	1682	Y	Y	Y
TR1	1750	N	Y	Y
TR1	1751	N	Y	Y
L25, L55	1802	N	Y	Y
L25, L55	1806	N	Y	Y
L25, L55	1856	N	Y	Y
L25, L55, D25, D55	1909	N	Y	Y

D25, D55, L25, L55, S25, S55	1951	N	Y	Y
L25, L55	2735	N	Y	Y
D25, D55, L25, L55	6013	Y	Y	Y
D25, D55, L25, L55	6025	Y	Y	Y
D25, D55, L25, L55	6061	Y	Y	Y
D55, L55	8750	N	Y	Y
D25, L25	8802	N	Y	Y
D25, D55, L25, L55	9001	N	Y	Y
L25, L55	9002	N	Y	Y
L25, L55	9003	N	Y	Y
L25, L55	9210	N	N	N
L25, L55	9211	N	N	N
L25, L55	9212	N	N	N
L25, L55	9213	N	N	N
L25, L55	9215	N	N	N
L25, L55	9218	N	N	N
L25, L55	9400	N	N	N
L25, L55	9600	N	N	N
D25, D55, L25, L55	9690	N	Y	Y
L25, L55	9692	N	Y	Y
L25, L55	9695	N	Y	Y
D55, L55	9697	N	Y	Y
D25, D55, L25, L55	9700	N	N	N
L25, L55	9735	N	Y	Y
D25, D55, L25, L55, S25, S55	9954	N	N	N
D25, D55, L25, L55, S25, S55	9955	N	N	N
D25, D55, L25, L55, S25, S55	9956	N	N	N
D25, D55, L25, L55, S25, S55	9957	N	N	N
D25, D55, L25, L55, S25, S55	9958	N	N	N
D25, D55, L25, L55, S25, S55	9959	N	N	N
D25, D55, L25, L55, S25, S55	9966	N	N	N
D25, D55, L25, L55	9970	N	N	N
D25, D55, L25, L55	9972	N	N	N
D25, D55, L25, L55	9976	N	N	N
D25, D55, L25, L55	9977	N	N	N
D25, D55, L25, L55	9978	N	N	N
D25, D55, L25, L55	9979	N	N	N
D25, D55, L25, L55	9980	N	N	N
D25, D55, L25, L55	9981	N	N	N
D25, D55, L25, L55	9982	N	N	N
D25, D55, L25, L55	9983	N	N	N
D25, D55,	9984	N	N	N

```
L25, L55
D25, D55,          9985       N       N       N
L25, L55
D25, D55,          9989       N       N       N
L25, L55
```

If field installed on a purchased machine, parts removed or replaced become the property of IBM and must be returned.

For additional information and current prices, contact your local IBM representative.

Alternative service

ICA Maintenance

```
                        IOR
                    IBM same day
  Machine           On-site Repair
  Type-Model-Feature (IOR, 24 x 7)

  3584-D25
  3584-D55
  3584-L25
  3584-L55
  3584-S25
  3584-S55
  3584-TR1
```

ServiceElect (ESA) charges

For ServiceElect (ESA) maintenance service charges, contact IBM Global Services at 888-IBM-4343 (426-4343).

IBM Global Financing

IBM Global Financing offers competitive financing to credit-qualified customers to assist them in acquiring IT solutions. Offerings include financing for IT acquisition, including hardware, software, and services, from both IBM and other manufacturers or vendors. Offerings (for all customer segments: small, medium, and large enterprise), rates, terms, and availability can vary by country. Contact your local IBM Global Financing organization or visit

   http://www.ibm.com/financing

IBM Global Financing offerings are provided through IBM Credit LLC in the United States, and other IBM subsidiaries and divisions worldwide to qualified commercial and government customers. Rates are based on a customer's credit rating, financing terms, offering type, equipment type, and options, and may vary by country. Other restrictions may apply. Rates and offerings are subject to change, extension, or withdrawal without notice.

Financing solutions from IBM Global Financing can help you stretch your budget and affordably acquire the new product. But beyond the initial acquisition, our end-to-end approach to IT management can also help keep your technologies current, reduce costs, minimize risk, and preserve your ability to make flexible equipment decisions throughout the entire technology life cycle.

Order now

To order, contact the Americas Call Centers or your local IBM representative, or your IBM Business Partner.

To identify your local IBM representative or IBM Business Partner, call 800-IBM-4YOU (426-4968).

```
Phone:      800-IBM-CALL (426-2255)
Fax:        800-2IBM-FAX (242-6329)
For IBM representative: callserv@ca.ibm.com
For IBM Business Partner: pwcs@us.ibm.com
Mail:       IBM Teleweb Customer Support
            ibm.com® Sales Execution Center, Americas North
            3500 Steeles Ave. East, Tower 3/4
            Markham, Ontario
            Canada
            L3R 2Z1
```

Reference: YE001

The Americas Call Centers, our national direct marketing organization, can add your name to the mailing list for catalogs of IBM products.

Note: Shipments will begin after the planned availability date.

Trademarks

Linear Tape File System, Power Systems, i5/OS and Electronic Service Agent are trademarks of IBM Corporation in the United States, other countries, or both.

IBM, Tivoli, System i, System p, System x, System z, System Storage, Magstar, OS/400, AIX, Global Technology Services and ibm.com are registered trademarks of IBM Corporation in the United States, other countries, or both.

Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, and service names may be trademarks or service marks of others.

Terms of use

IBM products and services which are announced and available in your country can be ordered under the applicable standard agreements, terms, conditions, and prices in effect at the time. IBM reserves the right to modify or withdraw this announcement at any time without notice. This announcement is provided for your information only. Additional terms of use are located at:

   http://www.ibm.com/legal/us/en/

For the most current information regarding IBM products, consult your IBM representative or reseller, or visit the IBM worldwide contacts page

   http://www.ibm.com/planetwide/us/