IBM System Storage TS2900 Tape Autoloader

The IBM System Storage TS2900 Tape Autoloader (Machine Type 3572) provides compact high-capacity low-cost solutions for simple unattended data backup. The library has a compact 1U form factor with easy access to tape cartridges via a removable magazine. The IBM System Storage TS2900 Tape Autoloader is an external stand-alone or rack-mountable unit that incorporates an IBM Ultrium 3 or Ultrium 4 Half-High Tape Drive. It is equipped with a Serial Attached SCSI (SAS) host adapter attachment that has a data transfer rate of up to 3.0 Gbps.

The IBM System Storage TS2900 Tape Autoloader has a removable cartridge magazine providing 9 data cartridge slots including a configurable 2-slot I/O Station. IBM System Storage TS2900 Tape Autoloader is an entry point for IBM LTO tape automation. This autoloader uses the IBM patented high density (HD) slot technology.

Standard features include:
► Application-Managed Encryption (with LTO4)
► Barcode Reader
► LCD display for local management
► Web Guided User Interface (GUI) for remote management
► Configurable I/O Station
► Removable magazine with IBM patented HD Slot technology

Optional features include the following:
► Transparent System-Managed and Library-Managed Encryption
► Choice of rack-mount or desktop packaging

For the reminder of this chapter we will use the terms TS2900 or TS2900 Tape Autoloader as abbreviations of the IBM System Storage TS2900 Tape Autoloader.
7.1 Description

The IBM System Storage TS2900 Tape Autoloader (Machine Type 3572 1U Autoloader) supports one LTO3 or one LTO4 Half-High tape drives.

Two models are available for TS2900:

- **3572-S4H**, it comes with a Ultrium 4 Half-High Tape Drive that has a SAS interface, which has a native data transfer rate of up to 3 Gbps. The SAS Ultrium 4 Tape Drive comes with an SFF-8088 interface. The Ultrium 4 Tape Drive provides a sustained native data transfer rate of 120 MB/s.

- **3572-S3H**, it comes with a Ultrium 3 Half-High Tape Drive that has a SAS attachment. The Ultrium 3 Half-High Tape Drive has a maximum native data transfer rate of up to 60 MB/s.

**Note:** The IBM System Storage TS2900 Tape Autoloader comes ready to be mounted in a standard 19 inch rack. Feature code 7006 must be ordered which provides the rack mounting hardware. If you want to install the TS2900 as a desk-side feature code 7010 must be ordered that provide you the adequate covers.

Cartridge supported in the IBM System Storage TS2900 Tape Autoloader include:

- IBM LTO Tape Cartridge (Ultrium 4)-800 GB native physical capacity
- IBM LTO Tape Cartridge (Ultrium 3)-400 GB native physical capacity
- IBM LTO Tape Cartridge (Ultrium 2)-200 GB native physical capacity
- IBM LTO Tape Cartridge (Ultrium 1)-100 GB native physical capacity
- WORM cartridges

Note that cartridge support is dependent on the tape drive installed in the TS2900. Only the cartridge types supported by the LTO3 or LTO4 drive installed are also supported in the TS2900.

The library media capacity can be further increased using hardware compression (2:1 compression factor). The library supports the movement of any media generation in any slot or drive. It is set up to the host application to limit any operations that may result in unsupported media issues.

The TS2900 has a 3 Gbps single-port SFF-8088 SAS connector. This is the same connector as for all of the other IBM tape products supporting the SAS interface. The drive is integrated into the library. There is no drive Field Replacement Unit (FRU) or Customer Replacement Unit (CRU) because the entire library is a CRU.

Designed for tape automation, the TS2900 Tape Autoloader can be attached to IBM System i or i5, iSeries, AS/400, IBM System p or p5, pSeries, RS/6000, IBM z or z9™, xSeries, Hewlett-Packard (HP), Sun, UNIX, and PC servers. To determine the latest supported servers, visit the Web at:


The IBM Ultrium 4 LTO Tape Drive with a Fibre Channel or a SAS interface is encryption capable. The IBM LTO4 Tape Drive supports Application-Managed Encryption (AME), System-Managed Encryption (SME), and Library-Managed Encryption (LME).

Depending on what IBM Ultrium Tape Drive is installed in the TS2900 the following Data Cartridges can be used:

- The TS2900 uses the IBM TotalStorage LTO Ultrium 400 GB Data Cartridge or the 400 GB WORM cartridge when the IBM Ultrium 3 Tape Drive is installed. The Ultrium 3 Tape Drive
has the capability of writing up to 400 GB native capacity and up to 800 GB with 2:1 compression. IBM Ultrium 3 Tape Drives can read and write LTO Ultrium 2 Data Cartridges and read LTO1 data cartridges.

- The TS2900 uses the IBM TotalStorage LTO Ultrium 800 GB Data Cartridge or 800 GB WORM Cartridge when the IBM Ultrium 4 Tape Drive is installed. The Ultrium 4 Tape Drive has the capability of writing up to 800 GB native capacity and up to 1600 GB with 2:1 compression. IBM Ultrium 4 Tape Drives can read and write LTO Ultrium 3 Data Cartridges, can read Ultrium 2 Data Cartridges, and does not support Ultrium 1 Data Cartridges.

The library has a capacity of 9 tape cartridges, providing a media capacity of up to 9.6 TB (19.2 TB with 2:1 compression) data storage per TS2900.

Figure 7-1 shows the front view of the TS2900. On the front side, you see the cartridge magazine. The I/O slot is accessible from the lower left.

![Figure 7-1 IBM System Storage TS2900 Tape Autoloader](image)

### 7.2 TS2900 characteristics

The TS2900 Tape Autoloader has an improved robotic system that moves along an axis from front to back between the cartridge magazine. This limited movement provides robust robotics. The standard barcode reader is installed on the picker.

#### 7.2.1 Components

TS2900 Tape Autoloader houses a Cartridge Magazine, Operator Panel, Accessor, Library Controller Card, Power supply, and a Half-High Tape Drive:

Figure 7-2 shows the top view of the TS2900. The right side of the image is the rear of the library and the left side is the front of the TS2900. The TS2900 Tape Autoloader is not a modular system and not allow you to change parts.
The components shown in Figure 7-2 are:

1. **Cartridge magazine:** This magazine can hold up to 9 cartridges and houses the I/O slot, for a total of 10 slots. The front slot of the first column in the cartridge magazine can be configured as an I/O Station or cleaning slots. The back slot of the first column of the cartridge magazine is used as the exchange slot. The I/O Station is used to import and export cartridges without interrupting normal library operation. Cleaning cartridges are used to clean the tape drive heads.

2. **Accessor:** This component contains the library robot and the barcode reader. The accessor moves cartridges to and from the

3. **Library Control Board:** The library control board manages the entire library, including the Operator Panel and Accessor, and is responsible for monitoring the library to ensure that the library is functioning properly. It stores vital product data (VPD) such as library settings, serial number, library logs, and Accessor calibration backup data.

4. **Power Supply:** The power supply is the sole source of power for the library.

5. **Tape Drive:** This library supports the Ultrium 3 or Ultrium 4 tape drive. The tape drive in the library is packaged in a container called a *drive sled*. The drive sled is not a CRU.

**Note:** Because there is no need to open the top cover of the TS2900, you should not remove it. No customer serviceable components are inside the library. The whole library is a CRU. IBM provide you a replacement of the TS2900 Tape Autoloader in case of defect.

In the following Figure 7-3 we show you the components viewed from the rear of the TS2900 Tape Autoloader.
Figure 7-3  TS2900 Tape Autoloader rear panel components

The components shown in Figure 7-3 are:

1. **Power connector**: Here in this connector the library connects to a 110/220 volt Ac power supply.

2. **Power switch**: The library is powered ON when the power supply switch on the rear panel is ON. The library has no independent power switch on the front panel.

3. **SAS Connection**: Here is the Serial Attached SCSI host interface cable connection. The Ultrium 3 and the Ultrium 4 SAS drive use the SFF-8088 connection at the drive end and the SFF-8088 or SFF-8470 at the host adapter end.

4. **Ethernet Port**: Here in this port the customer connect the library to the network.

5. **Shipping Lock screw**: The shipping lock screw is used to restrain the accessor robot assembly during transportation. Store the shipping lock screw in the storage slot on the rear panel of the library and cover with the label for future use.

6. **Air vent**: These vents allow air to escape from the power supply and tape drive sled.

### 7.2.2 Operator Control Panel

The library is equipped with an Operator Control Panel (OCP). By means of the OCP a user can perform simple actions with the media changer. The OCP interface allows a user to monitor the media changer operation, make configuration changes and perform media access commands.

**Note**: When a user executes a medium access command through the OCP interface the media changer will enter the off-line state. When the media changer is off-line the media changer will report Not Ready on the SCSI bus.

For media changer SCSI command refer to *IBM System Storage TS2900 SCSI Reference, GC27-2211*.

**The Operator Control Panel interface**

The Operator Panel is located on the front of the library and allows users to work locally on the library. The Operator Panel features a monochrome 16-character LCD graphic display. Library operations and service functions are performed from this screen. The Web User Interface allows users and administrators to view and perform some library functions from remote sites.
Figure 7-4 shows the level menu tree structure of the Operator Panel on the front of the TS2900 Tape Library. For an extensive description of the OCP functions please refer to the OCP specification in *IBM System Storage TS2900 Tape Autoloader Setup, Operator, and Service Guide*, GC27-2212.

### 7.2.3 Robotics

The IBM System Storage TS2900 Tape Autoloader uses a new independent tape loader, threader motors and a 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.

### 7.2.4 Bar Code Reader

The bar code reader is an integral part of the library Accessor. The bar code reader reads each cartridge bar code label and the fiducial labels that identify the types of cartridge magazines and tape drive installed in the library and provides inventory feedback to the host application, Operator Panel, and Web User Interface.

The library stores the customized inventory data in memory. The code for this library supports an 8 or more character volume serial number (VOLSER) on the bar code label on the tape cartridge. This library does not support a 6-character VOLSER.

### 7.2.5 Cartridge storage

The TS2900 Tape Autoloader has one removable magazine with 10 cartridge slots. The slots are organized as five High Density (HD) slots (2 x 5 = 10) but one of the ten slots is reserved for library swap space, so the magazine has a total user capacity of 9 cartridges.

When the magazines are filled with cartridges you can log in the TS2900 using the Web UI to look at which cartridges are stored and in which storage slot location as demonstrated in Figure 7-5 on page 161.
Left part of the magazine is the I/O station. You can use the Web User Interface to show a library map of the magazine as shown in Figure 7-5.

The I/O station is part of the magazine. You can open the I/O station using the OCP.

7.3 IBM Ultrium LTO Half-High Tape Drives

TS2900 Tape Autoloader houses LTO4 HH Tape Drive or LTO3 HH Tape Drive. In this section, we describe some of the highlights of the Half-High Ultrium 4 and the Half-High Ultrium 3 tape drives. The TS2900 Tape Autoloader might be an ideal tape autoloader for small clients who want to have a reliable tape drive with LTO technology. Most of the functions we summarize in this section are common between the LTO3 and the LTO4, but they differ in performances characteristics.

7.3.1 LTO4 Half-High Tape Drive

In the following topics, we show you the characteristics of the LTO4 Half-High Tape Drive. For additional details you may refer to “IBM LTO4 Half-High (HH) Tape Drive” on page 76.

Performance highlights

The TS2900 Tape Autoloader incorporates fourth-generation of IBM Half-High Ultrium 4 tape drive technology. It offers the following significant improvements over the Half-High Ultrium 3 tape drive in terms of performance. The maximum tape drive throughput data rate is up to 120 MB/s of native data transfer rate. Data tracks are written 16 at a time.
Servo and track layout technology
There are 896 data tracks in Ultrium 4 versus 704 data tracks in Ultrium 3, used to read and write data to the data cartridge. These tracks are grouped in five servo bands as explained in “Servo tracks” on page 35. 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.

Dynamic speed matching
The Ultrium 4 Half-High Tape Drive is designed to perform dynamic speed matching (at one of seven speeds, 31 to 120 MB/s) to adjust the tape drives native data rate as closely as possible to the net host data rate (after data compressibility has been factored out). Speed matching on the Ultrium 4 Half-High model ranges from 31 to 120 MB/s versus 30 to 60 MB/s on Ultrium 3 Half-High Tape Drives. There is a 256 MB internal data buffer in the Ultrium 4 Tape Drive versus the 128 MB internal data buffer in the Ultrium 3 Tape Drive.

Surface Control Guiding Mechanism
The IBM patented Surface Control Guiding Mechanism is designed to guide the tape along the tape path in the IBM Ultrium LTO Tape Drive. This method uses the surface of the tape, rather than the edges, to control tape motion. Ultrium 4 and Ultrium 3 Half-High Tape Drives use Surface Control Guiding Mechanism.

Channel calibration
The channel calibration feature of the Ultrium 4 Tape Drive and on the Ultrium 3 Tape Drive customizes each Read/Write data channel for optimum performance. The customization enables compensation for variations in the recording channel transfer function, media characteristics, and Read/Write head characteristics.

Magneto resistive head design
Magneto resistive (MR) head design, which uses flat lap head technology in the MR heads for Ultrium 4, helps minimize contact, debris accumulation, and wear on the tape as it moves over the Read/Write heads.

Separate writing of multiple filemarks
Separate writing of multiple filemarks is designed to request 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 has two advantages:

1. It helps improve performance if a subsequent append overwrites somewhere after the first filemark.
2. Write of multiple filemarks typically indicates a point where an append operation might occur after the first of these filemarks.

This change helps prevent having to rewrite data sets containing customer data and the first filemark if such an append occurs.

Note: Although the TS2900 Tape Autoloader provides the capability for excellent tape performance, other components of the system may limit the actual performance achieved. Also, 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.
Sleep mode
To save energy, the LTO4 and LTO3 tape drives use a feature called *sleep mode*. To enter sleep mode, the tape drive must be inactive for a minimum of 30 seconds. The tape drive will go out of this sleeping mode again after receiving a SCSI command, a command across the Library/Drive interface (LDI or RS-422), or on a load or unload request. When in sleep mode, the drive response time to commands that do not require media motion increases by up to ten microseconds. Commands that require media motion might be delayed an additional 100 milliseconds, because the tape must be re-tensioned.

Statistical Analysis and Reporting System (SARS)
The Ultrium 4 Half-High Tape Drive and the Ultrium 3 Half-High Tape Drive use SARS to help isolate failures between media and hardware. The SARS uses the data cartridge performance history saved in the Cartridge Memory (CM) module and the drive performance history kept in the drive flash Electronically Erasable Programmable Read-Only Memory (EEPROM) to help determine the likely cause of the failure. SARS can cause the drive to request a cleaning tape, to mark the media as degraded, and to indicate that the hardware has degraded. When a drive dump is taken from the drive, the Support Center can determine if the failure is in the Tape Drive itself or on the Data Cartridge. SARS is also used in the Ultrium 3 Half-High Tape Drive.

7.3.2 LTO3 Half-High Tape Drive

Following in this section, we summarize the main characteristics of the Half-High Ultrium 3 tape drives. Most of the functions are similar to the Ultrium 4 Half-High Tape Drive described in session 7.3.1, “LTO4 Half-High Tape Drive” on page 161. For additional informations related to the LTO3 Half-High Tape Drive refer to 2.3.2, “IBM LTO3 Half-High (HH) Tape Drive” on page 72. Characteristics are the following:

**Servo and track layout technology:** The Ultrium 3 Half-High Tape Drive use 704 data tracks to read and write data to the data cartridge.

**Dynamic speed matching:** The Ultrium 3 Tape drive is designed to perform *dynamic speed matching* (at one of four speeds of 30, 40, 50, or 60 MB/s) to adjust the tape drives native data rate as closely as possible to the net host data rate (after data compressibility has been factored out). This helps the number of backhitch repositions and improves throughput performance.

**Surface Control Guiding Mechanism:** This function has been designed to guide the tape along the tape path. This is the same function as per LTO4 HH Tape Drive.

**Channel calibration:** The channel calibration feature of the Ultrium 3 Tape Drive customizes each Read/Write data channel for optimum performance.

**Magneto resistive (MR):** This is a head design which uses flat lap head technology in the MR heads for Ultrium 3.

**Separate writing of multiple filemarks:** This function is designed to request any write command of two or more filemarks to cause a separate data set to be written containing all filemarks after the first.

**Sleep mode:** The Ultrium 3 Half-High Tape Drive has a power management function that is designed to control the drive electronics to be either completely turned off or stay in low-power mode when the circuit functions are not needed for drive operation.
Statistical Analysis and Reporting System (SARS): The Ultrium 3 Half-High Tape Drive use SARS to help isolate failures between the media and the hardware.

7.4 Physical attachments

The TS2900 Tape Autoloader is only available with Serial Attached SCSI (SAS) interface that has data rate of 3 Gbps.

7.4.1 SAS interface

The IBM Ultrium 4 SAS Half-High and the IBM Ultrium 3 SAS Half-High Tape Drives installed into TS2900 comes with one SFF-8088 interface on the back of the tape drive. For a more detailed description of SAS, see “Serial-Attached SCSI” on page 56.

At the time of writing, two HBAs were supported:
- LSI Logic SAS3800X
- IBM SAS HBA Controller model 25R8060

Figure 7-6 show the back side of the SAS Half-High Tape Drive with one SFF-8088 interface. The TS2900 SAS port is shown in Figure 7-3 on page 159.

Figure 7-6  Back side of the SAS Half-High Tape Drive

No terminator is needed, because the SCSI bus is automatically terminated.

7.4.2 Persistent binding

When you boot a server, it discovers devices and assigns them SCSI target and LUN IDs. It is possible for these SCSI assignments to change between reboots. Certain operating systems do not guarantee that devices are always allocated the same SCSI target ID after rebooting. Also, some software depends on this association, so you do not want it to change. Persistent binding addresses the issue of SCSI ID assignment.

Persistent binding is an HBA function that allows a subset of discovered targets to be bound between a server and device. Implemented by a worldwide node name (WWNN) or worldwide port name (WWPN), persistent binding causes a tape drives worldwide name (WWN) to be bound to a specific SCSI target ID.

After a configuration has been set, it survives reboots and any hardware configuration changes because the information is preserved. If a drive needs to be replaced, the new drive assumes the WWNN of the old drive because the WWNN for the drive is location-dependent within the library. Because the WWNN does not change, persistent binding does not need to be changed, which causes an outage.

You can find additional information about persistent binding in Implementing IBM Tape in UNIX Systems, SG24-6502, and Implementing IBM Tape in Linux and Windows, SG24-6268.
7.5 LTO data cartridges

When processing the Ultrium Tape Cartridge, the Ultrium Tape Drive uses a linear, serpentine recording format. The Ultrium 3 drive reads and writes data on 704 tracks, sixteen tracks at a time, and the Ultrium 4 tape drive writes data on 896 tracks. The first set of tracks is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the cartridge is full, or until all data is written. Refer to “Tape cartridge” on page 42 for more details.

To ensure that your IBM Ultrium Tape Drive conforms to the IBM specifications for reliability, use only IBM LTO Ultrium tape cartridges. The IBM TotalStorage LTO Ultrium 400 GB and 800 GB Data Cartridge cannot be interchanged with the media used in other IBM non-LTO Ultrium tape products.

The native data capacity of Ultrium data cartridges is listed in Table 7-1.

Table 7-1   Native capacity

<table>
<thead>
<tr>
<th>Data cartridge</th>
<th>Native data capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrium 4 WORM</td>
<td>800 GB (1600 GB at 2:1 compression)</td>
</tr>
<tr>
<td>Ultrium 3 WORM</td>
<td>400 GB (800 GB at 2:1 compression)</td>
</tr>
<tr>
<td>Ultrium 4</td>
<td>800 GB (1600 GB at 2:1 compression)</td>
</tr>
<tr>
<td>Ultrium 3</td>
<td>400 GB (800 GB at 2:1 compression)</td>
</tr>
<tr>
<td>Ultrium 2</td>
<td>200 GB (400 GB at 2:1 compression)</td>
</tr>
<tr>
<td>Ultrium 1</td>
<td>100 GB (200 GB at 2:1 compression)</td>
</tr>
</tbody>
</table>

7.5.1 Cartridge compatibility

Table 7-2 on page 165 show you the compatibility matrix among the four types of Ultrium cartridges.

Table 7-2    Ultrium data cartridge compatibility

<table>
<thead>
<tr>
<th>IBM Ultrium Tape Drive</th>
<th>IBM TotalStorage LTO Ultrium Data Cartridge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>800 GB (Ultrium 4) 400 GB (ultrium 3) 200 GB (Ultrium 2) 100 GB (Ultrium 1)</td>
</tr>
<tr>
<td>Ultrium 4</td>
<td>Read/Write                  Read/Write          Read only                 N/A</td>
</tr>
<tr>
<td>Ultrium 3</td>
<td>N/A                         Read/Write          Read only</td>
</tr>
<tr>
<td>Ultrium 2</td>
<td>N/A                         N/A                  Read/Write          Read/Write</td>
</tr>
<tr>
<td>Ultrium 1</td>
<td>N/A                         N/A                  N/A                  Read/Write</td>
</tr>
</tbody>
</table>

Capacity scaling

To control the capacity of the cartridge (for example, to obtain a faster seek time) issue the SCSI command SET CAPACITY. For information about this command, refer to the IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference.
7.5.2 Write Once Read Many (WORM)

Certain records retention and data security applications require a Write Once Read Many (WORM) method for storing data on tape. To meet this data storage requirement, a new WORM feature is available on IBM LTO Ultrium generation 3 drives. You can enable the WORM feature by upgrading to WORM-capable drive firmware and using a special WORM tape cartridge.

WORM Media

A specially formatted WORM tape cartridge is required, because standard Read/Write media are incompatible with the WORM feature. Each WORM cartridge has a unique, worldwide cartridge identifier (WWCID), which comprises the unique Cartridge Memory (CM) chip serial number and the unique tape media serial number.

Data security on WORM media

Certain built-in security measures help ensure that the data written on a WORM cartridge does not become compromised, for example:

► The format of an IBM Ultrium 3 and Ultrium 4 400 GB and 800 GB WORM Tape Cartridge is unlike that of standard Read/Write media. This unique format prevents a drive that lacks WORM-capable firmware from writing on a WORM tape cartridge.

► When the drive senses a WORM cartridge, the firmware prohibits changing or altering user data already written on the tape. The firmware keeps track of the last appendable point on the tape.

7.5.3 Cleaning cartridge

A specially labeled IBM LTO Universal Ultrium Cleaning Cartridge cleans the drive in your library. One cleaning cartridge is shipped with the TS2900.

The TS2900 Tape Autoloader supports automatic cleaning, host based cleaning, and manual cleaning. The library can also be configured for dedicated cleaning cartridge slots. This is achieved by reducing the number of active slots, whereby total slots and active slots are equal the reserved slots. A reserved slot is not accessible to any host application. In fact, the host has no knowledge that the slot even exists. Any reserved slot can be used to hold a cleaning cartridge. A reserved slot that contains a cleaning cartridge is referred to as a dedicated cleaning slot. The dedicated cleaning slots can be used for automatic cleaning and for manual cleaning. Host based cleaning requires that the cleaning cartridge be located in a host accessible storage slot. The dedicated cleaning slots may be used by either logical library in a partitioned library. To remove a cleaning cartridge, export it from the library.

The IBM Cleaning Cartridges are valid for 50 uses. The cartridges LTO-CM chip tracks the number of times that the cartridge is used.

7.5.4 Cartridge Memory chip (LTO-CM)

All generations of the IBM LTO Ultrium Data Cartridges include a Linear Tape-Open Cartridge Memory (LTO-CM) chip that contains information about the cartridge and the tape (such as the name of the manufacturer that created the tape), as well as statistical information about the cartridges use.

The LTO-CM also helps determine the reliability of the cartridge by storing data about its age, how many times it has been loaded, and how many errors it has accumulated. Whenever a tape cartridge is unloaded, the tape drive writes any pertinent information to the cartridge.
memory. The storage capacity of the LTO-CM is 4096 bytes for Ultrium 3 and 8192 bytes for Ultrium 4.

For additional details related to the LTO-CM refer to “Cartridge memory (LTO-CM)” on page 45.

7.6 TS2900 Tape Autoloader setup

After unpacking and installing the TS2900 you must perform a few steps to connect it to a host. We describe these steps in the following section.

We provide hints and tips to make it easier for you to set up the TS2900. For a detailed description, follow the IBM System Storage TS2900 Tape Autoloader Setup, Operator, and Service Guide, GC27-2212.

The TS2900 Tape Autoloader is a Customer Setup Unit (CSU) and will not be installed and tested by an IBM Service Support Representative (SSR). We describe the following:

- TS2900 Tape Autoloader initial setup
- TS2900 Library modes
- User Privilege Comparison
- Web User Interface
- Network configuration
- Encryption setting
- Setting up e-mail and Single Network Management Protocol (SNMP)
- Updating the drive and library firmware

7.6.1 TS2900 Tape Autoloader initial setup

The TS2900 Tape Autoloader can be configured and monitored remotely as well as update of the firmware of the library and the drive can be done remotely. These can be accomplished using the Web Interface via the Ethernet connection to access the TS2900. For the initial setup you use configuration from the Operator Panel which is:

- Network Address: Set IP Address for IPv4.
- Library mode: Random

Making a direct connection to the TS2900 might require a crossover Ethernet cable. Initial setup involve you to specify which library operation mode has to be selected.

7.6.2 TS2900 Library modes

In the next section we describe the two library modes available on the TS2900 Tape Autoloader. Figure 7-7 on page 168 show you the Library Mode menu tree.
You may select the Library Mode from the operator mode. Use **Configuration → Configure Autoloader → Configure Loader Mode** to set the loader access mode in your TS2900. Two loader modes are available for the TS2900:

- **Random** mode, the library allows the servers (hosts) application software to select any data cartridge in any order. It is the servers responsibility to move the cartridges between the I/O station, storage slots, and tape drives. The application must execute an `audit` Tivoli Storage Manager command to get the inventory from the TS2900 so that the application is aware of the location of the data cartridges.

- **Sequential** mode, the library firmware predefines the selection of the cartridges. After initialization, the firmware causes the library to select the first available cartridge found (counting from 1 through 9) for loading into the drive. In Figure 7-8 on page 170, you find the tree structure of the Library mode menu.

In combination with Sequential mode, you can turn on two additional modes:

1. **Autoload** The way in which Sequential Mode works depends on the Autoload and Loop settings, they are:
   - If the Autoload option is set to **ON**, the accessor loads the first cartridge (cartridge located in the slot with the lowest numeric value) found in the storage inventory area into the drive when the library powers ON. If the library powers ON with a cartridge already in the drive, sequential mode starts with that cartridge unless the host issues a
rewind and unload command to the drive. In that case, the next cartridge in sequence will be loaded into the drive.

- If the Autoload option is set to **OFF**, sequential mode is started by selecting the **Move Cartridge** command to load the first cartridge into the drive. The sequence then starts with the cartridge loaded into the drive. For example, if a cartridge from the fifth lowest numeric storage slot containing a cartridge is loaded using the **Move Cartridge** command, after the host issues a rewind/unload command, the next cartridge loaded is the cartridge from the next higher numeric slot. Cartridges do not need to be in contiguous slots.

2. **Loop** Sequential mode with loop mode **ON** loads the cartridge in the lowest numerical slot after the cartridge in highest numerical slot has been filled and sent back to its home slot. The accessor will immediately start loading the first cartridge into the drive when the last cartridge (cartridge in the highest numeric slot) is unloaded and placed back into storage. This allows endless backup operations without user interaction.

Sequential mode is stopped when a cartridge is removed from the drive using the **Move Cartridge** command. The next sequential cartridge is not loaded. To restart sequential mode, use the **Move Cartridge** command to load a cartridge. The loading sequence will resume from that numeric slot in the cartridge inventory. The number of active slots in the library determines the number of slots that the library will access before repeating each loop and the number of reserved cartridge slots.

You also define the number of **Active Slots** you want to assign in your library.Slots can be reserved so that they are invisible to the host. It might be necessary to set the number of active slots in order to match the number of available slots to the Independent Software Vendor (ISV) software licensing.

Note: When the TS2900 Tape Autoloader is connected to a System i host you must IPL the input/output adapter (IOA) otherwise the System i host will not recognize the new mode. First, investigate if there are more IOAs under the IOP. When for example, a disk adapter is under the same IOP, this IOA will also be IPLed.

You can connect the library to the host after setting up the library mode. Only SAS host connections is available with SCSI protocol.

### 7.6.3 User Privilege Comparison

You can manually assign user privilege levels to the user accounts created within the library. Those permit to control access to the screens and operations within the library preserving the integrity of the library and the data stored in it.

There are four types of user privileges in the library that you can use:

- **Users** This user allows to monitor the library but not to perform actions that affect the physical library.
- **Superusers** This user has authority to operate the physical and logical library but not to perform actions that affect the library configuration.
- **Administrator** This user has access to the physical and logical libraries including configuration. One and only one administrator user must be assigned the login name *admin*. 
### Service

This user allows access to the entire physical and logical library. In addition, the Service user can access diagnostic tools to help identify and resolve library and drive problems.

Multiple users can be logged in the TS2900 at the same time through the Web User Interface.

### 7.6.4 Web User Interface

There are two ways to configure the TS2900 using the Operator Panel and the Web User Interface. We strongly recommend that you configure, manage, and control the TS2900 by using the Web User Interface. In order to use the Web User Interface, you need to set the Internet Protocol (IP) address of the TS2900 from the operator panel. See also “TS2900 Tape Autoloader initial setup” on page 167.

To configure the TS2900, you do the following using the Operator Panel:

1. Power on the TS2900 and wait until the hardware and software are initialized and the inventory is finished. This process takes a few minutes. The login window is displayed when the inventory is complete. Figure 7-8 shows the login window of the Operator Panel.

   ![Login Panel](image)

   **Figure 7-8** TS2900 Tape Autoloader login panel

2. To log in, press Enter to display the User Login password window. Figure 7-9 shows the login password window.

   ![Password Panel](image)

   **Figure 7-9** TS2900 Tape Autoloader Login password panel

3. Enter the 4-character password for the TS2900. The factory password is 0000. The password can be changed in the configuration menu. When the password is entered successfully, the Operator Panel displays the first available option that is Unlock Magazine. See Figure 7-10 on page 171.
4. You are now logged in the TS2900. To proceed with the IP configuration, step forward to the next options, until the panel show you Configuration. See Figure 7-11 for reference.

5. You now start to configure the IP addresses, selecting Configuration → Configure Network Settings. In the Network Settings panel, you may configure the IP address for the TS2900 and one of the following settings:

- Configure Link Speed
- Configure Dynamic Host Configuration Protocol (DHCP)
- Change IP Address
- Change Subnet Mask
- Change Gateway
- Configure Time Server

6. The TS2900 can now be remotely controlled from any server in the network using the Web User Interface. However, there are prerequisites from a server point of view. The Web UI Java Applet, which is running on the TS2900 requires Java 1.5.0 or higher for full functionality and is best viewed using Internet Explorer® 7.0 or higher. If your server does not have Java installed, or if you need to upgrade your installation, download the latest version of the Java Runtime Environment (JRE™) for your platform from:

   http://www.java.com

   Follow the instructions provided to enable and configure the Java Runtime Environment for your browser.

7. When the JRE on your server is installed or upgraded, open your browser and enter the IP address of the TS2900.

   Figure 7-12 shows the Java security warning message.

   **Note:** If you receive a warning message pop ups the first time that you connect to the TS2900 Tape Autoloader this message is normal and does not indicate an error.
8. Select **Always trust content from this publisher** to avoid this message in subsequent browser sessions and click Run. After launching the Web User Interface, the login window is displayed. You will receive panel as shown in Figure 7-13 on page 172.

![Java security warning message](image)

**Figure 7-12** Java security warning message

Use the **Account** and **Password** according to the User Privilege levels described in 7.6.3, “User Privilege Comparison” on page 169. The factory default account passwords are:

- Administrator User account is `admin` and the password is `secure`
- Service User account is `service` and the password is `ser001`

9. After you log in the TS2900 using the Web User Interface, a Welcome page is displayed. Here you see the summary status of the TS2900 Tape Autoloader, the accessor status, drive status, firmware level, and the serial number. Figure 7-14 on page 173 shows an example of the Web UI using the Administrator account.
In the next section we continue configuring the TS2900 Network Interface and describe how to set up data encryption. For a complete overview of all the configuration settings, see the *IBM System Storage TS2900 Tape Autoloader Setup, Operator, and Service Guide*, GC27-2212.

### 7.6.5 Network configuration

Here in this session we show you the network configuration panel. In this panel you can select two types of transportation protocols IPv4 and IPv6 or both of them in Dual-Stack configuration IPv4+IPv6.

If you want to set network settings use **Configure Library → Network** from the Web User interface. Figure 7-15 on page 174 show you the Network Configuration panel viewed from the Web User Interface.
Configure the network using the following settings:

**Link speed**
- Ethernet duplex mode (Auto, 10Base-T Full, 10Base-T Half, 100Base-TX Full, 100Base-TX Half).

**TCP/IP settings**
- IPv4, IPv6, and dual stack IPv4/IPv6 are supported.
- IPv4 setting: Select Use IPv4 to enable the IPv4 Internet Protocol. Select the corresponding radio button to obtain an IP address automatically (DHCP) or use static IP address settings. Enter the following parameters if using static IP address settings:
  - **IPv4 address**: Sets the TCP/IPv4 address of the library on the network.
  - **Subnet mask**: Defines and limits users within a local network.
  - **Gateway**: Allows access outside the local network.

**IPv6 setting**
- Select Use IPv6 to enable the IPv6 Internet Protocol. The corresponding radio button to obtain an IP address automatically (DHCP), to obtain an IP address using stateless auto configuration, or use static IP address settings. Enter the following parameter if using static IP address settings:
  - **IPv6 address**: Sets the TCP/IPv6 address of the library on the network.
Prefix Length
Decimal value indicating the number of contiguous, high-order bits comprising the network portion of the address.

Gateway
Allows access outside the local network.

DNS server IP address
Sets the IP address of the DNS server. The DNS server, if entered, allows the encryption, date and time, and notifications IP addresses to be specified using hostnames instead of numerical IP addresses.

Click Submit to transfer the settings to the library. A dialog message is displayed when the settings have been updated successfully.

Click Refresh to read the current settings from the library.

7.6.6 Encryption setting

In this section we give an overview of the steps needed to setup the tape encryption in the library.

Note: The optional Transparent Encryption Key feature enabling SME and Library-Managed Encryption (LME) is not available on TS2900 Tape Autoloader purchased through High Volume (HVEC) channels.

TS2900 Tape Autoloader uses TCIP/IP to communicate with the server where the EKM is installed. The TS2900 supports up to two key manager addresses, where each key manager is specified using the IP address and port number of a server that has the EKM installed. The EKM is supported on z/OS, i5/OS, AIX, Linux, HP-UX, Sun Solaris, and Windows. The IBM EKM can be downloaded from this Web site:
http://www-1.ibm.com/support/docview.wss?&uid=ssg1S4000504

Encryption policy is used for TS2900 to set up encryption when Library-Managed encryption is selected. Encryption policy is a set of rules, or policies, that specify which data cartridges are to be encrypted. How and where these rules are set up depends on the operating environment.

To setup encryption on your TS2900 Tape Autoloader follow the following steps:

1. Go to the Welcome page of the TS2900 using the Web Interface and select Configure Library → Encryption to configure an encryption method for data being stored on tape cartridges. The panel in Figure 7-16 on page 176 show you the Encryption menu.
You may specify the encryption method you want to use. Select from the Encryption panel the Encryption Method pull-down menu. You have four options available:

**None**
No encryption is used.

**Application-Managed Encryption**
This option is used for encryption in operating environments that run an application capable of generating and managing encryption policies and keys. If you select Application-Managed Encryption no further configuration steps are necessary.

**System-Managed Encryption**
This option is used for encryption in operating environments where no application is capable of key management runs. Encryption is set up implicitly through each instance of the IBM device driver.

**Library-Managed Encryption**
This option is used for transparent encryption by the TS2900 tape drive.

Note: SME and LME are transparent. A data cartridge using SME can be decrypted using LME, and the reverse, provided both have access to the same EKM keystore.

2. Next step show you how configure the Encryption Policy. From the Welcome Page, specify Encryption and then Encryption Policy. See Figure 7-17 on page 177.

Three encryption policy options are available:

**Encrypt All**
Encrypt All is the default setting. All data cartridges within the logical partition loaded into the tape drive are encrypted.
Internal Label - Selective Encryption

This option is used only for Symantec Veritas NetBackup.

Internal Label - Encrypt All

This option is used only for Symantec Veritas NetBackup.

There is also an Engineering Use Only option available. As the name implies this option is only for IBM Support personnel (under the direction of the drive development team) to provide a solution to an unforeseen problem or to support a unique configuration. These options are not intended for use by the client without the guidance of IBM Support.

Select Encrypt All and click Submit.

3. Next step allow you to configure the EKM Server Setting. From the Welcome Page of the TS2900 select Encryption. See Figure 7-17 on page 177 for reference.

In our example, we used for the primary EKM IP address: 9.11.221.242 and the second EKM IP address: 9.11.221.188. The TCP port number is 3801 to access the EKM console. You may select Secure Socket Layer (SSL) for a secure access to the EKM. You can see in Figure 7-17 that the port number is 443 when you enable SSL for the EKM console.

To see if a data cartridge is encrypted, use the option Library Map from the Welcome page and click on the cartridge that is inserted in the partition that has encryption enabled. In our example, the cartridge in the drive is encrypted. See Figure 7-18 on page 178.
7.6.7 Notification

There are still few settings to be configured before connecting the TS2900 Tape Autoloader to the host. You can change the settings using the Operator Panel or using the Web User Interface. From the Welcome page for the TS2900 select **Notifications**. Two options are available for sending notifications to the host:

**SMTP**

This feature automatically sends an e-mail containing event information to the e-mail addresses specified whenever an event of a certain level occurs. The contents of the e-mail message are similar to the information that can be obtained by Single Network Management Protocol (SNMP) traps without using SNMP management software.

**SNMP**

This is a set of protocols for managing complex networks. SNMP works by sending messages, called protocol data units (PDUs), to different parts of a network. Agents, which are SNMP-compliant devices, store data about themselves in Management Information Bases (MIBs) and return this data to the SNMP requesters, such as the hosts monitoring application.

SNMP traps are alerts or status messages that can be collected, monitored, and used to proactive manage attached libraries using the SNMP protocol with the host servers. The tape library supports transmission of SNMP traps and collection of MIB information as an SNMP agent. SNMP traps can be received using an SNMP manager and MIB information can be collected using an MIB browser.

Figure 7-19 on page 179 shows the SMTP Mail notification setting window.
7.6.8 Firmware upgrade

After setting up and configuring the TS2900 Tape Autoloader we recommend that you verify that the latest firmware is installed for both the library and the tape drive. It is your responsibility to verify and maintain the firmware. Determine the current level of firmware available from the IBM Technical Support Web sites:
If the installed firmware of your library or tape drive is down-level, download the firmware from the IBM Web site to your local server.

There are several options to update the firmware of the library or the tape drive. You can use the drivers application interface, for example, NTUTIL, the Web User Interface of the TS2900 or an IBM tool called IBM TotalStorage Tape Diagnostic Tool (ITDT). We recommend that you use the Web User Interface for updating the library or drive firmware.

ITDT can also be used for updating the firmware of the tape drive. This tool is driver independent and can also be used for testing the tape drives and taking drive dumps.

**Note:** Updating the library firmware is not supported.

ITDT tool is supported on the following servers:

- Microsoft Windows Server 2008 SP1
- Microsoft Windows Server 2003 (32-bit IX86)
- AIX 5L 5.2, 5.3 and 6.1 (64-bit pSeries)
- Linux systems with Kernel 2.6, glibc 2.2.5 and later (32-bit IX86)
- Linux systems with Kernel 2.6, glibc 2.2.5 and later (64-bit pSeries)
- Linux systems with Kernel 2.6, glibc 2.3.3 and later (64-bit zSeries)
- Solaris 9 and 10 (64-bit SPARC)
- HP-UX Version 11i v1 and v2 (PA-Risc and Itanium)
- i5/OS Version 5 Release 3 and Version 5 Release 4 (iSeries), only tape drives

The latest version of the ITDT is V2.0 and it comes in two flavors:

**ITDT SE**

This is a version like the previous ITDT version and is mainly a command line driven tool.

**ITDT GE**

This is called ITDT Graphics Edition, and is a Graphical User Interface version that you use if the Operating Systems running on the servers are Window XP or 2003. Please install Java before using ITDT-GE. You can download a Java version from:

- http://www.ibm.com/java
- http://www.java.com

You can download the ITDT tool from this IBM Web site:

http://www-03.ibm.com/servers/storage/support/

To locate the tool, search on ITDT V2.0.

After updating the firmware it is now time to populate your TS2900 Tape Autoloader with data cartridges and to connect your TS2900 to a host. For ordering data cartridges and the features, see Appendix A, “IBM LTO Ultrium and 3592 media” on page 491.

### 7.6.9 SCSI Host Bus Adapter (HBA) support

For SCSI hosts, verify that the HBA of your server is supported. Check the IBM Interoperability Matrix, which you can find at:

http://www-03.ibm.com/servers/storage/tape/resource-library.html#interoperability

Select **TS2900 Tape Autoloader**.
The library uses a single SCSI or Loop ID per drive and dual logical unit numbers (LUNs) to control the tape drive (LUN 0) and library accessor (LUN 1). The library requires a host bus adapter (HBA) that supports LUN scanning. If it is not enabled, your host system will not scan beyond LUN 0 and will fail to discover the library. It will only see the tape drive.

**Note:** Some HBAs, such as RAID controllers, do not support LUN scanning.

A drive with a SAS (Serial Attached SCSI) interface can be linked directly to controllers. SAS is a performance improvement over traditional SCSI because SAS enables multiple devices (up to 128) of different sizes and types to be connected simultaneously with thinner and longer cables, its full-duplex signal transmission supports 3.0 Gbps. Up to four Ultrium 3 or Ultrium 4 single port Half-High drives or two Ultrium 4 dual port drives can be attached. At the library end, the drive or port can be attached via a SFF-8088 cable to the interposer cable. In addition, SAS drives can be hot-plugged.

SAS drives will auto-negotiate speed. There are no configurable topologies thus no feature switches associated with SAS. The SAS Ultrium 3 and Ultrium 4 Half-High drives are single ported and can only be attached to one host. The Ultrium 3 and Ultrium 4 SAS drive use the SFF-8088 connection at the drive end and SFF-8088 or SFF-8470 at the host adapter end. Initially, only point-to-point connections are supported.

### 7.6.10 Installing tape device drivers

To communicate with the TS2900 Tape Autoloader the appropriate tape device driver must be installed on your server. Depending on your host operating system, the latest tape device driver must be installed on your server. Visit the Web site:

http://www-03.ibm.com/servers/storage/tape/

Select **Support & Download** and in the next window, you can type TS2900 in the search technical support box. Here, you can download the latest device driver for your operating system.

Another way to get the latest device driver is to visit this Web site:

ftp://index.storsys.ibm.com/devdrvr

Choose your operating system and download the device driver.

We do not discuss installing the device driver in this publication. Information about how to install the device driver are described step-by-step in

- *Implementing IBM Tape in Unix Systems*, SG24-6502
- *Implementing IBM Tape in Linux and Windows*, SG24-6268
- *IBM Tape Device Drivers Installation and Users Guide*, GA27-2130

All publications are available and can be downloaded from the Web.

You have now completed setting up your TS2900 installing your FC HBA, checking that your HBA is supported, and installing the right device driver.

We recommend that you register yourself for My Support at the IBM Technical Support Web site. When you register at My Support, you will automatically receive an e-mail when there is new firmware available for the TS2900 or other news concerning the TS2900. To register at My Support, go this Web site:

7.7 Technical specification

In the next session we summarize all the technical specification of the TS2900 Tape Autoloader.

Physical specifications
The TS2900 is a small-sized tape drive with the following specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>48.30 cm (19.01 in.)</td>
</tr>
<tr>
<td>Depth</td>
<td>85.0 cm (33.46 in.)</td>
</tr>
<tr>
<td>High</td>
<td>4.4 cm (1.73 in.)</td>
</tr>
<tr>
<td>Weight</td>
<td>Library only 13 kg (28.66 lbs)</td>
</tr>
</tbody>
</table>

Electrical specifications
The following values are for a TS2900:

- Voltage: 100 to 240 Vac.
- Frequency: 50 to 60 Hz.
- Power consumption: 110 W

7.8 Feature codes

Table 7-3 shows the available feature codes for the TS2900 Tape Autoloader.

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Feature code</th>
</tr>
</thead>
<tbody>
<tr>
<td>3572 Rack Mount Option (FC7006)(^a)</td>
<td>TS2900 Tape Autoloader with LTO3 HH SAS drive and with rack-mount kit</td>
<td>S3H 7006</td>
</tr>
<tr>
<td></td>
<td>TS2900 Tape Autoloader with LTO4 HH SAS drive and with rack-mount kit</td>
<td>S4H 7006</td>
</tr>
<tr>
<td></td>
<td>TS2900 Tape Autoloader with LTO 3 HH SAS drive and with rack-mount kit; Xcc/HVEC</td>
<td>S3H 7006 (SEO # 3572S3R)</td>
</tr>
<tr>
<td></td>
<td>TS2900 Tape Autoloader with LTO4 HH SAS drive and with rack-mount kit; Xcc/HVEC</td>
<td>S4H 7006 (SEO # 3572S4R)</td>
</tr>
<tr>
<td>3572 Desk-side Covers (FC7010)(^b)</td>
<td>TS2900 Express Seller Tape Autoloader with LTO3 HH SAS drive &amp; desktop covers</td>
<td>S3H 7010 (SEO # 3572S3E)</td>
</tr>
<tr>
<td></td>
<td>TS2900 Express Seller Tape Autoloader w/LTO4 HH SAS drive &amp; desktop covers</td>
<td>S4H 7010 (SEO # 3572S4E)</td>
</tr>
<tr>
<td>2m SAS/Mini-SAS 1x Cable</td>
<td>S4H/S3H</td>
<td>5402 (P/N 95P4711)</td>
</tr>
<tr>
<td>5.5m SAS/Mini-SAS 1x Cable</td>
<td>S4H/S3H</td>
<td>5406 (P/N 95P4712)</td>
</tr>
</tbody>
</table>
2m Mini-SAS/Mini-SAS 1x Cable (from HBA/Interposer SFF-8088 to drive with SFF-8088) | S4H/S3H | 5502 (P/N 95P4713)  
5.5m Mini-SAS/Mini-SAS 1x Cable (from HBA/Interposer SFF-8088 to drive with SFF-8088) | S4H/S3H | 5506 (P/N 95P4714)  
Transparent LTO Encryption | S4H | 5901 (P/N 45E3797)  
1 Cleaning Cartridge | S4H/S3H | 8002 (P/N 23R7008)  
3572 Additional Magazine | S4H/S3H | 8111 (Part Number 45E3793)  
Ultrium 3 Data Cart (5-Pack) | S3H/S4H | 8305 (P/N 95P2020)  
Ultrium 4 Data Cartridges (5-pack) | S4H | 8405 (P/N 95P4278)

- FC7006 applies to the models you see in the middle column of the table. For the High Volumes Sellers, they use the SEO number when ordering the TS2900 Tape Autoloader with the rack-mountable kit.
- FC7010 applies to the models you see in the middle column of the table. For the High Volumes Sellers, they use the SEO number when ordering the TS2900 Tape Autoloader with the rack-mountable kit.