IBM Tape Device Drivers

User's Guide

IBM

Twenty-fourth Edition (April 2019)

This twenty-fourth edition of the *IBM Tape Device Drivers Installation and User's Guide,* GC27-2130-23, replaces and makes obsolete the following manual: *IBM Tape Device Drivers Installation and User's Guide,* GC27-2130-22.

Read this first

Accessing online technical support

For online technical support for your Library, visit:

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

Registering for My Notification

My Notification registration provides email notification when firmware levels have been updated and are available for download and installation. To register for My Notification:

1. Visit the web at http://www-01.ibm.com/software/support/einfo.html.
2. Click **My Notifications**.

Note: Library firmware and tape drive firmware are verified and released together. When updating to the latest firmware, verify that all installed components such as tape drives, and library are at the latest levels noted on the Support website. Mixing different levels of library and tape drive firmware is not supported and can cause unpredictable results.

Contacting IBM technical support

In the USA: Call 1-800-IBM_SERV (1-800-426-7378).

All other Countries/Regions: Visit www.ibm.com/support

To open a Service Request online: Under **Support & downloads**, click **Open a service request**.

Preface

These publications and URLs provide user information and installation assistance for IBM® tape drive, medium changer, and library device drivers.

Related information

Reference material, including the Adobe PDF version of this publication, is available at the following url: http://www-01.ibm.com/support/docview.wss?uid=ssg1S7002972.

A companion publication that covers programming aspects for the device drivers is: *IBM Tape Device Drivers: Programming Reference*, GA32-0566.

IBM tape products

IBM tape product publications

- *IBM TS1120, TS1130, TS1140, TS1150, TS1155, and TS1160 Tape Drives and TS1120 Controller Introduction and Planning Guide*
- *IBM TS1120 Tape Drive and Controller Operator Guide*, GA32-0556
- *IBM TS3500 Tape Library Operator Guide*, GA32-0560
- *IBM TS3500 Tape Library Introduction and Planning Guide*, GA32-0559
- *IBM TS4500 Tape Library Introduction and Planning Guide*, SC27-5990
- *IBM 3953 Library Manager Model L05 Operator Guide*, GA32-0558
- *IBM 3953 Tape System Introduction and Planning Guide*, GA32-0557
- *IBM Tape Drive 3592 SCSI Reference*, GA32-0570
- *IBM Introduction and Planning Guide 3592 Models J1A, E05, E06, EU6, E07/EH7, E08/EH8, and J70, C06, C07 Controllers*, GA32-0555
- *IBM Operator Guide 3592 Models J1A, E05, E06, EU6, E07/EH7, E08/EH8, J70 and C06*, GA32-0556
- *IBM LTO Ultrium 3-H Tape Drive Setup, Operator, and Service Guide*, SC23-5231
- *IBM TS2230 Tape Drive Setup, Operator, and Service Guide*, GC27-2099
- *IBM TS2230 Tape Drive Installation Quick Reference*, GC27-2100
- *IBM TS2240 Tape Drive Setup, Operator, and Service Guide*, GC27-2151
- *IBM TS2240 Tape Drive Installation Quick Reference*, GC27-2167
- *IBM TS2250 Tape Drive Setup, Operator, and Service Guide*, GC27-2275
- *IBM TS2250 Tape Drive Installation Quick Reference*, GC27-2276
- *IBM TS2260 Tape Drive Setup, Operator, and Service Guide*, GC27-2226
- *IBM TS2260 Tape Drive Installation Quick Reference*, GC27-2226
- *IBM TS2270 Tape Drive Setup, Operator, and Service Guide*, SC27-8519
- *IBM TS2270 Tape Drive Installation Quick Reference*, GC27-2276
- *IBM TS2280 Tape Drive Setup, Operator, and Service Guide*, SC27-4649
- *IBM 3580 Tape Drive Models L33/L3H Setup, Operator, and Service Guide*, GC26-7708
- *IBM 3580 Tape Drive Models L33/L3H Quick Reference*, GC26-7709
- *IBM TS2340 Tape Drive Models L43/S43 Setup, Operator, and Service Guide*, GC27-2103
- *IBM TS2340 Tape Drive Models L43/S43 Quick Reference Card*, GC27-2104
- *IBM TS2350 Tape Drive Setup, Operator, and Service Guide*, GC27-2277
- *IBM TS2350 Tape Drive Installation Quick Reference*, GC27-2278

- *IBM TS2360 Tape Drive Setup, Operator, and Service Guide*, GC27-2228
- *IBM TS2360 Tape Drive Installation Quick Reference*, GC27-2278
- *IBM TS3500 Tape Library Planning and Operator Guide,* GA32-0408
- *IBM TS3500 Tape Library Maintenance Information*, 19P2440
- *IBM TS3500 Tape Library with ALMS: Introduction and Planning Guide*, GA32-0593
- *IBM TS3500 Tape Library with ALMS: Operator's Guide*, GA32-0594
- *IBM TS3500 Tape Library with ALMS: Tape System Reporter User's Guide*, GA32-0589
- *IBM TS3310 Tape Library Setup and Operator Guide*, GA32-0477
- *IBM TS3310 Tape Library Maintenance Information*, GA32-0478
- *IBM TS3310 Tape Library SCSI Reference*, GA32-0476
- *IBM TS3100 Tape Library and TS3200 Tape Library Setup, Operator, and Service Guide*, GA32-0545
- *IBM TS3100 Tape Library and TS3200 Tape Library Installation Quick Reference*, GA32-0548
- *IBM TS3100 Tape Library and TS3200 Tape Library SCSI Reference*, GA32-0547
- *IBM TS4300 Tape Library User's Guide*, SC27-4629
- *IBM TS4300 Tape Library Getting Started Guide*, SC27-4630
- *IBM TS4300 Tape Library SCSI Reference*, SC27-4641

To access the latest documentation for your product, go to the IBM Publications Center at http://www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss. Select your country, then click **Search for publications** to find the desired publication. Publications can be viewed and downloaded from the website.

AIX

The following URL points to information about IBM System p (also known as pSeries) servers: http://www-1.ibm.com/servers/eserver/pseries.

HP-UX

The following URL relates to HP HP-UX systems: http://www.hp.com.

Linux

The following URLs relate to Linux distributions: http://www.redhat.com and http://www.suse.com.

Solaris

The following URL relates to Oracle Solaris systems: http://www.oracle.com/us/sun/index.html .

Microsoft Windows

The following URL relates to Microsoft Windows systems: http://www.microsoft.com .

Additional Information

The following publication contains additional information related to the IBM tape drive, medium changer, and library device drivers: *American National Standards Institute Small Computer System Interface* X3T9.2/86-109 X3.180, X3B5/91-173C, X3B5/91-305, X3.131-199X Revision 10H, and X3T9.9/91-11 Revision 1.

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Special printing instructions

This Tape Device Drivers Installation and User's Guide contains sections for each type of operating system/platform; for example, AIX, HP-UX, Linux, Oracle Solaris, Windows; and a separate section on these operating systems for the 3494 Enterprise tape library.

Note: When the page range is selected for the section you want to print, note that the print page range is based on the page controls for Adobe Acrobat, not the page printed on the actual document. Enter the Adobe page numbers to print.

 Important printer note

This area indicates the pages that will actually print in your specified range of pages.

Ignore the page number appearing on the page itself when entering page ranges for your printer.

Figure 1. How to print Adobe pdf files

If you want to print one or more separate sections of the manual, follow these steps:

1. Navigate to the beginning of the section and note the page number.
2. Navigate to the last page in the section and note that page number.
3. Select **File** > **Print**, then choose **Pages** and enter the page range for the section. Only the page range entered prints.
4. Repeat these steps to print additional sections.

Attention: Only one Table of Contents and one Index exists for this entire book. If you want to print those items, you must repeat the previous process, entering the page range for the Table of Contents and the Index page range, respectively.

Contents

Figures

Tables

Chapter 1. Introduction

This publication describes the IBM Tape and Medium Changer Device Drivers and IBM Tape Diagnostic Tool (ITDT) for various operating systems. Not all devices are supported by all operating systems, drivers, or ITDT. Refer to the **Hardware Requirements** section for details.

Purpose

The IBM tape and medium changer device drivers are designed specifically to take advantage of the features that are provided by the IBM tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape functions (such as backup and restore) and medium changer operations (such as cartridge mount and unmount), and to the advanced functions needed by full tape management systems. Whenever possible, the driver is designed to take advantage of the device features transparent to the application.

The most current information on hardware and software requirements for IBM tape and medium changer device drivers can be found in the individual platform readme files or with the subsequent links.

Hardware requirements

The tape drivers and the IBM Tape Diagnostic Tool (ITDT) are developed to support various versions of different platforms. For the latest support, refer to the Interoperation Center website - http://www.ibm.com/systems/support/storage/config/ssic/.

Note: A single Fibre Channel host bus adapter (HBA) for concurrent tape and disk operations is not recommended. Tape and disk devices require incompatible HBA settings for reliable operation and optimal performance characteristics. Under stress conditions (high I/O rates for either tape, disk, or both) where disk and tape subsystems share a common HBA, stability problems are observed. These issues are resolved by separating disk and tape I/O streams onto separate HBAs and by using SAN zoning to minimize contention. IBM is focused on assuring server/storage configuration interoperability. It is strongly recommended that your overall implementation plan includes provisions for separating disk and tape workloads.

For information about this issue, see the following Redbook, section 4.1.3 in http://www.redbooks.ibm.com/abstracts/sg246502.html?Open.

Software requirements

If you use a third-party application, consult with your application provider about the compatibility with IBM tape device drivers.

For detailed driver requirements for each operating system, refer to the appropriate chapter. To obtain the most current service and documentation for this software, refer to Appendix A, "Accessing documentation and software online," on page 293.

IBM tape products

The IBM tape product family provides an excellent solution for customers with small to large storage and performance requirements.

1. IBM Virtualization Engine TS7650
2. IBM TS2250/TS2260/TS2270 tape drive
3. IBM TS2350/TS2360 tape drive
4. IBM TS1140/TS1150/TS1155/TS1160 tape drive (Enterprise)

5. IBM TS3200 tape library

6. IBM TS3500 and TS4500 tape library (also known as IBM UltraScalable tape library 3584)

7. IBM TS3310 tape library

8. IBM TS3100 tape library

9. IBM TS4300 tape library

The image illustrates the attachment of various current products to an open systems server.
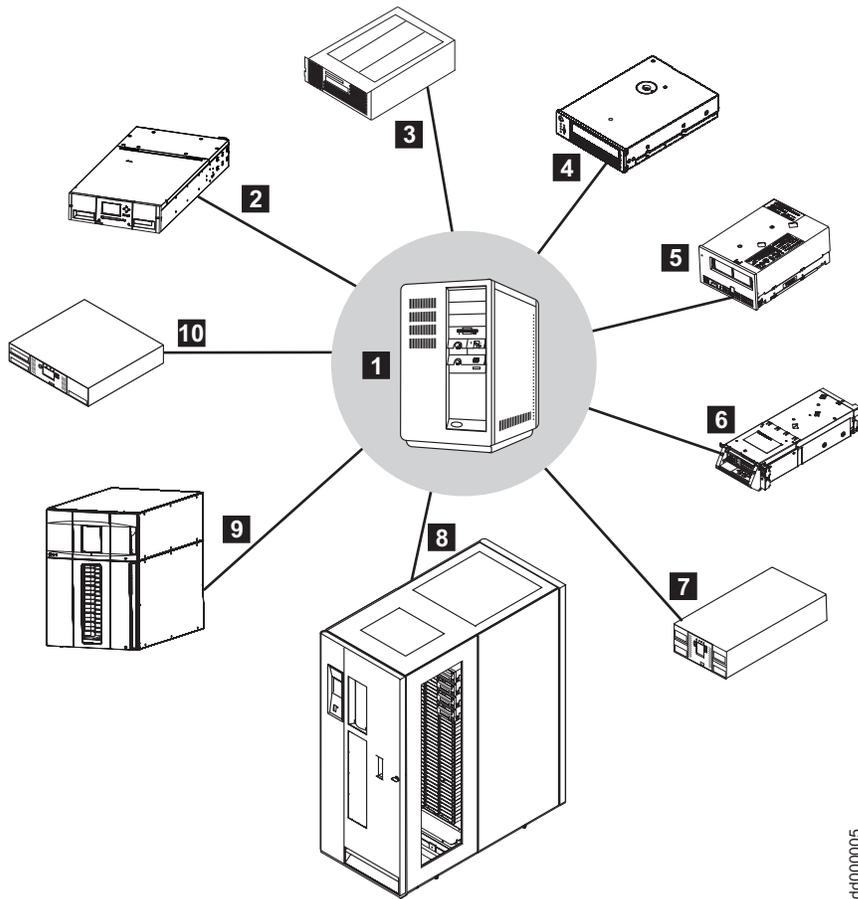
Figure 2. Current attachment array

1 Open Systems Server		**6** IBM TS1140/TS1150/TS1155/TS1160 tape drive [also known as Enterprise]	
2 IBM TS4300 Tape Library		**7** IBM TS3200 tape library	
3 IBM Virtualization Engine TS7650		**8** IBM TS3500 or TS4500 tape library	
4 IBM TS2250/TS2260/TS2270 Ultrium 3/4/5/6/7/8 Half Height tape drive		**9** IBM TS3310 tape library	
5 IBM TS2350/TS2360 (or 3580) Ultrium 3/4/5/6/7/8 Full Height tape drive		**10** IBM TS3100 tape library	

Chapter 2. Common extended features

Purpose

This chapter provides general information about the IBM device drivers, requirements, and advanced functionality.

Path failover and load balancing

Device driver path failover support configures multiple physical paths to the same device within the device driver and provides two basic functions:

1. Automatic failover to an alternate physical path when a permanent error occurs on one path.
2. Dynamic load balancing for tape devices by using multiple host bus adapters (HBA).

Path failover is supported on certain tape products with the latest IBM device drivers available on the following website - http://www.ibm.com/support/fixcentral. Instructions for downloading drivers can be found in Appendix A, "Accessing documentation and software online," on page 293. Some devices require a path failover feature code to be installed before path failover support is enabled in the device driver. Refer to "Supported devices and feature codes" on page 7 for a list of supported devices and what path failover feature code is required for your machine type.

At startup or configuration, the system detects multiple logical devices of the tape drive. Each logical device is a physical path to the same tape drive. A backup and restore application can open and use only one logical device at a time because they represent the same physical device.

Without path failover support, if a permanent path error occurs (because of an HBA or cable failure, for example), the application fails. It is possible to initiate manual failover by restarting the application on the alternate logical device, but the application must be restarted from the beginning. A long backup or restore operation might be in progress when the path error occurred. Sometimes manual failover requires operator intervention to reset the drive because a SCSI Reservation might still exist on the failing HBA path.

When path failover support is enabled on all logical devices, the device driver configures them internally as a single device with multiple paths. The application can still open and use only one logical device at a time. If an application opens the primary device and a permanent path error occurs, the device driver initiates failover error recovery automatically on an alternate path. If successful, the current operation continues on an alternate path without interrupting the application. The data path failover error recovery first restores the previous device state, SCSI Reservation, and tape position. Then, it tries the failing operation again.

Automatic failover

The automatic failover support provides error recovery on an alternate path when a permanent error occurs on the primary path. This support is transparent to the running application. The two types of path failover are Data Path failover (DPF) and Control Path failover (CPF). They are closely related. However, the difference is that DPF is an automatic failover support for the transfer of data, which provides error recovery for systems that are connected to tape drives. CPF is an automatic failover support for the transfer of commands to move tape cartridges. Examples of different configurations that can be constructed follow.

Data path failover

The following flowcharts outline the different types of configurations for data path failover (DPF). These configurations are presented in order of best practices as recommended by IBM.

Dual Host Bus Adapters (HBAs) to a multi-port drive

Consider a multipath connection that consists of two Host Bus Adapters (HBAs) connected through a fabric to a multi-port drive.
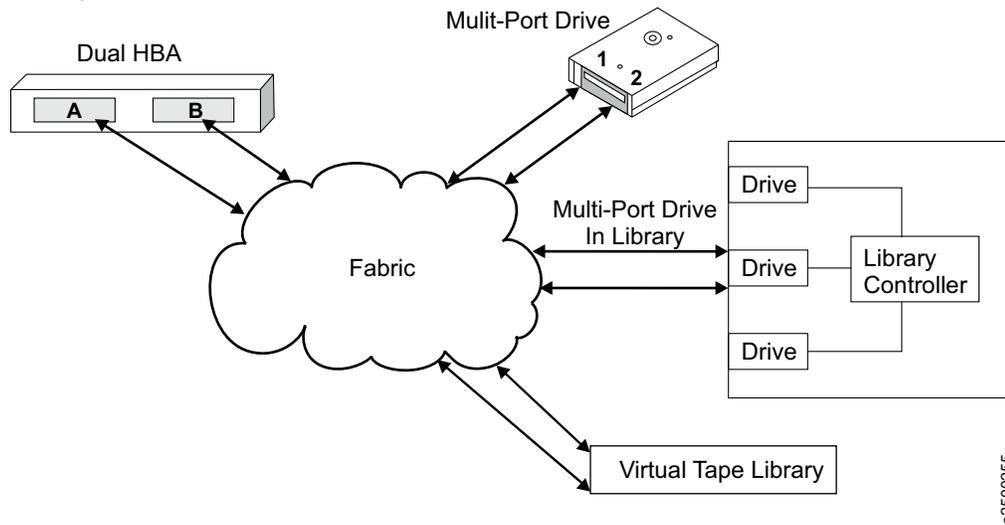
Figure 3. Dual HBA and multi-port drives

As seen in , four available paths are available between the drive and the host system. These paths are

HBA A to drive port 1 [A, p1]
HBA A to drive port 2 [A, p2]
HBA B to drive port 1 [B, p1]
HBA B to drive port 2 [B, p2]

One path is the primary path and the other three are alternate paths. If [A, p1] is the primary path and if HBA A fails, two valid paths ([B, p1] and [B, p2]) remain. The DPF tries to switch to one of the available configured paths. Conversely, if the cable to port 1 of the drive fails with [A, p1] as the primary path, two valid paths to the drive [A, p2] and [B, p2] are still available. Without DPF support, if a permanent path error occurs (because of HBA or cable failover, for example), the application fails. With DPF, if the permanent failure occurs with this configuration, two valid physical paths for the data are still available for transmitting data. The running application is not affected.

If the path that failed is restored, the device driver claims the path as available and uses it as a valid alternate path in most conditions. This action is dependent on Operating System and HBA behavior, not the IBM tape device driver behavior.

Dual Host Bus Adapters (HBAs) to a single-port drive

Consider a multipath connection that consists of two HBAs connected through a fabric to a single-port device.
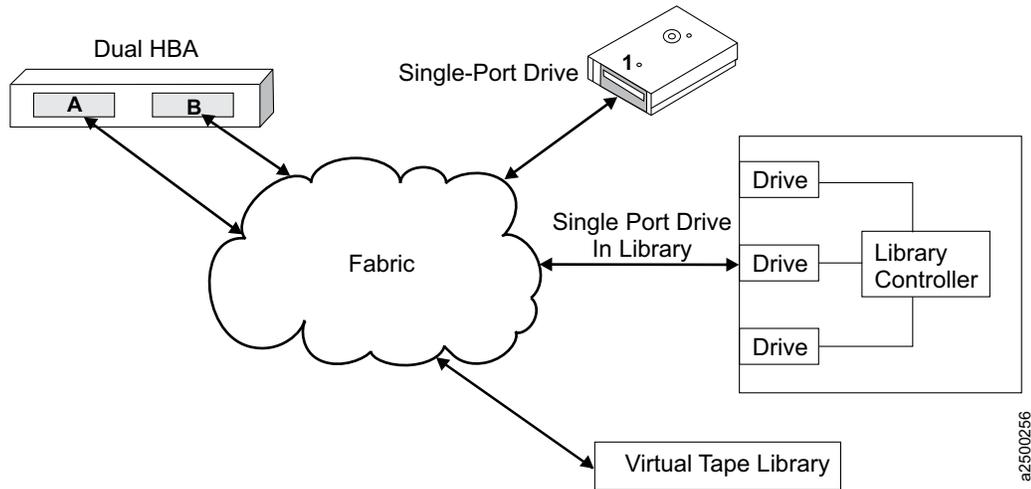
Figure 4. Dual HBA and single-port drive

This configuration supplies two physical paths to the same device. However, if the port or cable from the device fails, the automatic failover does not work. That connection is severed and a permanent path error occurs. If, however, the failure was with one of the HBAs or their cables, the automatic data path failover selects the other HBA. Then, the information continues through the alternate path. An example here is with the connections [A, p1] and [B, p1]. If [A, p1] is the primary path and a failure occurs with the HBA or HBA cable, then DPF automatically moves the connection to [B, p1] without affecting the application.

Single Host Bus Adapters (HBA) to a multi-port drive

Consider a single path from the HBA through the fabric to a multi-port device.
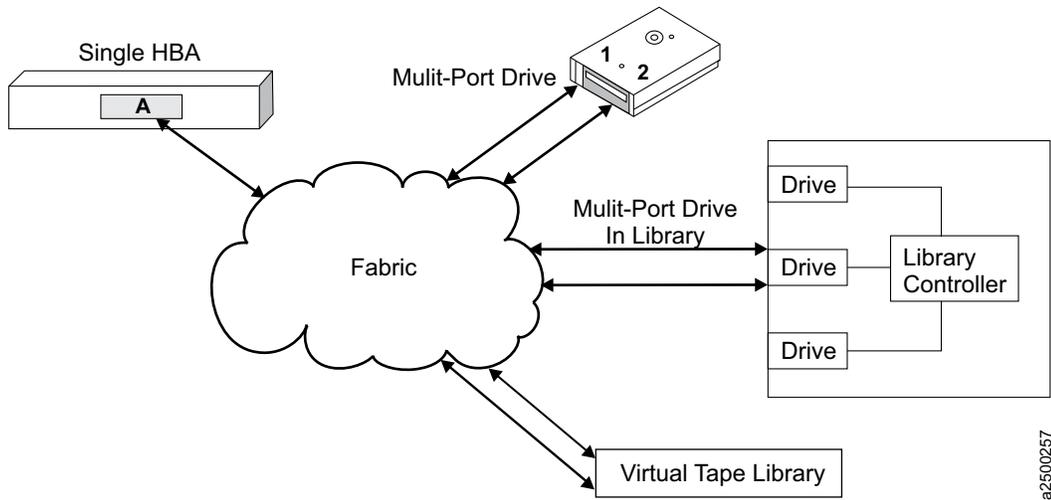
Figure 5. Single HBA and multi-port drive

This configuration also provides a failover path unless the failure is with the HBA or the HBA's cable. At which point, the connection is severed and a permanent path error occurs. Whereas, if the failure occurs on the device side, an alternative path is still available for the information to go through which DPF automatically failovers to.

Control path failover

The following flowcharts outline the different types of configurations for control path failover (CPF). These configurations are presented in order of best practices as recommended by IBM.

Dual Host Bus Adapters (HBAs) to multi-port drives

Consider a multipath connection that consists of two Host Bus Adapters (HBAs) connected through a fabric to the library by at least two drives.
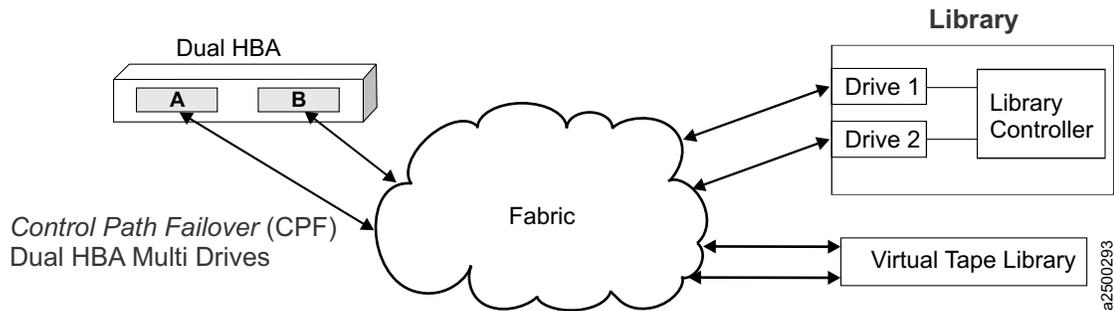
Figure 6. Dual HBA and multi-port drives

As seen in Figure 6 on page 6, four available paths are available between the drive and the host system. These paths are

HBA A to drive 1 [A, d1]
HBA A to drive 2 [A, d2]
HBA B to drive 1 [B, d1]
HBA B to drive 2 [B, d2]

As with DPF, one path is the primary path and the other three are alternate paths. If [A, d1] is the primary path and if HBA A fails, two remaining valid paths ([B, d1] and [B, d2]) are still available. The CPF attempts to switch to one of the available configured paths. Conversely, if the cable to drive 1 or drive 1 fails with [A, d1] as the primary path, two valid paths to the drive ([A, d2] and [B, d2]) are available. Without CPF support, if a permanent path error occurs (because of HBA or cable failover, for example), the application fails. With CPF, if a permanent failure with this configuration occurs, two valid physical paths are available for the data to be transmitted. Also, the running application is not affected.

If the failed path is restored, the device driver claims the path as available and uses it as a valid alternate path in most conditions. This action is dependent on Operating System and HBA behavior, not the IBM tape device driver behavior.

Note: In the operating systems logs, reservation conflict information might appear, which is because of scsi2 reservations that are not cleared. However, the device driver continues to try any paths that are available to make the reservation conflict transparent to the operating system.

Single Host Bus Adapter (HBA) to multi-port drives

Consider a single path from the HBA through the fabric to two drives in a library.
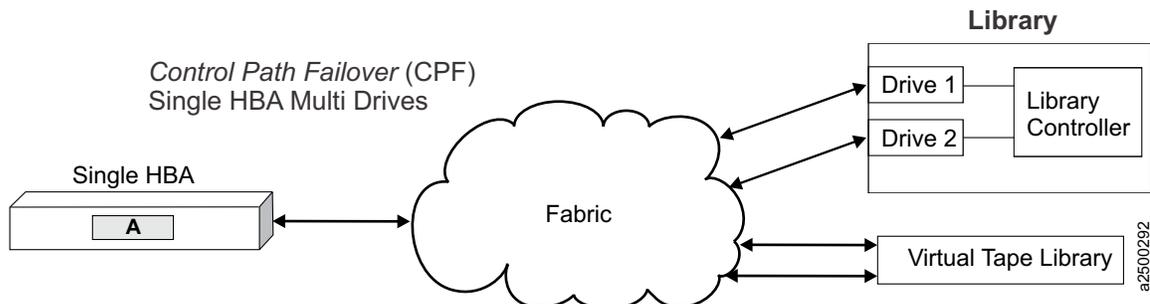
Figure 7. Single HBA and multi-port drives

This configuration also provides a failover path unless the failure is with the HBA or the HBA's cable. At which point, the connection is severed and a permanent path error occurs. Whereas, if the failure occurs

with a drive or a drive's cable, an alternative path is still available for the information to go through which CPF automatically failovers to.

Dynamic load balancing

The dynamic load balancing support optimizes resources for tape devices that have physical connections to multiple host bus adapters (HBA) in the same machine. When an application opens a device that has multiple configured HBA paths, the device driver determines which path has the HBA with the lowest usage. Then, it 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. Then, that path is assigned 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 host bus adapters whenever possible and balance the load between them to optimize the resources in the machine.

For example, consider a machine with two host bus adapters, HBA1 and HBA2, with multiple tape drives attached. Each tape drive is connected to both HBA1 and HBA2. Initially, there are no tape drives currently in use. When the first application opens a tape drive for use, the device driver assigns the application to use HBA1. When a second application opens a tape drive for use, the device driver assigns the second application to use HBA2. A third application is assigned to HBA1 and a fourth application is assigned to HBA2. Two applications are assigned to HBA1 and two applications are assigned to HBA2.

If the first application finishes and closes the device, there is now one application with HBA1 and two applications with HBA2. When the next application opens a tape drive, it is assigned to HBA1, so again there are two applications with HBA1 and two applications with HBA2. Likewise, if the second application finishes and closes the device, HBA2 has one application that is assigned to it. The next application that opens a tape drive is assigned to HBA2.

The dynamic load balancing support is independent from the automatic failover support. Regardless of the path that is assigned initially for load balancing, if that path fails, the automatic failover support attempts recovery on the next available path.

Dynamic Runtime Attributes

There are frequently field issues where customers must know which Initiator is holding a reservation in a drive or preventing the media from being unloaded. Also, they must correlate which drive special file name is used for the drive (such as `rmt2`). Sometimes this issue occurs over transport bridges and translators, losing any transport identifiers to help in this effort. LTO5, 3592 E07 (Jag 4) and later physical tape drives support attributes that are set to the drive dynamically by a host. This function is called Dynamic Runtime Attributes (DRA).

This feature is enabled by default. The attributes are set in the drive by the host during open, close, device reset, and data path change only. If there is a problem with sending the attributes to the drive, the error is ignored and not returned to the application.

There is no *ioctl* in the IBM tape drivers to retrieve the dynamic runtime attributes but is an upcoming command on ITDT. The attributes can also be retrieved through a pass through *ioctl* to issue **Read Dynamic Runtime Attributes** SCSI command (see applicable *IBM Tape Drive SCSI Reference*). See the host platform section for any special information that pertains to the driver that concerns DRA. If there is a question whether your driver level supports DRA, see the fixlist that comes with your driver to see whether it was added. Updates are also required with the drive firmware.

Supported devices and feature codes

Path failover is supported only for the devices that are listed in . Path failover includes Control Path failover (CPF) for tape libraries and Data Path failover (DPF) for tape drives. To use path failover support, some devices require feature codes as listed in .

Table 1. Supported devices and feature codes	
Supported tape library/drive	**Feature code (FC), if required**
TS3500 and TS4500	Standard, no FC required (DPF) FC 1682 (CPF)
TS4300/LTO	FC 1682 (CPF and DPF)
TS3310/LTO	FC 1682 (CPF and DPF)
TS3200/LTO	FC 1682 (CPF and DPF)
TS3100/LTO	FC 1682 (CPF and DPF)
TS7650/All	Standard, no FC required (CPF and DPF)

Note:

1. Path failover is not supported on parallel SCSI (except for some parallel SCSI drives on AIX® operating systems). Path failover is only supported on SAS devices that are attached to Windows and Linux for Intel/AMD processor-based servers. SAS is not supported on System p servers (AIX and Linux).

2. Path failover is not supported on Virtual Tape Libraries (except for the libraries that are listed in Table 1 on page 8) that emulate IBM tape devices.

3. If your device does not support path failover, you must disable this option in the device driver. See the specific platform section for driver default behavior and enable/disable failover instructions.

Data encryption

Tape and library requirements

For specific encryption support, refer to SSIC at http://www.ibm.com/systems/support/storage/config/ssic/.

The following three major elements comprise the tape drive encryption solution.

- **The encryption-enabled tape drive**

  The 3592 Model E07 and newer model tape drives, and the LTO Ultrium 4 and newer Ultrium drives are encryption capable. All TS1120 Model E05 tape drives with Feature code 5592 or 9592 are encryption capable. They are functionally capable of completing hardware encryption, but this capability is not yet activated. To run hardware encryption, the tape drives must be encryption-enabled. Encryption can be enabled on the encryption-capable tape drives through the **Tape Library Specialist Web** interface. Refer to the appropriate section in the documentation for your library for information about how to enable encryption.

  Note: FC 1604, Transparent LTO Encryption, is required to use system-managed or library-managed encryption on LTO Ultrium 4 and newer tape drives. It is not required for application-managed encryption. Refer to the sections on each method of encryption for information.

- **Encryption key management**

  Encryption involves the use of several kinds of keys, in successive layers. How these keys are generated, maintained, controlled, and transmitted depends upon the operating environment where the encrypting tape drive is installed. Some data management applications, such as Tivoli® Storage Manager, can run key management. For environments without such applications or where application-agnostic encryption is wanted, IBM provides a key manager (such as the Tivoli Key Lifecycle Manager or the IBM Security Key Lifecycle Manager) to complete all necessary key management tasks.

- **Encryption policy**

The method that is used to implement encryption. It includes the rules that govern which volumes are encrypted and the mechanism for key selection. How and where these rules are set up depends on the operating environment.

The LTO Ultrium 6 and later encryption environment is complex and requires knowledge beyond that of product trained Service Support Representatives (SSRs). The Encryption function on tape drives (desktop, stand-alone, and within libraries) is configured and managed by the customer. In some instances, SSRs are required to enable encryption at a hardware level when service access or service password controlled access is required. Customer setup support is by Field Technical Sales Support (FTSS), customer documentation, and software support for encryption software problems. Customer 'how to' support is also provided with a support line contract.

In the open system environment, there are two methods of encryption management to choose from. These methods differ in where you choose to locate your encryption key manager application. Your operating environment determines which is the best for you, with the result that key management and the encryption policy engine might be in any one of the three environmental layers: application layer, system layer, and library layer.

Application-managed tape encryption

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

Refer to "Planning for application-managed tape encryption" on page 9 for details on the hardware and software requirements for application-managed encryption. For details on setting up application-managed tape encryption refer to the Tivoli Storage Manager documentation or for information, visit the following site - http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp

It is required to use the latest device drivers available. Refer to Appendix A, "Accessing documentation and software online," on page 293 for downloading drivers. In different operating system environments, refer to the applicable chapter for each operating system.

Library-managed tape encryption

This method is best for encryption-capable tape drives in open attached IBM tape libraries. Scratch encryption policies that specify when to use encryption are set up through the IBM Tape Library Specialist Web interface. Policies are based on cartridge volume serial numbers. Key generation and management are run by an encryption key manager. Policy control and keys pass through the library-to-drive interface, therefore encryption is transparent to the applications.

Refer to "Planning for library-managed tape encryption" on page 10 for details on the hardware and software requirements for library-managed encryption. For details on setting up library-managed encryption on encryption-capable tape drives, refer to the *IBM Tape Library Operator's Guide* for your library.

Planning for application-managed tape encryption

Note: Contact your IBM representative for information about encryption on the IBM encryption-capable tape drive.

To run encryption on the encryption-capable tape drive, the following is required.

- Encryption-capable tape drive
- Encryption configuration features:

  – Library code updates and Transparent LTO Encryption feature code for encryption-capable libraries
  – Tape drive code updates

Application-managed tape encryption setup tasks

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

1. Install, cable, and configure the encryption-capable tape drive (refer your *IBM Tape Drive* or *Library Operator's Guide*)
2. Install appropriate IBM tape device driver level (Atape, for example).
3. Set up encryption policies. Refer to the appropriate Tivoli Storage Manager documentation.
4. Perform write/read operation to test encryption.
5. Verify encryption of the test volume by Autonomic Management Engine (AME): issue QUERY VOLUME FORMAT=DETAILED

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

Planning for library-managed tape encryption

Note: Contact your IBM representative for information about encryption on the IBM encryption-capable tape drive.

To complete encryption on the encryption-capable tape drive, the following items are required.

- Encryption-capable tape drive
- Keystore (Refer to documentation on Security Key Lifecycle Manager (SKLM))
- Encryption configuration features

  – Security Key Lifecycle Manager (SKLM)
  – Tape system library code updates and Transparent LTO Encryption feature code for encryption-capable libraries
  – Tape drive code updates

Library-managed tape encryption tasks

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

1. Install, verify, and configure

   a. Keystore
   b. EKM (Refer to documentation on Security Key Lifecycle Manager (SKLM)) for information on both.
2. Install and cable the encryption-capable tape drive (IBM service task for TS1120 Tape Drive).
3. Use IBM tape library specialist to enable the tape drive for library-managed tape encryption (refer to your *IBM Tape Drive* or *Library Operator's Guide*).
4. Use library diagnostic functions to verify.

Bulk rekey

For customers with Library-Managed Encryption with 3592 Enterprise tape drives and IBM tape and changer drivers that are running on open systems operating system (AIX, HP-UX, Linux, Solaris, Windows), sample code for completing bulk rekey operations is available. The sample code packages are provided "as-is" with limited testing, and are provided to give customers guidance on bulk rekey operations.

For UNIX operating systems, a sample script (**rekey_unix.sh**) is provided and must be used with the *tapeutil* version that is bundled in the same package. For Windows operating systems, a sample c program (**rekey_win.c**) is provided. Both of these sample programs must be used with both the IBM tape and changer drivers. In addition, data cartridges must be in storage cells, not in I/O station cells or tape drives.

For information and to download the sample code packages, see http://www.ibm.com/support/fixcentral/.

Encryption feature codes

To use system-managed and library-managed encryption, the Transparent LTO Encryption feature codes that are listed in Table 2 on page 11 are required for the associated IBM tape libraries with encryption-capable tape drives. If the drives in use are TS1120 tape drives, this feature code is not required for system-managed or library-managed encryption. If you are using application-managed encryption, no feature code is required on any encryption-capable tape drives.

Table 2. Feature codes (encryption)	
Tape library	**Feature code**
TS4500	FC 1604
TS3500	FC 1604
TS4300	FC 5900
TS3310	FC 5900
TS3100/3200	FC 5900

Chapter 3. AIX Tape and Medium Changer device driver

This chapter describes the IBM AIX Enhanced Tape and Medium Changer Device Driver (Atape) for IBM tape devices.

Purpose

The IBM AIX Enhanced Tape and Medium Changer device driver is designed to take advantage of the features that are provided by the IBM tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape operations (such as backup and restore) and medium changer operations (such as mount and unmount the cartridges), and to the advanced functions needed by full tape management systems. Whenever possible, the driver is designed to take advantage of the device features transparent to the application.

Data flow

The software that is described in this chapter covers the AIX Enhanced Device Driver (Atape device driver) and the interface between the application and the tape device. For data flow, refer to Figure 8 on page 13.
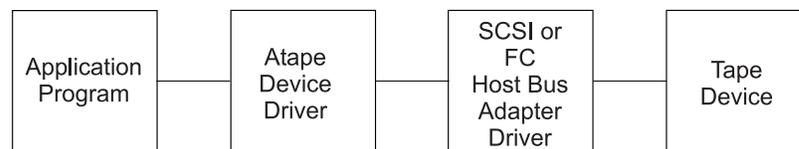
Figure 8. Data flow for AIX Device Driver (Atape)

Product requirements

Hardware requirements

Refer to "Hardware requirements" on page 1 the latest hardware that is supported by the Atape device driver.

Software requirements

The AIX Enhanced device driver (Atape device driver) supports AIX 5L Version 5.3 and later releases on IBM POWER-based AIX servers.

For current software requirements, refer to the "Software requirements" on page 1.

Installation and configuration instructions

The recommended procedure for installing a new version of the device driver is to uninstall the previous version.

Instructions for uninstalling the device driver are outlined in "Uninstalling" on page 16.

1. At the end of the installation procedure, the **installp** facility automatically runs the AIX **bosboot** command to update the boot record with the newly installed Atape files. When the **bosboot** command completes, the following messages are displayed:

```
0503-292 This update does not fully take effect until after a system reboot.
installp: bosboot process completed.
```

This message refers to the updates to the boot record only. If the installation summary shows that the Atape driver was installed successfully, it is not necessary to reboot the machine currently.

If the installation summary shows that the installation failed, you must reboot the machine and attempt to install the Atape driver a second time.

2. During the Atape install, the following entries are entered into the two system files.

   • **/usr/lpp/bosinst/cdfs.optional.list** to help the system image backup to DVD/CD media

   The entry list in **/usr/lpp/bosinst/cdfs.optional.list**:

```
/usr/lib/drivers/Atape      /usr/lib/drivers/Atape      Atape.driver
/usr/lib/methods/cfgAtape   /usr/lib/methods/cfgAtape   Atape.driver
/usr/lib/methods/ucfgAtape  /usr/lib/methods/ucfgAtape  Atape.driver
/usr/lib/methods/defAtape   /usr/lib/methods/defAtape   Atape.driver
/usr/lib/methods/udefAtape  /usr/lib/methods/udefAtape  Atape.driver
/usr/lib/methods/chgAtape   /usr/lib/methods/chgAtape   Atape.driver
```

   • **/usr/lpp/bosinst/tape/tapefiles1** to create a bootable tape

   The entry list in **/usr/lpp/bosinst/tape/tapefiles1**:

```
/usr/lib/drivers/Atape
/usr/lib/methods/ucfgAtape
/usr/lib/methods/cfgAtape
/usr/lib/methods/udefAtape
/usr/lib/methods/defAtape
/usr/lib/methods/chgAtape
```

   The entries are removed from the files when Atape is uninstalled.

   ⚠️ **Attention:** The entries might be lost when a user upgrades the AIX file set of **bos.sysmgt.sysbr** for System Backup and BOS Install Utilities after Atape installation. It is recommended that the user check whether the entries still exist and add the entries into the files if needed.

Installation procedure

For information on obtaining the latest version of device drivers and the latest documentation, refer to Appendix A, "Accessing documentation and software online," on page 293.

Preinstallation considerations

Before the installation starts, verify the following items:

1. The tape device is properly functioning, properly attached to the server, and is powered up.

2. You logged on to the server on an account that has *root* authority.

3. You have a command shell window open on the server to run the installation procedure.

4. Make sure that the current path is defined in the command shell PATH variable. This definition can be accomplished in the Korn shell by using the following command:

```
EXPORT PATH=.:$PATH
```

5. If the tape device was configured previously by another device driver (not Atape), remove any existing device definitions for it. The following command is an example: **rmdev -l ost1 -d**

Installation procedure

Enter the following command to list the currently installed *Atape.driver* version:

```
lslpp -l Atape.driver
```

Enter the following command to install the Atape driver in the current directory. For example

```
installp -acXd Atape.x.x.x.x Atape.driver
```

This command installs and commits the Atape driver on the system.

Configuring Tape and Medium Changer devices

After the driver software is installed and a tape device is connected to the adapter, the device can be configured and made available for use. Access to the device is not provided until the device is configured.

Note: If the tape device was configured previously by another SCSI device driver, such as OST (Other SCSI Tape), issue the following command to remove the device definition before the following steps are completed.

```
rmdev -l [device]
```

Configure a tape device by using one of the following procedures.

- Enter the following command with no parameters.

```
cfgmgr
```

  The command configures all devices automatically (including any new tape or medium changer devices).
- Power Off your subsystem and reboot the system to configure it automatically and make available any new tape or medium changer devices on the system.

Configuring limitations

The subsequent limitations are applied for the Atape driver that runs on an AIX host.

Maximum supported number of tape devices	1024
Maximum supported number of HBA ports	32
Maximum supported number of paths for a device (DPF/ CPF)	16/16
Maximum LUN size per target for FC HBA*	4095

Note: *On AIX systems, the maximum LUN number is 4095. Since Atape supports up to 1024 devices, Atape configures a total of 1024 devices by using the range from LUN 0 - 4095. For instance, a device with LUN 4095 at a SCSI target address can be configured by Atape if the total number of devices on the system is less than 1024.

Every opened tape device uses a certain amount of resources. The user must also consider other resources such as physical memory and virtual space on the system before you attempt to reach the limits.

Deconfiguring tape devices

Note: In the following examples, replace the letter *n* with the appropriate number for the chosen device.

Deconfigure the tape device by using one of the following procedures:

1. The first method leaves the tape device that is defined in the configuration database. It is similar to bringing the device offline (not in use).

   Enter the following command to bring the **/dev/rmtn** tape device offline, but leave it defined in the device database.

   ```
   rmdev -l rmtn
   ```

2. The second method brings the tape device offline and removes its definition from the device database.

   Enter the following command.

   ```
   rmdev -l rmtn -d
   ```

   The device driver is not unloaded from the kernel until the last device is deconfigured.

Deconfiguring Medium Changer devices

Note: In the following examples, replace the letter *n* with the appropriate number for the chosen device.

Deconfigure the medium changer device by using one of the following procedures:

1. The first method leaves the device that is defined in the configuration database. It is similar to bringing the device offline.

   Enter the following command to bring the **/dev/smcn** medium changer device offline, but leave it defined in the device database.

   ```
   rmdev -l smcn
   ```

2. The second method brings the medium changer device offline and removes its definition from the device database.

   Enter the following command.

   ```
   rmdev -l smcn -d
   ```

   The device driver is not unloaded from the kernel until the last device is deconfigured.

Uninstalling

⚠️ **Attention:** All devices that use the Atape driver must be closed and cannot be in use when Atape is uninstalled or the uninstall fails.

You can uninstall the Atape device driver by using the **smit** command menu to uninstall software and selecting **Atape.driver** or by using the following **installp** command

```
installp -u Atape.driver
```

Tape drive, media, and device driver parameters

This chapter describes the parameters that control the operating modes of the AIX Enhanced Tape and Medium Changer Device Driver.

Configuration parameters

The operating parameters for the tape drive and device driver are set and changed by configuration parameters. The installation defaults are provided for all parameters initially. The AIX **smit** command is used to set these parameters when a device is configured or to change these parameters. The AIX **chdev** command is used to change the configuration parameters.

The configuration parameters are used to set the operating mode of the tape drive and device driver when a device is opened. These parameters can be queried by an application. Some parameters can be temporarily changed during the *open* subroutine by an application. But, they are always restored to the configuration values when a device is closed. The configuration parameters are

- Alternate Pathing
- Autoloading
- Emulate autoloader (359x devices only)
- Block size
- Buffered mode (359x devices only)
- Compression
- Fail degraded media (359x devices only)
- Logical write protect (359x devices only)
- Logging
- Maximum size of the log file
- New logical name
- Read error recovery time (359x devices only)
- Record space mode
- Reservation key
- Reservation support
- Reservation type
- Retain reservation
- Rewind immediate
- System encryption
- System encryption for Write Commands
- Trailer labels
- SCSI status busy retry

Alternate pathing

This parameter enables or disables the path failover support when a device is configured."Data Path failover and load balancing support for tape drives" on page 28 for a description of the path failover and failover support.

The installation default is no (path failover is not enabled).

Autoloading

This parameter enables the autoloading feature of the device driver. It is used with the autoloading capability of the autoloader, ACF, ACL, or CSL installed on the tape device.

Note: The autoloading feature is not supported on the IBM 3584 UltraScalable tape library and the IBM 3583 Ultrium Scalable tape library with more than one IBM 3580 Ultrium tape drive installed.

Note: The autoloading feature is supported only on the following device types and configurations:

- IBM 3490E Models C11, C22, E01, E11, F01, and F11
- IBM Enterprise Tape System 3590, Models B11, E11, and H11
- IBM Magstar® MP 3570 Models B01, C01, B11, and C11
- IBM Magstar MP 3570 Models B02, B12, C02, and C12 (configured in split mode only)
- IBM 7332 (all models)

Do not enable autoloading if one of the following conditions is true.

- The device is used by an application that provides library medium changer support for the IBM 3581 or IBM 3583.
- The device is installed in a 3494 Enterprise Tape Library.
- The device is used by an application with stack loader support.
- The application is MKSYSB.
- The tapes that are read were not written with the autoloading feature.

Tapes that are created with AUTOLOAD=YES are not readable in configurations without Atape autoload enabled, or on other UNIX operating systems, or on device types/models that are different from the backup device type/model.

If the parameter is set to On, then the tape stacker acts as one large virtual tape. During a read, write, or forward space file operation, no end of tape is detected by the application. When the end of tape is reached, the device driver automatically rewinds and unloads the tape, then loads the next tape. Then, it continues reading or writing the next tape. The following conditions are required to use this feature:

- The autoloading parameter must be set to On.
- The cartridge stacker must be loaded with one or more tapes.
- The ACF, ACL, or CSL must be set to Automatic, System, or Random mode.

This feature allows multivolume backups (with commands such as **tar**) without prompting for a volume change.

The installation default is Off (no autoloading).

Emulate autoloader

This parameter controls how the device driver operates when the ACF on the IBM Enterprise Tape System 3590, the IBM Magstar MP tape device, or the IBM 3490E Model F*xx* is set to Random mode. If this parameter is set to On and the ACF is in Random mode, the device driver emulates an autoloading tape drive. When an unload command is sent to the device driver to unload a tape, the tape is unloaded, returned to the magazine, and the next tape in the magazine is loaded automatically into the tape drive. If this parameter is set to Off, the normal unload operation occurs, and the tape remains in the drive.

The emulate autoloader parameter can be used for legacy applications that are written for the IBM 3490E Automated Cartridge Loader (ACL) when the IBM Enterprise Tape System 3590, the IBM Magstar MP 3570, or the IBM 3490 Model F autoloader is set to Random mode. This parameter eliminates the need to reconfigure the autoloader of the device Random or Automatic operation.

The installation default is Off (do not emulate autoloader).

Note: On IBM Magstar MP 3570 Models B02, C02, and C12, this feature is supported only when the two drives are configured in Split mode, or in Base mode with one drive that is configured and available to AIX. This feature does not work in Base mode if both drives are in the available state to AIX.

Block size

This parameter specifies the block size that is used for read and write operations. A value of zero is the variable block size. Any other value is a fixed block size.

The installation default is zero (use variable length) except for the IBM 7332 4-mm Tape Cartridge Autoloader, for which the default is a fixed block size of 1024 bytes.

Buffered mode

When a **write** command is processed, the data is either stored directly on the physical tape or buffered in the tape device. Buffering can increase the device performance.

The installation default is On (use Buffered mode).

Compression

Hardware compression is implemented in the device hardware. This parameter turns the compression feature On and Off. If compression is enabled, then the effective performance can increase based on the compressibility of the data.

The installation default is On (use compression).

Fail degraded media

This parameter controls whether the device driver fails a tape operation when degraded media is detected by the IBM Enterprise Tape System 3590. If a tape is loaded and the IBM 3590 cannot read the positioning information from the tape, the device driver is notified when the first command is sent to the tape drive. If this parameter is set to On, the device fails the command and returns a media error to the application. If this parameter is set to Off, the device driver does not fail the command.

Degraded media is a correctable condition that prevents the IBM Enterprise Tape System 3590 from running high speed **Locate** operations. A **Locate** command can take over 20 minutes, depending on the wanted position and the amount of data on the tape. This parameter is intended for use by real-time applications that cannot tolerate long **Locate** commands.

The installation default is Off (do not fail the tape operation if degraded media is detected).

Logging

This parameter turns the volume information logging on and off. If logging is set to On, the statistical information about the device and media is saved in a log file when a tape is unloaded. If logging is set to Off, the information is not saved. This parameter has no effect on error logging because error logging is always enabled. For information, refer to "Device and volume information logging" on page 31.

The installation default is Off (no logging).

Maximum size of the log file

This parameter specifies the number of entries that are made before the log file starts to wrap. Each entry is approximately 2 KB (2048 bytes). After the log file starts to wrap, the number of entries stays constant. Each time a new entry is made, the oldest entry is overlaid. For information, refer to "Device and volume information logging" on page 31.

The installation default is 500.

New logical name

Setting this parameter changes the logical name of the device to a new name as specified. After the logical name is changed, the new logical name parameter is cleared. For information, refer to "Persistent Naming Support" on page 25.

There is no installation default value for this parameter.

Read error recovery time

This parameter controls the read error recovery time for the IBM Enterprise Tape System 3590. If this parameter is set to On, the recovery time for read errors is limited to a maximum of 5 seconds. If this parameter is set to Off, full recovery is used by the device and can take up to 10 minutes. This parameter is intended for use by real-time applications that cannot tolerate long delays when data is read from the tape.

The installation default is Off (do not limit the read error recovery time).

Record space mode

This parameter specifies how the device driver operates when a forward or backward space record operation encounters a filemark. The two modes of operation are SCSI and AIX.

The SCSI mode is the default mode of operation. When a forward or backward space record operation is issued to the driver and a filemark is encountered, the device driver returns **-1** and the *errno* variable is set to input/output error (EIO). The tape is left positioned after the filemark (the end-of-tape side of the filemark on the forward space and the beginning-of-tape side of the filemark on the backward space).

The AIX mode returns the same EIO *errno* value as the SCSI mode when a filemark is encountered except that the tape is left positioned before the filemark (the beginning-of-tape side of the filemark on the forward space and the end-of-tape side of the filemark on the backward space).

The installation default is SCSI mode.

Reservation key

This parameter specifies the SCSI Persistent Reservation key that is used by the device driver when either the **Reservation Type** parameter is SCSI Persistent Reserve and the **Alternate Pathing** parameter is set to no or when the **Alternate Pathing** parameter is set to **Yes**.

The default for this attribute is blank (NULL).

If the **Reservation Key** parameter is specified as blank (NULL), then the device driver uses an internal unique key for all devices on the host they are configured on. Another AIX host that shares devices also have an internal unique key for all devices if the **Reservation Key** parameter was blank (NULL).

If the default is not used, then the Reservation Key value can be specified as either a 1-8 character ASCII alphanumeric key or a 1-16 hexadecimal key that has the format 0xkey. If fewer than 8 characters are used for an ASCII key (such as host1), the remaining characters are set to 0x00 (NULL). If less than a 16 hexadecimal key is used, the remaining bytes are set to 0x00.

Note: When a Reservation Key is specified on each host that shares a device, the key must be unique to each host.

Reservation support

The parameter of **reserve_support** indicates that the Atape driver manages the reservation for the tape device when it is enabled. Atape reserves the tape device in open and releases it in close, and maintains the reservation in error recovery procedure (ERP).

Note: For the medium changer, this parameter is not applied when the **Alternate Pathing** (path failover) parameter is set to **Yes**. The device driver forces the setup to be disabled and the medium changer is not reserved in open when the **Alternate Pathing** parameter is set to **Yes**.

The installation default is **Yes**.

Reservation type

This parameter specifies the SCSI Reservation type that is used by the device driver, either a **SCSI Reserve 6** command or a **SCSI Persistent Reserve** command.

Note: This parameter is not used if the **Alternate Pathing** (path failover) parameter is set to **Yes**. The device driver uses SCSI Persistent Reserve when the **Alternate Pathing** parameter is set to **Yes**.

The installation default is SCSI Reserve 6.

Retain reservation

When this parameter is set to 1, the device driver does not release the device reservation when the device is closed for the current open. Any subsequent opens and closes until the **STIOCSETP** IOCTL is issued with **retain_reservation** parameter set to 0. The device driver still reserves the device on open to make sure that the previous reservation is still valid.

The installation default is Off (the reservation is released in close).

Rewind immediate

This parameter turns the immediate bit On and Off in rewind commands. If it is set to On, the rewind tape operation runs faster. However, the next command takes a long time to finish unless the rewind operation is physically complete. Setting this parameter reduces the amount of time that it takes to close a device for a **Rewind on Close** special file.

The installation default is Off (no rewind immediate) except for the IBM 7332 4-mm Tape Cartridge Autoloader, for which the default is On (rewind immediate).

System encryption

This parameter specifies whether System-Managed Encryption must be used. For information, refer to "System-managed encryption" on page 30.

The installation default is No.

System encryption for Write commands

This parameter controls if System-Managed Encryption is used for Write commands. For information, refer to "System-managed encryption" on page 30.

The installation default is Custom.

Trailer labels

If this parameter is set to On, then writing a record past the early warning mark on the tape is allowed. The first write operation to detect EOM fails, and the *errno* variable is set to ENOSPC. No data is written during the operation. All subsequent write operations are allowed to continue until the physical end of the volume is reached and EIO is returned.

This parameter can also be selected by using one of three device special files that allow trailer-label processing. The special files are `rmtx.40`, `rmtx.41`, and `rmtx.60`, where *x* is the name of the device (for example, `rmt0.40`).

The installation default is Off (no trailer labels).

SCSI status busy retry

Atape retries the SCSI command fail due to the SCSI status **Busy** when the parameter of **busy_retry** is set to On. Otherwise, Atape fails the SCSI command if it is set to Off.

The installation default is Off.

Media parameters

The ability to set or change media parameters is a tape diagnostic and utility function, refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

The media parameters can be queried and set by ITDT or the tape diagnostic and utility function by using the Query/Set Parameters option in the window.

These parameters cannot be set or changed by the configuration procedures. The media parameters are

- Capacity scaling
- Logical write protect
- Volume ID for logging

- Archive mode unthread (AMU)

Capacity scaling

This parameter sets the capacity or logical length of the current tape on IBM Enterprise Tape System 3590, IBM Enterprise Tape System 3592, or Magstar MP tape subsystems. By reducing the capacity of the tape, the tape drive can access data faster at the expense of data capacity.

Capacity scaling can be set at 100% for the entire tape (which is the default) or set at 75%, 50%, or 25% of the tape or any device-specific hexadecimal value. For example, on IBM 3592, to change capacity scaling from a 300 GB format tape (100%) to a 60 GB format tape, select the capacity scaling option. Then, select the option to enter a hexadecimal value and enter 35. Capacity scaling remains with the tape across mounts until it is changed.

Note:

1. The tape position must be at the start of the tape to change this parameter from its current value.
2. Changing this parameter deletes any existing data on the tape.
3. Attempting to set capacity scaling that is not supported by a device or the current loaded media always returns 100% and cannot be changed. For example, 60 GB media for the IBM 3592 cannot be capacity scaled and is always 100%.

Logical write protect

This parameter sets or resets the logical write protect of the current tape on IBM Enterprise Tape System 3590, IBM Enterprise Tape System 3592, or Magstar MP tape subsystems. The three types of logical write-protect are associated-protect, persistent-protect, and write-once read-many (WORM)-protect.

Associated protect remains only while the current tape is mounted or associated with the tape drive. It is reset when the tape is unloaded or the tape drive is reset.

Persistent protect remains or persists with the tape across mounts until it is reset.

WORM protect also remains with the tape across mounts, but (unlike persistent protect) it cannot be reset on the tape. After a tape is WORM protected, it can never be written on again.

Note:

1. The tape position must be at the start of the tape to change this parameter from its current value.
2. Attempting to set logical write protect that is not supported by a device or the current loaded media always returns "No" and cannot be changed.

Volume ID for logging

This parameter is the volume ID of the current loaded tape. It is used in the log file entry (if volume logging is active) to identify the entry with a particular volume. The device driver sets the volume ID to UNKNOWN initially and when the tape is unloaded.

Archive mode unthread (AMU)

This parameter turns Archive mode unthread (AMU) On and Off. When it is set to On, Atape manages and works the AMU feather that rewinds the tape cartridge to the end of tape at a low tension for long-term storage. The AMU feature on the tape drive is enabled for 3592 tape drives and disabled for LTO tape drives by default. To enable or disable this feature on the tape drive, the parameter must be turned on in the Atape driver.

Special files

When the driver is installed and a tape device is configured and available for use, access is provided through the special files. These special files, which consist of the standard AIX special files for tape devices (with other files unique to the Atape driver), are in the **/dev** directory.

Special files for tape devices

Each tape device has a set of special files that provides access to the same physical drive but to different types of functions. As shown in <u>Table 3 on page 23</u>, in addition to the tape special files, a special file is provided for tape devices that allow access to the medium changer as a separate device.

Note: The asterisk (*) represents a number that is assigned to a particular device (such as **rmt0**).

For tape drives with attached SCSI medium changer devices, the **rmt*.smc** special file provides a separate path for commands that are issued to the medium changer. When this special file is opened, the application can view the medium changer as a separate SCSI device.

Both this special file and the **rmt*** special file can be opened at the same time. The file descriptor that results from opening the **rmt*.smc** special file does not support the following operations.

- Read
- Write
- Open in Diagnostic mode
- Commands that are designed for a tape drive

If a tape drive has a SCSI medium changer device that is attached, then all operations (including the medium changer operations) are supported through the interface to the **rmt*** special file. For detailed information, refer to <u>Table 3 on page 23</u>.

Table 3. Special files for tape devices

Special file name	Rewind on Close (Note 1)	Retension on Open (Note 2)	Bytes per Inch (Note 3)	Trailer Label	Unload on Close
/dev/rmt*	Yes	No	N/A	No	No
/dev/rmt*.1	No	No	N/A	No	No
/dev/rmt*.2	Yes	Yes	N/A	No	No
/dev/rmt*.3	No	Yes	N/A	No	No
/dev/rmt*.4	Yes	No	N/A	No	No
/dev/rmt*.5	No	No	N/A	No	No
/dev/rmt*.6	Yes	Yes	N/A	No	No
/dev/rmt*.7	No	Yes	N/A	No	No
/dev/rmt*.10 (Note 4)	No	No	N/A	No	No
/dev/rmt*.20	Yes	No	N/A	No	Yes
/dev/rmt*.40	Yes	No	N/A	Yes	No
/dev/rmt*.41	No	No	N/A	Yes	No
/dev/rmt*.60	Yes	No	N/A	Yes	Yes

Table 3. Special files for tape devices (continued)					
Special file name	Rewind on Close (Note 1)	Retension on Open (Note 2)	Bytes per Inch (Note 3)	Trailer Label	Unload on Close
/dev/rmt*.null (Note 5)	Yes	No	N/A	No	No
/dev/rmt*.smc (Note 6)	N/A	N/A	N/A	N/A	N/A

Note:

1. The Rewind on Close special files write filemarks under certain conditions before rewinding.
2. The Retensions on Open special files rewind the tape on open only. Retensioning is not done because these tape products complete the retension operation automatically when needed.
3. The Bytes per Inch options are ignored for the tape devices that are supported by this driver. The density selection is automatic.
4. The **rmt*.10** file bypasses normal close processing, and the tape is left at the current position.
5. The **rmt*.null** file is a pseudo device similar to the **/dev/null** AIX special file. The input/output control (*ioctl*) calls can be issued to this file without a real device that is attached to it, and the device driver returns a successful completion. Read and write system calls return the requested number of bytes. This file can be used for application development or debugging problems.
6. The **rmt*.smc** file can be opened independently of the other tape special files.

Special files for Medium Changer devices

After the driver is installed and a medium changer device is configured and made available for use, access to the robotic device is provided through the **smc*** special file in the **/dev** directory.

Table 4 on page 24 shows the attributes of the special file. The asterisk (*) represents a number that is assigned to a particular device (such as **smc0**). The term **smc** is used for a SCSI medium changer device. The **smc*** special file provides a path for issuing commands to control the medium changer robotic device. For information, refer to Table 4 on page 24.

Table 4. Special files for Medium Changer devices	
Special file name	Description
/dev/smc*	Access to the medium changer robotic device
/dev/smc*.null	Pseudo medium changer device

Note: The **smc*.null** file is a pseudo device similar to the **/dev/null** AIX special file. The commands can be issued to this file without a real device that is attached to it, and the device driver returns a successful completion. This file can be used for application development or debugging problems.

The file descriptor that results from opening the **smc** special file does not support the following operations:

- Read
- Write
- Commands that are designed for a tape device

Persistent Naming Support

Persistent naming support is used to ensure that attached devices are always configured with the same logical name based on the SCSI ID, LUN ID, and host bus adapter (HBA), even when the system is rebooted.

When the AIX operating system is booted, the HBA runs a device discovery and assigns a default logical name to each device found in a sequential order. If there are three tape drives attached to a parallel SCSI adapter, each with a LUN ID of 0 and a target address of 0, 1, and 2, the HBA initially configures them as Available with the following logical names.

```
rmt0    target 0, lun 0    Available
rmt1    target 1, lun 0    Available
rmt2    target 2, lun 0    Available
```

Run the following commands before the machine is rebooted.

```
- rmdev -dl rmt1
- rmdev -dl rmt2
```

On the next reboot, if the existing rmt1 target 1 device is powered off or not connected, the HBA initially configures two devices as Available with the following logical names:

```
rmt0    target 0, lun 0    Available
rmt1    target 2, lun 0    Available
```

If the previous rmt1 target 1 device is powered on after reboot and the **cfgmgr** command is run, the HBA configures the device as rmt2 instead of rmt1.

```
rmt2    target 1, lun 0    Available
```

This is one example, but there are other cases where the logical names of devices could change when the system is rebooted. For applications that need a consistent naming convention for all attached devices, it is accomplished with persistent naming support by defining a unique logical name (other than the AIX default names) that are associated with the specific SCSI ID, LUN ID, and HBA that the device is connected to.

Changing the logical name after initial boot

The logical name of a device can be changed after an initial boot and configured. This procedure can be done by using the **SMIT** menu or the **chdev** command from a script or command line.

For example, a default rmt0 logical name for a tape drive can be changed to rmt-0, tape0, or any descriptive name wanted. In this example, if the three tape drives are changed to rmt-0, rmt-1, and rmt-2, and the system is then rebooted with rmt-1 powered off, the HBA detects that unique names are predefined for the attached devices, and the HBA uses those names. In this case, the devices configure as follows:

```
rmt-0    target 0, lun 0    Available
rmt-1    target 1, lun 0    Defined
rmt-2    target 2, lun 0    Available
```

Since rmt-1 is not detected by the HBA but is predefined at the SCSI ID and LUN ID, it remains in the defined state and is not configured for use. But, the next rmt-2 tape drive configures as the same name at the same location after reboot.

Changing the logical name with SMIT

To change the logical name by using SMIT, complete the following steps:

1. Run **SMIT** from a command line and select **Devices**.

2. Select **Tape Drive**.

3. Select **Change/Show Characteristics of a Tape Drive**.

4. Select the logical device to be changed from the list displayed.

5. In the **New Logical Name** field, enter a non-AIX default logical name.

6. Press **Enter** to process the change.

Changing the logical name with the chdev command

The logical name of a device can be changed by using the **chdev** command. For example, to change the logical name of the device from rmt0 to rmt-0, run

```
chdev -l rmt0 -a new_name=rmt-0
```

The output of this command displays

```
rmt0 changed
```

Note:

- When path failover is enabled, if you change the logical name for either a primary or alternate device, only the individual device name changes.
- Follow the naming convention whenever you run **mksysb**, **bosboot**:
  - The prefix name of "rmt" cannot be changed.
  - A sequence number must be a positive integer. The smallest sequence number is 0.
  - The prefix name cannot contain non-numerical characters. For example, **rmt1_rescu** is not an acceptable prefix name.
  - When a device instance logical name is generated, the SMIT tool automatically assigns the next available sequence number (relative to a specific prefix name). The next available sequence number is defined as the smallest sequence number for a particular prefix name that is not yet allocated.

Control Path failover support for tape libraries

Note: The library control path failover feature code must be installed before enabling the path failover support in the Atape device driver. Refer to "Automatic failover" on page 3 for what feature codes might be required for your machine type.

The Atape device driver path failover support configures multiple physical control paths to the same logical library within the device driver. It also provides automatic failover to an alternate control path when a permanent error occurs on one path. This support is transparent to the running application.

Configuring and unconfiguring path failover support

Path failover support is not enabled automatically when the device driver is installed. It must be configured initially on each logical device after installation. When path failover support is enabled for a logical device, it remains set until the device is deleted or the support is unconfigured. The alternate path failover setting is retained even if the system is rebooted.

To enable or disable the support on a single logical device, use the **SMIT** menu to **Change/Show Characteristics of a Tape Drive**, select the logical device to change such as smc0, smc1, then select **Yes** or **No** for **Enable Path Failover Support**. The support can also be enabled or disabled by using the **chdev** command, for example,

```
chdev -l smc0 -aalt_pathing=yes
chdev -l smc1 -aalt_pathing=yes
chdev -l smc0 -aalt_pathing=no
chdev -l smc1 -aalt_pathing=no
```

Primary and alternative paths

When the device driver configures a logical device with path failover support enabled, the first device that is configured always becomes the primary path. On SCSI attached devices, **-P** is appended to the location field. On Fibre attached devices, **-PRI** is appended to the location field of the device.

When a second logical device is configured with path failover support enabled for the same physical device, it configures as an alternative path. On SCSI attached devices, **-A** is appended to the location field. On Fibre attached devices, **-ALT** is appended to the location field of the device.

A third logical device is also configured as an alternative path with either **-A** or **-ALT** appended, and so on. The device driver supports up to 16 physical paths for a single device.

The labeling of a logical device as either a primary or alternative path is for information only, to

1. Be able to identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled as the primary path for each physical device. However, many (multiple) logical devices can be labeled as an alternative path for the same devices.

2. Provide information about which logical devices configured on the system have path failover support enabled.

Querying primary and alternative path configurations

You can see the primary and alternative path configuration for all devices with the **lsdev** command. Two or more logical devices can be configured for a single physical device, but the first device that is configured is labeled the primary device. All other logical devices that are configured after the first device are labeled as alternative devices. To see this information, run the **lsdev -Cc** tape command and look at the location field in the data. Run the following command,

```
lsdev -Cc tape | grep P
```

For example, you can easily determine how many physical devices are configured with path failover support.

Note: Show the primary and alternative path configuration for any device by using tape diagnostic and utility functions. Refer to .

Configuring and unconfiguring primary and alternative devices

Logical devices that are configured as alternative paths can be unconfigured and reconfigured at any time after the initial configuration is run. Unconfiguring an alternative path device removes that device from the primary device path list, removes the **-A** or **-ALT** appended to the location field, and changes the device to the **Defined** state. The primary and any other alternative devices are still available.

Likewise, configuring a new alternative path device or reconfiguring an existing one in the **Defined** state adds that device to the primary device path list, appends **-A** or **-ALT** to the location field, and makes the device available.

Logical devices that are configured as primary paths can also be unconfigured and reconfigured at any time after initial configuration is run. However, the operation is different for a primary device. When a primary device is unconfigured, the following events occur.

1. All alternative devices are unconfigured as described previously.

2. The primary device is unconfigured.

3. The **-P** or **-PRI** appended to the location field is removed.

4. The device is changed to the **Defined** state.

5. All alternative devices that were unconfigured are reconfigured. The first device that is reconfigured becomes the new primary device. All remaining alternative devices are reconfigured as alternative paths.

These methods can unconfigure and reconfigure physical devices on the system when device connections or addressing changes are made.

Data Path failover and load balancing support for tape drives

Note:

1. Some devices require a path failover feature code that is installed before the path failover support is enabled in the Atape device driver. Refer to "Automatic failover" on page 3 for what feature code might be required for your machine type.

2. DPF keys do not need to be added if you are running the latest drive code on Ultrium 3 and Ultrium 4 drives.

3. This function is not supported for devices that are attached through an IBM San Data Gateway or on the IBM Virtualization Engine TS7510.

4. The AIX operating system supports only a static configuration of devices, which also applies to the Path Failover and Failover Support. When devices are initially configured at a specific SCSI ID and physical connection (drive port, host bus adapter, and switch number/port, if applicable) and in the Available state, changing the physical device address/connection without either rebooting or unconfiguring and reconfiguring the devices has unpredictable results and is not supported.

Installing Data Path failover license key

Use the following command line script to query, add, or delete license keys for this feature before the path failover feature is enabled as described below. The key is a 16-digit hexadecimal value, for example, 1234567890abcdef.

All key values "A-F" must be entered in lowercase letters as "a-f."

- Query installed keys: dpf_keys
- Install a license key: dpf_keys -a key
- Delete a license key: dpf_keys -d key

Configuring and unconfiguring path failover support

Path failover support is not enabled automatically when the device driver is installed. It must be configured initially on each logical device after installation. When path failover support is enabled for a logical device, it remains set until the device is deleted or the support is unconfigured. The path failover setting is retained even if the system is rebooted.

Path failover support can be enabled on all configured devices at one time, or it can be enabled or disabled selectively by logical device. It might be desirable at times to configure some, but not all, logical paths to a device with the support enabled.

To enable the support globally on all currently configured devices, run the command

```
/usr/lpp/Atape/instAtape -a
```

This action unconfigures all devices that have path failover set to **No**, and reconfigures all devices, setting path failover to **Yes**.

To enable or disable the support on a single logical device, use the **SMIT** menu to **Change/Show Characteristics of a Tape Drive**, then select **Yes** or **No** for **Enable Path Failover Support**. The support can also be enabled or disabled by using the **chdev** command, for example:

```
chdev -l rmt0 -aalt_pathing=yes
chdev -l rmt0 -aalt_pathing=no
```

Primary and alternative paths

When the device driver configures a logical device with path failover support enabled, the first device that is configured always becomes the primary path and PRI is appended to the location field of the device. When a second logical device is configured with path failover support enabled for the same physical device, it configures as an alternative path and ALT is appended to the location field. A third logical device is configured as the next alternative path with ALT appended, and so on. The device driver supports up to 16 physical paths for a single device.

For example, if rmt0 is configured first, then rmt1, the **lsdev -Cc** tape command output is similar to the following command.

```
rmt0 Available 20-60-01-PRI IBM 3590 Tape Drive and Medium Changer (FCP)
rmt1 Available 30-68-01-ALT IBM 3590 Tape Drive and Medium Changer (FCP)
```

If rmt1 is configured first, then rmt0, the command output is similar to the following.

```
rmt0 Available 20-60-01-ALT IBM 3590 Tape Drive and Medium Changer (FCP)
rmt1 Available 30-68-01-PRI IBM 3590 Tape Drive and Medium Changer (FCP)
```

The labeling of a logical device as either a primary or alternative path is for information only, to

1. Identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled the primary path for each physical device. However, many (multiple) logical devices can be labeled as an alternative path for the same devices.
2. Provide information about which logical devices configured on the system have path failover support enabled.

Querying primary and alternative path configuration

You can see the primary and alternative path configuration for all devices with the **lsdev** command. Two or more logical devices might be configured for a single physical device, but the first device that is configured is labeled the primary device. All other logical devices that are configured after the first device are labeled as alternative devices.

To see this information, run the **lsdev -Cc tape** command and look at the location field in the data. By running lsdev -Cc tape | grep PRI, for example, you can easily determine how many physical devices on the RS/6000® or System p (also known as pSeries) server are configured with path failover support.

Configuring and unconfiguring primary and alternative devices

Logical devices that are configured as alternative paths can be unconfigured and reconfigured at any time after the initial configuration is run. Unconfiguring an alternative path device removes that device from the primary device path list, removes the **ALT** appended to the location field, and changes the device to the **Defined** state. The primary and any other alternative devices are still available. Likewise, configuring a new alternative path device or reconfiguring an existing one in the **Defined** state adds that device to the primary device path list, appends **ALT** to the location field, and makes the device available.

Logical devices that are configured as primary paths can also be unconfigured and reconfigured at any time after initial configuration is run. However, the operation is different for a primary device. When a primary device is unconfigured, the following events occur.

1. All alternative devices are unconfigured as described previously.
2. The primary device is unconfigured.
3. The **PRI** appended to the location field is removed.
4. The device is changed to the **Defined** state.

5. All alternative devices that were unconfigured are reconfigured. The first device that is reconfigured becomes the new primary device. All remaining alternative devices are reconfigured as alternative paths.

These methods unconfigure and reconfigure physical devices on the system when device connections or addressing changes are made.

System-managed encryption

Device driver configuration

System-managed encryption can be set on a specific tape drive by using the standard **SMIT** panels to **Change/Show Characteristics** of a tape device or the command line **chdev** command. There are two new attributes added for encryption.

```
sys_encryption "yes/no"              Use System Encryption FCP Proxy
Manager
wrt_encryption "off/on/custom"       System Encryption for Write Commands at BOP
```

The `sys_encryption` attribute enables device driver system-managed encryption for a tape drive by setting the value to **yes**.

The `wrt_encryption` attribute controls whether the device driver can set the tape drive to encryption enabled for write commands. When set to **off**, the tape drive uses encryption for read operations; write operations do not use encryption. When set to **on**, the tape drive uses encryption for both read/write operations. When set to **custom**, the device driver does not modify current tape drive setting. The custom setting is intended for applications that use system-managed encryption to control write encryption without device driver intervention.

Note: If `wrt_encryption` is set to **on**, an application cannot open a tape drive by using the append mode.

Querying tape drive configuration

Querying the tape drive configuration is a tape diagnostic and utility function. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Testing data encryption configuration and connectivity

A data encryption test is available to validate the **ibmekm.conf** file server entries and test tape drive to server connectivity operations.

This test is a tape diagnostic and utility function. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Error logging

Encryption errors are logged along with other tape operation errors by using the standard TAPE_ERR1 Template "Tape Operation Error" with associated sense data in the detail data.

An encryption failure is indicated when the `asc/ascq` in the sense data is EFxx or EExx. Refer to the tape drive hardware reference for information on the **asc/ascq** being reported. The **asc/ascq** can be found in the first column of the second row in detail sense data. For example,

```
Detail Data
SENSE DATA
0A00 0000 5A08 25FF 0000 00FF FF00 0000 0000 0000 F000 0600 0000 1458 0000 0000
EF11 FF02 D105 0000 0009 0191 0002 0000 0000 0A00 0000 0000 0000 0000 0000 0000
0000 0000 0000 FFFF FF00 0000 FFF0 B7E3 0001 2127 0000 0000 0000 0000 3930 3220
2020 2000 0041 4A00 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

Field support information

When encryption failures require field support or development analysis, the following data must be provided for a problem on a specific tape drive from the machine (rmt1 for example) for the device driver. Tape drive dumps and EKM server logs might be needed in addition to this information.

```
errpt -a > errpt.rmt1
lsattr -El rmt1 > lsattr.rmtl
All Atape files in /var/adm/ras/Atape*
```

Problem determination

A set of tools is provided with the device driver to determine whether the device driver and the tape device are functioning correctly. The standard AIX interface is provided for problem determination.

Dump support

Dump support is provided through the dump entry point in the driver. Refer to appropriate AIX manuals for a description of how to use the dump devices and how to read the dump data.

Dump device commands

To list the current dump devices, enter the following command,

```
sysdumpdev -l
```

To establish the **rmt1** tape device as a secondary dump device, enter the following command,

```
sysdumpdev -s /dev/rmt1
```

To run a dump operation, use the **sysdumpstart** command. To send the dump data to the secondary dump device, enter the following command:

```
sysdumpstart -s
```

Note: This command stops the system. Use the **sync** command to ensure that the cache is flushed before the **sysdumpstart -s** command is issued.

To list the last dump data, enter the following command,

```
sysdumpdev -z
```

After the dump data is placed on the tape, copy it to a file on the disk before the **crash** command is used to process it. For example,

```
dd if=/dev/rmt1 of=tapedump1 ibs=4096 obs=512
crash tapedump1
```

Note: The *ibs* value is the input block size.

If the block size of the tape device is larger than the block size sent during the dump process, the dump operation fails. Set the block size to zero on the tape device and experiment with the *ibs* value for the **dd** command.

Device and volume information logging

An optional logging utility is provided to log the information about the device and the media. The information is extensive for some devices and limited for other devices. If set to **On**, the logging facility gathers all available information through the **SCSI Log Sense** command.

This process is a separate facility from error logging. Error logging is routed to the system error log. Device information logging is sent to a separate file.

The following parameters control this utility,

- Logging
- Maximum size of the log file
- Volume ID for logging

Refer to "Tape drive, media, and device driver parameters" on page 16 for a description of these parameters.

Each time the rewind and unload sequence occurs or the **STIOC_LOG_SENSE** *ioctl* command is issued, an entry is added to the log. Each time a new cartridge is loaded, the values in the device log buffers are reset with the **Log Sense** command. The log data is gathered on a per-volume basis.

Log file

The data is logged in the `/usr/adm/ras` directory. The file name is dependent on each device; therefore, each device has a separate log. An example of the **rmt1** device file is

```
/usr/adm/ras/Atape.rmt1.log
```

The files are in binary format. Each entry has a header followed by the raw **Log Sense** pages as defined for a particular device.

The first log page is always page 0x00. This page, as defined in the SCSI-2 ANSI specification, contains all pages that the device supports. Page 0x00 is followed by all pages that are specified in page 0x00. The format of each following page is defined in the SCSI specification and the device manual.

Tape log utility

A tape log utility is installed with the *tapelog* device driver that displays the contents of the log file in ASCII text. The log pages are shown as hexadecimal values in dump format.

The syntax for the tape log utility is

```
tapelog -l Name [-d] or tapelog -f File [-d]
```

Note:

1. **Name** is the logical name of the device (such as **rmt0**).
2. **File** is the name of a log file (such as `Atape.rmt0.log`).
3. The **-d** parameter, if used, deletes the log file for the specified device.

The contents of the log file are displayed as standard output. To save the log in a file, use the AIX redirection function. For example,

```
tapelog -l rmt0 > rmt0.log
```

Reservation conflict logging

When the device driver receives a reservation conflict during open or after the device is opened, it logs a reservation conflict in the AIX error log. Before it logs the error, the device driver issues a **Persistent Reserve In** command to determine whether a SCSI Persistent Reservation is active on the reserving host to get the reserving host initiator WWPN (worldwide port name) and reserve key. If successful, the device driver logs this information as follows,

```
Reserving host key xxxxxxxx WWPN xxxxxxxx
```

Where the first xxxxxxxx is the actual reserve key, and the second xxxxxxxx is the reserving host initiator WWPN.

After the reserving host WWPN is initially logged, subsequent reservation conflicts from the same reserving host WWPN are not logged. This action prevents multiple entries in the error log until either the reserving host WWPN is different from the one initially logged or the device driver reserved the device and another reservation conflict occurs.

If the **Persistent Reserve In** command fails, the detail data contains the following entry with the errno from the failing **Persistent Reserve In** command.

```
Unable to obtain reserving host information, errno x
```

The possible *errno* values are

- ENOMEM - Device driver cannot obtain memory to run the command
- EINVAL - Device has a Persistent Reservation but does not support the Persistent Reserve In service action
- EBUSY - Device failed the command with reservation conflict and has an SCSI-2 Reserve active
- EIO - Unknown I/O failure occurred

Error logging

The device driver provides logging to the AIX system error log for various errors. The error log can be viewed for specific devices by using the **Error Log Analysis** utility that is provided with the tape drive service aids. Refer to "Error Log Analysis" on page 38. The error log can also be viewed by using the **smit** or the **errpt** command.

Error log templates

The error log templates the device driver uses follow the same format as the default AIX tape error log entries. Each error log entry is identified by an error label and contains detail data that is associated with the type of error. The following items describe the error labels and detail data for the templates that are used for logging tape device, media, and SCSI adapter-related errors in the AIX system error log.

Error labels

Errors are logged with an associated error label and error ID. The error label indicates the basic type of error.

- TAPE_ERR1

  Tape media error
- TAPE_ERR2

  Tape hardware error
- TAPE_ERR4

  SCSI Adapter detected error
- TAPE_ERR5

  Unknown error
- RECOVERED_ERROR

  Temporary tape hardware or media error
- SIM_MIM_RECORD_3590

  3590 Service/Media Information Message (Log Page X '31')
- TAPE_SIM_MIM_RECORD

  Tape drive Service/Media Information Message (Log Page X '31')
- DEV_DUMP RETRIEVED

  Device dump retrieved

- TAPE_DRIVE_CLEANING

  Tape drive needs cleaning
- RESERVE_CONFLICT

  Reservation conflict

Detail data

Detail data is logged with the associated error that identifies the cause of the error. Detail data for the SIM_MIM_RECORD_3590 or TAPE_SIM_MIM_RECORD entries contain the raw data from Log Sense Page 31. Refer to the hardware reference manual for the format of this entry. All other error log entries use the following format for detail data:

```
Detail Data
SENSE DATA
aabb xxxx ccdd eeee eeee eeee eeee eeee ffgg hhxx ssss ssss ssss ssss ssss
ssss ssss ssss ssss ssss ....
```

aa
    Length of the command descriptor block (CDB).

bb
    SCSI target address.

xx
    Unused or reserved.

cc
    Start of CDB, *cc* is the operation code (byte 0).

dd
    Logical unit (byte 1) in the CDB.

ee
    Bytes 2 - 12 in the CDB.

ff
    Status validity field. If this field is 01, then a SCSI error was reported, and byte *gg* indicates the type of error. If this field is 02, then an adapter error was reported, and byte *hh* indicates the type of error.

gg
    This byte indicates the type of SCSI error that occurred.

- 02 CHECK CONDITION - Device reported a check condition.
- 08 BUSY STATUS - Target is busy.
- 18 RESERVATION CONFLICT - Target is reserved to another initiator.
- 22 COMMAND TERMINATED - Device terminated the command.
- 28 QUEUE FULL - Device command queue is full.

hh
    This byte indicates the type of adapter error that occurred. For parallel SCSI adapters, this byte is the general_card status code as defined in /usr/include/sys/scsi.h

- 01 HOST IO BUS ERROR - Host I/O bus error during data transfer.
- 02 SCSI BUS FAULT - SCSI bus protocol or hardware error.
- 04 COMMAND TIMEOUT - Command timed out before completion.
- 08 NO DEVICE RESPONSE - Target did not respond to selection phase.
- 10 ADAPTER HARDWARE FAILURE - Adapter indicated a hardware failure.
- 20 ADAPTER SOFTWARE FAILURE - Adapter indicated a microcode failure.
- 40 FUSE OR TERMINAL PWR - Blown terminator fuse or bad termination.
- 80 SCSI BUS RESET - Adapter indicated that SCSI bus was reset.

For FCP or SAS adapters, this byte is the adapter_status code as defined in `/usr/include/sys/scsi_buf.h`

- 01 HOST IO BUS ERROR - Host I/O bus error during data transfer.
- 02 TRANSPORT FAULT - Failure in the transport layer.
- 03 COMMAND TIMEOUT - Command timed out before completion.
- 04 NO DEVICE RESPONSE - Target did not respond to attempts to select it.
- 05 ADAPTER HARDWARE FAILURE - Adapter indicated a hardware failure.
- 06 ADAPTER SOFTWARE FAILURE - Adapter indicated a microcode failure.
- 07 WW NAME CHANGE - Adapter detected a new worldwide name for the device.
- 08 FUSE OR TERMINAL PWR - Blown terminator fuse or bad termination.
- 09 TRANSPORT RESET - Adapter detected an external SCSI bus reset.
- 0A TRANSPORT BUSY - The transport layer is busy.
- 0B TRANSPORT DEAD - The transport layer is inoperative.

ss

If byte *gg* indicates a check condition, the *ss* byte is the sense data from the device. Refer to the appropriate device reference manual for the specific format and content of these bytes.

Automatic dump facility

The device driver provides an automatic dump facility for devices that support reading a dump and indicating when a dump is available in device sense data. Whenever a check condition occurs and the sense data indicates that a dump is available, the device driver reads the dump from the device and stores it in the `/var/adm/ras` directory. A maximum of five dumps for each device are stored in this directory as

```
Atape.rmtx.dump1
Atape.rmtx.dump2
Atape.rmtx.dump3
```

Note: *X* is the device number, for example, **rmt0**.

When the device is first configured, the dump name is set to **dump1**. If more than three dumps occur, the driver starts over at **dump1**; therefore the last three dumps are always kept.

Dynamic Runtime Attributes

Field issues can occur where customers must know which initiator on a host is holding a reservation in a drive or preventing the media from being unloaded. Also, they must correlate which special file name is used for the drive (such as **rmt2**). Sometimes this issue occurs over transport bridges and translators, thus losing any transport identifiers to help this effort. LTO5, 3592 E07, 3592 E08, and later physical tape drives support attributes set to the drive dynamically by a host. This function is called Dynamic Runtime Attributes (DRA). Atape supports the feature, starting from 12.5.9.0.

The feature is enabled by default. The drive attributes on the host are set during the open, close, device reset, and data path change only. So, it does not have impact on the tape and system performance. The error is ignored and is not returned to application, when the information failed to send. However, a device attribute named as "host_attributes" is available to disable the DRA feature, when Atape runs with the virtual tape library for which the feature is not supported.

Run the **lsattr** command to display the attribute of host_attributes setup.

On LTO tape drive:

```
# lsattr -El rmt1
host_attributes yes     Host Dynamic Runtime Attribute (LTO-5 and later only) True
```

On 3592 tape drive:

```
# lsattr -El rmt4
host_attributes yes      Host Dynamic Runtime Attribute for 3592-E07 and later True
```

To modify the attribute of "host_attribute", run the **chdev** command.

```
# chdev -lrmt1 -a host_attributes=no
rmt1 changed
```

Trace facility

The AIX trace facility is supported for the device driver. The trace event is identified with a *hookword*. The hookword that is used by the device driver is 326. The trace can be initiated at any time before an operation on a tape device.

Enter the following AIX command to start the trace.

```
trace -a -j 326
```

This command starts the trace in the background and collects only the trace events with the 326 hookword (*Atape* device driver).

Enter the following AIX command to stop the trace.

```
trcstop
```

This command stops the trace after the tape operations are run.

Enter the following AIX command to view the trace.

```
trcrpt > trace.out
```

This command formats the trace output into a readable form and places it into a file for viewing.

Atape System Trace (ATRC) utility

The **atrc** trace utility is also installed with the device driver to start, stop, and format a device driver trace. To start the trace, enter the **atrc** command. To stop and format the trace, enter the **atrc** command again. The trace is formatted to an **atrc.out** AIX file in the current directory.

Component tracing

Later releases of AIX 5.3 and above support component tracing. Unlike system tracing that must be started and stopped, component tracing by default is on all the time and runs continually.

To determine whether component tracing is available, run the command **ctctrl -q** to display a list of supported components with their default settings. You must have root authority to run this command. Refer to the AIX **ctctrl man** page for a complete description of the **ctctrl** command and parameters.

To dump and format the current component trace to a file (for example, **actrc.out**) into the current directory, run the following commands.

```
ctctrl -D -c Atape
trcrpt -l Atape -o actrc.out
```

The Atape component trace can also be retrieved from a system dump. This action eliminates the need to start the Atape system trace before a system dump or to re-create an AIX system dump when a system trace is not running. The AIX system dump is normally stored in the **/var/adm/ras** directory as a **vmcore.x.BZ** file, where *x* is a dump number 1, 2, and so on.

To retrieve and format the Atape component trace from a dump file (for example, **vmcore.1.BZ**) to a file (for example, **actrc.dump**) into the current directory, run the following commands.

```
dmpuncompress /var/adm/ras/vmcore.1.BZ
trcdead -c /var/adm/ras/vmcore.1
trcrpt -l Atape -o actrc.dump
```

Atape Component Trace (ACTRC) utility

The actrc component trace utility is also installed with the device driver to dump and format the current Atape component trace. To dump and format the component trace, run the command **actrc**. The trace is formatted to an **actrc.out** file in the current directory.

Tape drive service aids

The service aids described in the following sections are accessible through the AIX diagnostic subsystem by using the AIX **diag** command and in the **Task Selection** menu by selecting **IBM Tape Drive Service Aids**. Refer to "Tape drive service aids details" on page 37.

Tape drive service aids are also available by using the Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Tape drive service aids details

The following service aid utilities are installed with the device driver:

- Force Microcode Dump
- Read Dump
- Microcode Load
- Error Log Analysis
- Reset Drive
- Create an FMR Tape

Force Microcode Dump

This utility forces a dump operation on the tape drive. After the dump operation is completed, the dump data can be transferred from the tape drive by using the **Read Dump** utility.

To access this utility -

1. Open the **Service Aids** window.
2. Select **Force Microcode Dump** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the IBM **Tape Drive Selection** window, then press **Enter**.

   The **Force Microcode Dump** operation starts, and a window opens when the operation is completed.

Read Dump

This utility transfers the dump data from the device to a file, a diskette, or a tape cartridge.

To access this utility -

1. Open the **Service Aids** window.
2. Select **Read Dump** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the IBM **Tape Drive Selection** window, then press **Enter**.
4. Enter the destination file name or device in the **Prompting for Destination** window. The default destination is the /dev/rfd0 diskette drive. To transfer the dump data to a tape cartridge, enter the

device name of the tape drive (for example, `/dev/rmt0`). To transfer the dump data to a file, enter the file name. Press **F7** to commit.

Note: On certain terminal types, it might be necessary to press **Esc** and the number **7** instead of **F7**.

The **Read Dump** operation starts, and a window opens when the operation is completed.

Microcode Load

This utility downloads microcode to the device from a file or a diskette (AIX format only).

Note: To download the microcode from a DOS diskette, you must first use the AIX **dosread** command to transfer the file from the DOS diskette to the AIX file. Then, you can use the **Microcode Load** utility to download the AIX file to the tape drive.

To access this utility -

1. Open the **Service Aids** window.
2. Select **Microcode Load** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the IBM **IBMTape Drive Selection** window, then press **Enter**.
4. Enter the source file name or device on the **Prompting for Source File** window. The default source is the `/dev/rfd0` diskette drive. To load from a file, enter the file name. Press **F7** to commit.

   Note: On certain terminal types, it might be necessary to press **Esc** and the number **7** instead of **F7**.
5. If the current microcode on a tape drive is Federal Information Processing Standard (FIPS) code, then a window opens and displays the following message.

   ```
   Warning: The drive is currently using FIPS code. Press Enter to
   continue with downloading new drive code.
   ```

   If you do not want to download the new code, press either **F3** to cancel or **F10** to exit without downloading new code. Otherwise, press **Enter** to continue with the download code procedure.

The **Microcode Load** operation starts, and a window opens when the operation is completed.

Error Log Analysis

This utility displays and analyzes the system error log entries for a specific tape drive and can be used for problem determination. The type of error, the SCSI command, and the sense data (if applicable) are displayed for each entry in the error log (one screen at a time).

To access this utility -

1. Open the **Service Aids** window.
2. Select **Error Log Analysis** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the IBM **Tape Drive Selection** window, then press **Enter**.
4. If entries are listed in the error log for the selected device, then the first entry is displayed. Press **Enter** to display the next entry.
5. After all entries are displayed, a window opens, and the operation is completed.

Reset Drive

This utility resets the tape drive.

To access this utility -

1. Open the **Service Aids** window.
2. Select **Reset Drive** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the IBM **IBMTape Drive Selection** window, then press **Enter**.

   The **Reset Drive** operation starts, and a window opens when the operation is completed.

Create an FMR Tape

This utility creates a field microcode replacement (FMR) cartridge tape by using the loaded functional microcode in the tape drive.

To access this utility -

1. Open the **Service Aids** window.
2. Select **Create an FMR Tape** from the IBM **Tape Drive Service Aids** window, then press **Enter**.
3. Select the device from the **IBMTape Drive Selection** window, then press **Enter**.

   The **Create an FMR Tape** operation starts, and a window opens when the operation is completed.

Performance considerations

This chapter describes the parameters and issues that can affect the perceived performance of the tape drive. In general, AIX applications that operate at a file level to move data between disk storage devices and tape do not use the full capabilities of a high end tape device. The goal of this discussion is to give an overview of the data path components that are involved in moving data between disk storage devices and tape. The following chapter describes basic techniques and common utilities in a specific environment that can be used to understand how a device is performing. Performance issues that are encountered by advanced application developers are beyond the scope of this document.

- Refer to the hardware reference for the specific device for performance specifications.
- Refer to the application documentation for information on device-specific application configuration.
- Refer to the operating system documentation for information on disk storage device striping and other techniques for improving file system performance.

Data path

The simplified model in <u>Figure 9 on page 39</u> shows the components that are involved in the data path for moving data at a file level between disk storage devices and tape.

Performance analysis must be approached by determining which component of the data path impacts performance. Typically, a performance problem can be isolated by looking at one leg of the data path at a time. The goal of this analysis is to confirm that the tape data path is not impacting the performance adversely.
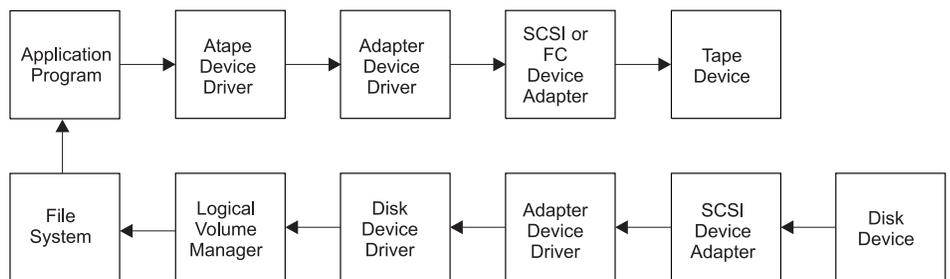
Figure 9. Data path for AIX device driver (Atape)

Common AIX utilities

The most commonly reported cause for poor tape performance is the use of small block sizes or the modification of the installation defaults for the tape device.

Note: The device parameters must not be changed from the defaults for most applications.

The following guidelines typically result in good tape path performance for use with AIX utilities:

1. Hardware compression must be enabled for maximum performance if the data sent to the device is uncompressed.
2. The **block_size** parameter must be set to variable (*block_size=0*) and command or application parameters that are specified to a block size appropriate for the device.
3. Block sizes of 128 KB or greater must be used to improve performance.

AIX iostat utility for tape performance

In releases of AIX 5.3 and earlier, the AIX **iostat** utility supports tape performance statistics in addition to other supported devices (such as disk). To determine whether the **iostat** utility supports the configured tape drives, run the command **iostat -p**. If the configured tape drives are supported, a list of configured tape drives are displayed with the statistics listed for each drive. Refer to the AIX **iostat man** page for a complete description of the **iostat** command and parameters. When the **Data Path Failover** feature is used, only the primary path for the tape drive is listed. The statistics apply to both the primary and alternative paths that are used.

Before Support is called

System performance tuning is not a support responsibility. If tests indicate that raw tape performance is below specifications, record the exact failing command. Then, collect the output from the commands in before support is contacted.

Table 5. Error description	
Information	**Command**
Configuration	`lscfg -v`
Device parameters	`lsattr -E -l rmtN`
Error log. Call hardware support if errors are found for TAPE_ERR* or SCSI* error labels.	`errpt -a`
Driver version	**lslpp -l Atape.driver**
Trace of failing command	Refer to "Trace facility" on page 36

Chapter 4. Linux Tape and Medium Changer device driver

This chapter describes the IBM Linux Tape and Medium Changer device driver (lin_tape).

For tape diagnostic and utility functions, refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Purpose

The lin_tape and medium changer device driver is designed to take advantage of the features that are provided by the IBM tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape operations (such as backup and restore) and medium changer operations (such as mount and unmount the cartridges), and also the advanced functions that are needed by full tape management systems. Whenever possible, the driver is designed to take advantage of the device features transparent to the application.

Data flow

The software that is described in this chapter covers the Linux device driver (lin_tape device driver) and the interface between the application and the tape device.
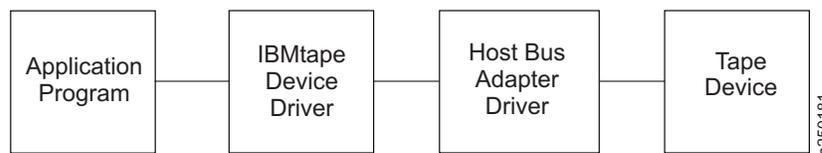
Figure 10. Data flow for Linux device driver (lin_tape)

Product requirements

Hardware requirements

For current hardware requirements, refer to the "Hardware requirements" on page 1.

Software requirements

For current software requirements, refer to the "Software requirements" on page 1.

Installation and Configuration instructions

The **lin_tape** device driver for Linux is provided in a source **rpm** package. The utility tools for **lin_tape** are supplied in binary **rpm** packages. Refer to Appendix A, "Accessing documentation and software online," on page 293. They are downloaded with the driver.

The following sections describe installation, configuration, uninstallation, and verification procedures for **lin_tape** and its utility tools. Refer to Linux documentation for **tar** command information and any Linux distribution that support **rpm** for **rpm** command information. You must have *root* authority to proceed with the installation of the driver. See the README file that can be downloaded with the driver at Fix Central. For information about downloading drivers, see Appendix A, "Accessing documentation and software online," on page 293.

This file contains the latest driver information and supersedes the information in this publication.

Conventions used

In subsequent pages, you see file names with *x.x.x* in them. The *x.x.x* refers to the version of the driver, which changes as IBM releases new driver levels. Use the actual driver version numbers as you complete the instructions.

Commands that you are to type are indicated with a leading ">" character, which indicates the shell prompt.

Note: This procedure is run with tape diagnostic and utility functions. See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Configuration limitations

Maximum supported number of tape devices	1024
Maximum supported number of HBA ports	16 (8 dual-port, 4 quad-port)
Maximum supported number of paths for a device (DPF/CPF)	16/16
Maximum LUNs per system	256

Every attached tape or library device uses a certain amount of resources. The user must consider resources such as physical memory and virtual space on the system, which might further limit the number of devices that can be attached.

Components created during installation

The lin_tape package consists of the device driver and a number of associated files. Components that are created during **lin_tape** installation (from the **rpm** package) are listed in Table 6 on page 42.

Table 6. Linux: Components created during lin_tape installation	
Component	**Description**
/lib/modules/(Your system's kernel name)/kernel/drivers/scsi/ lin_tape.ko **/lib/modules/(Your system's kernel name)/kernel/drivers/scsi/pfo.ko** Only when sfmp flag is used during build: **/lib/modules/(Your system's kernel name)/kernel/drivers/scsi/ sgmp.ko** **/lib/modules/(Your system's kernel name)/kernel/drivers/scsi/stmp.ko**	Device driver module for current kernel version
/usr/bin/lin_taped	lin_taped daemon
/etc/lin_taped.conf	lin_taped daemon configuration file
/usr/share/doc/lin_tape-xxx/lin_taped.Readme (for Red Hat) **/usr/share/doc/packages/lin_tape/lin_taped.Readme** (for SUSE LINUX)	Readme file for lin_taped daemon

Table 6. Linux: Components created during lin_tape installation (continued)	
Component	**Description**
/usr/share/doc/lin_tape-xxx/copying (for Red Hat) **/usr/share/doc/packages/lin_tape/copying** (for SUSE LINUX)	License documentation for **lin_tape**

Installation procedure

If **lin_tape** is already installed on your system, refer to the "Updating procedure" on page 43. This section assumes that you are installing the **lin_tape** device driver onto a system where it is not currently installed.

If you are installing **lin_tape** on a system that is running Linux for S/390® or Linux for zSeries, ensure that the OpenFCP adapter device driver **zfcp** is loaded in the kernel. Refer to "Configuring Tape and Medium Changer devices on IBM System z models" on page 45 for how to configure and install **zfcp**.

Make sure that the C/C++ development and kernel development packages are installed on your system. To install the **lin_tape** driver with all the added value of the lin_taped daemon, complete the following steps.

1. Download the appropriate level of the source **RPM** package to a directory of your choice on the Linux kernel for which you want to install it.

2. Run **rpmbuild --rebuild <filename>**, where: *<filename>* is the name of the RPM file. A binary RPM package is created for your kernel from the source RPM package. For example,

   ```
   >rpmbuild --rebuild lin_tape-1.x.x.x.0-1.src.rpm
   ```

   Note: For the current **lin_tape** driver, it is possible to enable path failover for *st/sg* interfaces. See Enabling path failover for *st* and *sg* interface for details. If path failover is enabled and you want to also enable it for *st* or *sg* devices, an extra flag that is named *sfmp* must be added at this step:

   ```
   >rpmbuild --rebuild -with sfmp lin_tape-1.x.x.x.0-1.src.rpm
   ```

3. Output from the build is printed to your screen. Near the end of the output, a line indicates the file name and location of your binary RPM package. For example, a line similar to the following is output to your screen.

   ```
   Wrote: /usr/src/redhat/RPMS/i386/lin_tape-1.x.x.x.0-1.i386.rpm
   ```

4. To install the **lin_tape** driver from the binary package, run **>rpm -ivh <filename>** For example,

   ```
   >rpm -ivh /usr/src/redhat/RPMS/i386/lin_tape-1.x.x.x.0-1.i386.rpm
   ```

   Note: For Ubuntu, run **alien -i --**scripts **<filename>** (starting with lin_tape version 3.0.33).

5. To install the lin_taped daemon, download it to your Linux file system and run rpm **-ivh** on the daemon RPM file. For example,

   ```
   >rpm -ivh /usr/src/redhat/RPMS/i386/lin_taped-1.x.x.x.0-rhel5.i386.rpm
   ```

   Note: For Ubuntu, run **alien -i --**scripts **<lin_taped*.rpm>**, and then run **sudo update-rc.d lin_tape** defaults.

Updating procedure

If your current **lin_tape** device driver was installed from an **rpm** package previously, you can uninstall the driver first, then install the newer version. For example,

On SLES and RHEL:

```
>rpm -e lin_taped
>rpm -e lin_tape
>rpmbuild --rebuild lin_tape.x.x.x.i386.rpm
>rpm -i lin_tape.x.x.x.i386.rpm
```

On Ubuntu:

```
apt purge lin-taped
apt purge lin-tape
```

Then, follow the installation procedure in the previous section.

Note: All tape devices that use the **lin_tape** device driver must be closed and cannot be in use when **lin_tape** is uninstalled.

Querying the installed package

The query is supported for the **lin_tape** device driver **rpm** package and SLES and RHELonly.

The installed **rpm** package can be queried by running the following commands to show information that is associated with the package.

To show information about **lin_tape** -

```
>rpm -qi lin_tape
```

To show the file list, enter the command

```
>rpm -ql lin_tape
```

To show the states of files in the package, for example, *normal*, *not installed*, or *replaced* -

```
>rpm -qs lin_tape
```

To query lin_tape package on Ubuntu:

```
dpkg-query --list lin-tape
```

Configuring Tape and Medium Changer devices on Intel-compatible systems

If you did not physically attach your tape and medium changer devices to your Linux server, complete the following steps.

1. Halt the Linux server.
2. Power down the Linux server.
3. Physically attach the tape and medium changers to the host bus adapter cards. Consult your hardware documentation for details.
4. Power on the tape and medium changer devices. Verify that they complete the initialization process.
5. Power on and boot the Linux server.

Note: Hot plugging SCSI devices while the Linux server is running can cause hardware damage.

After the driver software is installed and a tape device is connected to the adapter, the device can be configured and made available for use. Access to the device is not provided until the device is configured.

If your system is attached to a tape library with the integrated router, before the QLogic driver is installed, set the host type of the router to solaris and make sure that the logical unit numbers of the control unit, medium changer, and the connected tape drives are contiguous. Otherwise, the QLogic device driver does not recognize all of the attached devices. To view the LUNs of attached devices, log on to the router and use the **fcShowDevs** command. If the LUNs are not contiguous, use the **mapCompressDatabase** command to delete the invalid LUNs and make the valid LUNs contiguous.

When you run the **lin_tape** kernel module, it creates special files in the **/dev** directory.

Configuring Tape and Medium Changer devices on IBM System p models

Follow the same instructions as documented in the previous section. You must configure the Emulex Linux device driver if you have Fibre Channel tape devices that are attached to your System p (also known as pSeries) system.

On SLES at current kernels, it is required to set the **tmo** parameters for the scsi layer to handle device removal and rediscovery properly for lin_tape to be notified and detect devices:

```
cat /etc/udev/rules.d/52-rport-tmos.rules
ACTION=="add", KERNEL=="rport-*",
ATTR{fast_io_fail_tmo}="5"
ACTION=="add", KERNEL=="rport-*",
ATTR{dev_loss_tmo}="2147483647"
```

Configuring Tape and Medium Changer devices on IBM System z models

The Fibre Channel topology that is supported for System z® is point-to-point and fabric. Refer to the Linux on System z Fibre Channel documents for details on the supported configurations for Fibre Channel device attachment. The Linux Fibre Channel adapter device driver **zfcp** is available in the kernel that supports zSeries Fibre Channel Protocol. The zfcp device configuration methods in 2.6 (and higher) and 2.4 kernels are different. For 2.6 kernels and higher, refer to appropriate chapter in the Linux on System z document entitled *Linux on System z: Device Drivers, Features, and Commands*.

For 2.4 kernels, there are three ways to load the **zfcp** device driver to see the attached tape devices.

1. Create a **/etc/zfcp.conf** file and make a ram disk to statically attach tape devices into your system. You can use this method only if you have a persistent mapping in a SAN environment. Every time that you restart the system, the **zfcp** is automatically loaded and the tape devices can be seen from the system.

   You must add the device map into this file. The following code is an example of **zfcp.conf**.

   ```
   0xf1c0 0x1:0x5005076300402733 0x0:0x0000000000000000;\
   0xf1c1 0x1:0x5005076300402733 0x0:0x0001000000000000
   ```

   The **zfcp** device driver uses the "**map**" module parameter to recognize a physically attached tape device. **map** takes the following format,

   ```
   map="<devno><port scsi-id>:<wwpn><unit-scsi-lun>:<fcp-lun>;...."
   ```

   Where

   devno
   The device number of the host bus adapter (16 bits, see `/proc/subchannels`). It is `0xf1c0` or `0xf1c1` in the previous example.

   port scsi-id
   Linux internal SCSI ID assigned to the Fibre Channel port of the SCSI target device (32-bit, must not be 0, must be a unique one-to-one mapping for each worldwide port name. It is `0x1` in the previous example.

   wwpn
   Worldwide port name that identifies the Fibre Channel port of the SCSI target device (64-bit). It is `0x5005076300402733` in the previous example.

   unit scsi-lun
   Linux internal SCSI Logical Unit Number (32-bit). It is `0x0` in the previous example.

   fcp-lun
   Logical Unit Number that is associated with the SCSI target device (64-bit). In the previous example, `0x0000000000000000` is the Logical Unit Number 0, and `0x0001000000000000` is the Logical Unit Number 1.

For tape attachment, each logical unit number must be associated with a unique devno. If you use the same devno numbers for several logical units, you can ensure that each <unit-scsi-lun> is unique. After **/etc/zfcp.conf** is created, run the following commands.

```
>mk_initrd>zipl
```

Then restart the system. After it is booted up, your tape device must be shown in **/proc/scsi/scsi** file.

2. Modify the **/etc/modules.conf** file to add the **zfcp** module parameters; then run the **depmod –A** and **modprobe zfcp** command.

   Note: Do not use this choice together with the first one, otherwise it causes conflicts.

   The **zfcp** map in **/etc/modules.conf** always takes higher priority than the map in **/etc/zfcp.conf**.

   The following example demonstrates the **zfcp** configuration in **/etc/modules.conf**.

```
options zfcp map="\
0xf1c0 0x1:0x5005076300402733 0x0:0x0000000000000000;\
0xf1c1 0x1:0x5005076300402733 0x0:0x0001000000000000"
```

   The map arguments are the same as the ones listed in for the **/etc/zfcp.conf** file.

   After the **/etc/modules.conf** file is modified, save and close it. Then, run the following command.

```
>depmod -A
>modprobe zfcp
```

   This action installs the **zfcp** device driver and all of its prerequisite kernel modules. Now you can check the file **/proc/scsi/scsi** to see whether all of the attached tape devices are shown in this file. If not, then check the Fibre Channel connection, such as the fibre cables, or if the devices are powered on.

   Then, run the following commands to install **zfcp**.

```
>rmmod zfcp
>modprobe zfcp
```

3. Run the **modprobe zfcp** command first, then dynamically add a tape device into the system after you physically attach a Fibre Channel tape device to the switch.

   If you physically attach a tape device on the switch and zfcp is already loaded, you do not need to restart the Linux system to add this entry in the **/proc/scsi/scsi** file. The **zfcp** device driver provides an "add_map" proc system entry under the directory **/proc/scsi/zfcp** to dynamically add the device into the system. For example, to add two logical units from the example in Step 2 into the system, you can issue the following commands.

```
> echo "0xf1c0 0x1:0x5005076300402733 0x0:0x0000000000000000;\
0xf1c1 0x1:0x5005076300402733 0x0:0x0001000000000000"
> /proc/scsi/zfcp/add_map
> echo "scsi add-single-device 0 0 1 0" > /proc/scsi/scsi
> echo "scsi add-single-device 1 0 1 1" > /proc/scsi/scsi
```

   The **scsi add-single-device** takes four parameters, corresponding to the four parameters **scsi**, **Channel**, **Id**, and **Lun** in the **/proc/scsi/scsi** file. The value of **scsi** is 0 for the first devno, 1 for the second devno (if it is different from the first devno), and so on. The value of **Channel** can start from 0 for each different **scsi** value. The value of **Id** is the one you use for <unit scsi-lun> in the previous mapping. The value of **Lun** is the logical unit number of the target device, for example, the last number in the previous mapping. Currently, the **zfcp** device driver does not support dynamically removing the attached devices. If you must remove the tape devices from the system, do **rmmod zfcp**. Then, you can delete the entry in **/etc/modules.conf** and reload **zfcp**, or reload **zfcp** first and dynamically add the devices that you want. After you finished all the mapping, if you can see all of the attached tape devices in **/proc/scsi/scsi**, you successfully attached those devices to your system. Next, you can install the **lin_tape** device driver. Refer to the <u>"Installation procedure" on page 43</u> section for the instructions on how to install **lin_tape**.

On SLES at current kernels, it is required to set the **tmo** parameters for the scsi layer to handle device removal and rediscovery properly for lin_tape to be notified and detect devices:

```
cat /etc/udev/rules.d/52-rport-tmos.rules
ACTION=="add", KERNEL=="rport-*",
ATTR{fast_io_fail_tmo}=="?*", ATTR{fast_io_fail_tmo}="5"
ACTION=="add", KERNEL=="rport-*",
ATTR{dev_loss_tmo}=="?*", ATTR{dev_loss_tmo}="2147483647"
```

Uninstallation procedure

Note: All tape devices that use the **lin_tape** driver must be closed and cannot be in use when **lin_tape** is uninstalled or the uninstall fails.

On SLES and RHEL:

Run the following command to uninstall **lin_taped** before you uninstall **lin_tape**:

```
> rpm -e lin_taped
```

Run the following command to uninstall **lin_tape**:

```
>rpm -e lin_tape
```

On Ubuntu:

```
apt purge lin-taped
apt purge lin-tape
```

Tape drive, media, and device driver parameters

This chapter describes the parameters that control the operating modes of the IBM Linux Tape and Medium Changer device driver.

Configuration parameters

The configuration parameters are used to set the operating mode of the tape drive and device driver when a device is opened. The installation defaults are provided for all parameters initially. These parameters are kept on reopen, but are always restored back to the default values when the **lin_tape** device driver is reinstalled.

Note: This procedure is completed with tape diagnostic and utility functions. See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

The nonchangeable configuration parameters are

- Autoloading
- Density code
- Emulate autoloader
- Hook word
- Maximum block size
- Minimum block size
- Medium type
- Read SILI bit
- Record space mode
- Volume ID for logging
- Write protect

The changeable configuration parameters are

- Barcode length
- Block size
- Buffered mode
- Capacity scaling
- Compression
- Disable auto drive dump
- Disable SIM logging
- Dynamic attributes
- Logging
- Logical write protect
- Maximum SCSI transfer length
- Read past filemark
- Rewind immediate
- Trace
- Trailer labels
- Busy Retry

Nonchangeable parameters

The configuration parameters are used to set the operating mode of the tape drive and device driver when a device is opened. The nonchangeable parameters are detailed as follows.

Autoloading

This parameter enables the autoloading feature of the device driver. It is disabled by default and cannot be changed.

Capacity scaling

This parameter sets the capacity or logical length of the current tape. By reducing the capacity of the tape, the tape drive can access data faster at the expense of data capacity. Capacity scaling is not supported currently but might be supported in future releases of **lin_tape**.

Density code

This parameter is the density setting for the currently loaded tape. Some tape devices support multiple densities and report the current setting in this field. It cannot be changed by the application.

Emulate autoloader

This parameter currently is not supported and is ignored.

Hook word

This parameter is not supported in the **lin_tape** device driver.

Logical write protect

This parameter sets or resets the logical write protect of the current tape. This feature is not supported currently but might be supported in future releases of the **lin_tape**.

Maximum block size

This parameter is the maximum block size for the device.

Minimum block size

This parameter is the minimum block size for the device.

Medium type

This parameter is the media type of the current loaded tape. Some tape devices support multiple media types and different values are reported in this field.

Read SILI bit

SILI bit currently is not supported due to limitations associated with the Linux environment. SILI bit support can be enabled in future releases of the **lin_tape**.

Record space mode

This parameter specifies how the device driver operates when a forward or backward space record operation encounters a filemark. Only the SCSI mode is supported by **lin_tape**. When a forward or backward space record operation is issued to the driver and a filemark is encountered, the device driver returns **-1** and the *errno* variable is set to input/output error (EIO). On the forward space operation, the tape is left-positioned after the filemark (the end of tape side of the filemark). On the backward space operation, the tape is positioned before the filemark (the beginning of tape side of the filemark).

Volume ID for logging

This parameter is the volume ID of the currently loaded tape. The **lin_tape** device driver ignores this field.

Write protect

This parameter is set to TRUE if the currently mounted tape is logically or physically write protected.

Changeable parameters

The configuration parameters are used to set the operating mode of the tape drive and device driver when a device is opened. The changeable parameters are detailed as follows.

Barcode length

This parameter can be set to change the barcode length for a cartridge. For LTO cartridges the default is 8. It can be changed to 6 for LTO 1 and LTO 2 generation cartridges only. For 3592 cartridges the default is set at 6. It can be changed to 8. In the **/etc/modprobe.conf.local** file the following line must be added to reflect the desired change.

```
options lin_tape ibm3592_barcode=8
options lin_tape lto_barcode=6
```

Block size

This parameter specifies the block size that is used for read and write operations. A value of zero means a variable block size. Any other value is a fixed block size. The installation default is zero (variable length block size). Refer to "Maximum SCSI transfer length" on page 51 for guidance.

Buffered mode

This parameter specifies whether read and write operations must be buffered by the tape device. The default (recommended) value is TRUE.

Capacity scaling

This parameter sets the capacity or logical length of the current tape on Enterprise Tape System 3590 or 3592 tape subsystems. By reducing the capacity of the tape, the tape drive can access data faster at the expense of data capacity. Capacity scaling can be set at 100% for the entire tape (which is the default), or set at 75%, 50%, or 25% of the 3590 tape cartridge and more available capacity scaling for the 3592 standard 300 GB rewritable data cartridge. Capacity scaling remains with the tape across mounts until it is changed.

Note:

1. The tape position must be at the start of the tape to change this parameter from its current value.

2. Changing this parameter destroys any existing data on the tape.

3. For 3592 media types, capacity scaling is supported only for the standard 300 GB rewritable data cartridge. Attempting to set capacity scaling that is not supported by a device or the current loaded media always returns 100% and cannot be changed. For example, the 60 GB (Economy Data) cartridge for the IBM 3592 cannot be capacity-scaled and is always 100%.

Compression

Hardware compression is implemented in the device hardware. This parameter turns the hardware compression feature On and Off. If compression is enabled, the effective performance can increase, based on the compressibility of the data.

The installation default is On (use compression).

Disable auto drive dump

This parameter is provided in the **lin_tape** version 1.2.2 or later. It is set to FALSE by default. If it is FALSE and the lin_taped daemon is running and if an error occurs in the drive that creates a drive dump, the **lin_tape** device driver automatically retrieves the drive dump and saves it under the /var/log directory by default. You can specify another directory in the **/etc/lin_taped.conf** file. The dump is labeled with a .dmp extension on the file. Refer to "Configuring and running the lin_taped daemon" on page 64 for details.

Disable SIM logging

This parameter is provided in the **lin_tape** version 1.2.2 or later. It is set to FALSE by default. If it is FALSE and the lin_taped daemon is running and SIM/MIM data is generated by the drive, the **lin_tape** device driver automatically retrieves the data and saves it in a formatted text file under the /var/log directory by default. You can specify another directory in the **/etc/lin_taped.conf** file. Refer to "Configuring and running the lin_taped daemon" on page 64 for details.

This capacity is not applicable to IBM Ultrium tape drives.

Dynamic attributes

This parameter determines whether dynamic runtime attributes are attempted on open for supported drives. Default is 1 (on) meaning that the driver automatically attempts to set dynamic runtime attributes on open. This parameter can be changed to 0 (off) in the configuration file before the **lin_tape** is loaded. It is recommended to keep on dynamic attributes unless it produces an unexpected problem in the environment.

Logging (volume logging)

This parameter turns the volume information logging On or Off. With the **lin_tape** version 1.2.2 and later, the **lin_tape** device driver provides this support. It is set to On by default. If logging is On and the lin_taped daemon is running, the **lin_tape** device driver retrieves the full log sense data from the drive whenever a tape is unloaded, or the drive reaches a log threshold. The log file is saved in binary format under the directory /var/log by default. You can specify another directory in **/etc/lin_taped.conf** file. Refer to "Configuring and running the lin_taped daemon" on page 64 for details.

Note: This parameter is volume logging, which is different from error logging. **lin_tape** provides error logging whenever the lin_taped daemon is running. Refer to "Configuring and running the lin_taped daemon" on page 64 for details on error logging.

Logical write protect

This parameter sets or resets the logical write protect of the current tape on Enterprise Tape System 3590 tape subsystems. The three types of logical write protect are associated protect, persistent protect, and write-once read-many (WORM) protect.

1. Associated protect remains only while the current tape is mounted or associated with the tape drive. It is reset when the tape is unloaded or the tape drive is reset.
2. Persistent protect remains or persists with the tape across mounts until it is reset.
3. WORM protect also remains with the tape across mounts, but unlike persistent protect it cannot be reset on the tape. After a tape is WORM protected, it can never be written on again.

Note: The tape position must be at the start of the tape to change this parameter from its current value.

Maximum SCSI transfer length

In the **lin_tape** drivers with level lower than 3.0.3, the maximum transfer length per device per SCSI command is 262144 bytes (256 KB) by default. Variable block read/write requests with transfer length greater than the maximum transfer length fails [*errno*: EINVAL]. When a fixed block size is defined, large write requests are subject to both the granularity of the block size and the maximum transfer length. For example, with a fixed block size of 80000 bytes and maximum transfer length of 262144, a write request for 400000 bytes (5 blocks of 80000 each) is written to tape in two transfers. The first transfer is 240000 bytes (3 blocks) and the second transfer is 160000 (the remaining two blocks). You can increase the maximum transfer length to enhance the data throughput. This procedure can be done with ITDT with the Query/Set Parameters option, or a customized STIOCSETP input/output control (*ioctl*) call. However, setting the transfer length greater than the default 256 KB does not guarantee a noticeable increase in data throughput. Maximum transfer length of 256 KB is highly recommended.

In **lin_tape** driver with level 3.0.5 or higher and the open source driver **lin_tape**, the maximum transfer length is defined as the minimum length that the host bus adapter and the tape drive can support. This number is greater than 256 KB. It cannot be changed by the STIOCSETP ioctl call any more.

Read past filemark

If this parameter is set to true, when a fixed-length read operation encounters a filemark, it returns the number of bytes read before the filemark is encountered and positions the tape head after the filemark. If the **read_past_filemark** parameter is set to false, when the fixed-length read operation encounters a filemark, if data was read, the *read* function returns the number of bytes read, and positions the tape head before the filemark. If no data was read, then the *read* returns 0 bytes read and positions the tape head after the filemark.

This installation default is FALSE.

Rewind immediate

This parameter sets the immediate bit for rewind commands. If it is set to On, the rewind tape operation runs faster, but the next command takes a long time to finish unless the physical rewind operation is complete. Setting this parameter reduces the amount of time it takes to close a device for a Rewind on Close special file.

The installation default is Off (no rewind immediate).

Trace

This parameter turns the trace facility On or Off. With the lin_tape version 1.2.2 and later, the **lin_tape** device driver provides this support. It is set to On by default. If trace is On and the lin_taped daemon is running, the **lin_tape** device driver retrieves the trace from the driver if trace level is set to 1 or 2 in the **/etc/lin_taped.conf** file. The trace file is saved under the directory /var/log by default. You can specify another directory in **/etc/lin_taped.conf** file. Refer to "Configuring and running the lin_taped daemon" on page 64 for details.

Trailer labels

If this parameter is set to On, then writing records past the early warning mark on the tape is allowed. The first write operation after detecting the early warning mark fails and the *errno* variable is set to ENOSPC. No data is written during the operation. All subsequent write operations are allowed to continue until the physical end of the volume is reached and *errno* EIO is returned.

If this parameter is set to Off, then writing records past the early warning mark is not allowed. *Errno* variable is set to ENOSPC.

The installation default is On (with trailer labels).

Busy Retry

The parameter **busy_retry** determines how many times to retry a command when the device is busy. Default is 0 (off), and can be set up to 480 in the configuration file before the lin_tape is loaded.

Special files

After the driver is installed and a device is configured and made available for use, access is provided through the special files. These special files, which consist of the standard Linux special files for devices, are in the **/dev** directory.

Special files for the tape device

Each tape device has a set of special files providing access to the same physical drive but providing different attributes. Table 7 on page 52 shows the attributes of the special files.

Note: The asterisk (*) in **IBMtape*** represents a number assigned to a particular device, such as **IBMtape0**.

For tape drives with attached medium changer devices, the **IBMchanger*** special file provides a separate path for issuing commands to the medium changer. When this special file is opened, the application can view the medium changer as a separate device. Both the tape and changer special file can be opened at the same time.

Table 7. Linux: Special files for IBM tape devices	
Special file name	**Rewind on Close**
/dev/IBMTape*	YES
/dev/IBMTape*n	NO

Special files for the Medium Changer device

After the driver is installed and a medium changer device is configured and made available for use, access to the robotic device is provided through the **IBMchanger** special file in the/dev directory. The asterisk (*) represents a number that is assigned to a particular device, such as **IBMchanger0**. The term

IBMchanger is used for a SCSI medium changer device. The **IBMchanger*** special file provides a path for issuing commands to control the medium changer robotic device.

The file descriptor that results from opening the **IBMchanger** special file does not support the following operations.

- Read
- Write
- Open in Append mode
- Commands that are designed for a tape device

Persistent Naming Support

Lin_tape Persistent Naming is implemented through the Linux **udev** utility. **Udev** is a service that monitors changes in system hardware configuration and completes actions that are based on what devices are attached to the Linux system. It can be configured to create symbolic links (persistent names) to a device based on attributes that a driver exports for that device. The persistent name can then be used as the device name to open and complete IO to a tape drive or medium changer. This action makes it possible to reference a static name, such as

```
/dev/lin_tape/by-id/lin_tape4801101
```

This name is always associated with the same physical device, rather than being required to reference the device name **/dev/IBMtape0**, which can change names and become **/dev/IBMtape1** after the driver is reinstalled.

Lin_tape exports several attributes that can be used as the basis to create persistent names. These attributes can be reported to the user through **udevadm info** on recent Linux kernels, or **udevinfo** on older Linux kernels. The **udevinfo** and **udevadm** are **udev** management tools. These tools can query the **udev** database for device information and properties that are stored in the **udev** base for help creating **udev** rules.

Note: Udev, **udevinfo**, and **udevadm** are not implemented or maintained by the **lin_tape** driver. Refer to the man pages for **udevadm** or **udevinfo** for details on usage. These man pages are system specific and supersede all information in this document. For questions on these utilities, you must contact your Linux support representative.

An example is provided on **udev** for implementing a persistent name. The example must be customized to fit a user's needs and environment.

Note: Variations exist between kernels.

If a tape device is attached to the Linux system with worldwide port name 0x123456789ABCDEF0 with a current device name of **/dev/IBMtape0**, a user can run **udevadm** information to obtain information on exported attributes for this device. This procedure can be done as follows,

```
>udevadm info --attribute-walk --name /dev/IBMtape0
```

The output of this command includes something similar to

```
    ATTRS{serial_num}=="123456789"
    ATTRS{ww_node_name}=="0x123456789ABCDEF1"
    ATTRS{ww_port_name}=="0x123456789ABCDEF0"
```

If you are using **udevinfo**, enter the previous command as

```
>udevinfo -a -p `udevinfo -q path -n /dev/IBMtape0`
or
>udevinfo -a -p /sys/class/lin_tape/IBMtape0
(Both commands return the same information).
```

Also, on some kernels an attribute ATTRS{xxx} is replaced by SYSFS{xxx}. Furthermore, some kernels use a '=' (single equal sign) to indicate an attribute match and also an assignment. Whereas, other kernels

use a '==' (double equal sign) for a match and '=' for assignment. Place the attribute from the attribute list into your rules file **exactly as it appears** in the attribute list, as described here.

The **ww_port_name** is in a rules file that assigns a symbolic link to a device that has the listed worldwide port name. The file typically is placed in **/etc/udev/rules.d**, but this location might be changed by the **udev_rules** directive in the **/etc/udev/rules.conf** file. In this example, a file is created that is called **/etc/udev/rules.d/98-lin_tape.rules** and write a single line to the file.

```
KERNEL=="IBMtape*", ATTRS{ww_port_name}=="0x123456789ABCDEF0",
```

```
SYMLINK="lin_tape/by-id/lin_tape4801101"
```

Assuming that the **udev** service is running and configured correctly, the user can install or reinstall **lin_tape** with **modprobe**, and the symbolic link is created in the **/dev/lin_tape/by-id** folder. One line must be added to the **98-lin_tape.rules** file for each wanted symbolic link.

With lin_tape version 2.2.0, a parameter, **persistent_n_device**, is added to support persistent naming of no rewind devices. The default value is 0 (off). To enable this support, complete the following steps.

1. Modify the **98-lin_tape.rules** file to differentiate standard devices and no rewind devices. For example,

```
KERNEL=="IBMtape*[0-9]", ATTR{serial_num}=="1013000306", SYMLINK="lin_tape/by-id/IBMtape0"
KERNEL=="IBMtape*n", ATTR{serial_num}=="1013000306", SYMLINK="lin_tape/by-id/IBMtape0n"
```

2. Stop the lin_taped daemon.

```
lin_taped stop
```

3. Unload the **lin_tape** driver from the memory.

```
modprobe -r lin_tape

Only if sfmp was enabled unload stmp/sgmp:
modprobe -r stmp
modprobe -r sgmp

modprobe -r pfo
```

4. Add the following line in your **/etc/modprobe.conf** or **/etc/modprobe.conf.local** file (or, if you are running RHEL 6 or higher, in your **/etc/modprobe.d/lin_tape.conf** file).

```
options lin_tape  persistent_n_device=1
```

5. Reload the **lin_tape** driver into memory.

```
modprobe pfo
modprobe lin_tape

Only if sfmp was enabled load stmp/sgmp:
modprobe stmp
modprobe sgmp
```

Note: Wait at least 10 seconds between step 3 (modprobe -r lin_tape) and step 5 (modprobe lin_tape) in order for **udev** to correctly configure the devices.

6. Check that the devices are all correctly listed with the following command.

```
ls -l /dev/lin_tape/by-id/
```

7. Restart the lin_taped daemon.

```
lin_taped start
```

Control Path failover support for tape libraries

Note: The library control path failover feature code must be installed before control path failover support is enabled in the Linux **lin_tape** device driver. Refer to"Automatic failover" on page 3 to determine which feature code is required for your machine type.

The Linux **lin_tape** device driver control path failover support configures multiple physical control paths to the same logical library within the device driver. It also provides automatic failover to an alternative control path when a permanent error occurs on one path. This support is transparent to the running application.

Configuring and unconfiguring path failover support

Control path failover support is not enabled automatically when the device driver is installed. The Linux **lin_tape** device driver provides a driver parameter **alternate_pathing** for you to enable the library control path failover. To enable the failover support in the **lin_tape** device driver software, you must do the following steps after the **lin_tape** rpm package is installed:

1. `lin_taped stop` (stop the lin_taped daemon)
2. Unload the **lin_tape** driver from the memory.

   ```
   modprobe -r lin_tape

   Only if sfmp was enabled unload stmp/sgmp:
   modprobe -r stmp
   modprobe -r sgmp

   modprobe -r pfo
   ```

3. Add the following line in your **/etc/modprobe.conf** or **/etc/modprobe.conf.local** file (or, if you are running RHEL 6 or higher, in your **/etc/modprobe.d/lin_tape.conf** file)

   ```
   options lin_tape alternate_pathing=1
   ```

4. Reload the **lin_tape** driver into memory.

   ```
   modprobe pfo
   modprobe lin_tape

   Only if sfmp was enabled load stmp/sgmp:
   modprobe stmp
   modprobe sgmp
   ```

5. `lin_taped start` (restart lin_taped daemon)

You can ignore the `Unresolved symbols in /lib/modules/<your kernel name>/drivers/scsi/lin_tape.ko` message after the **depmod** command. You can check whether the **lin_tape** driver recognized multiple control paths for your library by reading the **/proc/scsi/IBMchanger** file.

- `cat/proc/scsi/IBMchanger`

If your library lists "Primary" or "Alternate" under "FO Path", you successfully enabled the control path failover feature for your library. If "NA" is listed under "FO Path", then the control path failover is not enabled. After control path failover support is enabled, it remains set until the **lin_tape** driver is reloaded with the **alternate_pathing** driver parameter set to OFF. The path failover setting is retained even if the system is rebooted. If you want to turn off the control path failover feature in the **lin_tape** device driver, you can complete the following steps.

1. `lin_taped stop`
2. Unload the **lin_tape** driver from the memory.

   ```
   modprobe -r lin_tape

   Only if sfmp was enabled, unload stmp/sgmp:
   modprobe -r stmp
   ```

```
modprobe -r sgmp

modprobe -r pfo
```

3. Delete the following line in your **/etc/modprobe.conf** file.

```
options lin_tape alternate_pathing=1
```

4. Reload the **lin_tape** driver into memory.

```
modprobe pfo
modprobe lin_tape

Only if sfmp was enabled load stmp/sgmp:
modprobe stmp
modprobe sgmp
```

5. `lin_taped start` (restart lin_taped daemon)

Enabling path failover for the *sg* interface

Through a collaboration effort that is named **join driver**, control path failover is supported through the *sg* interface, by using the latest **lin_tape** driver version on RHEL and SLES over Intel only.

Note: It is important to review hardware and software requirements before path failover is enabled. See "Path failover and load balancing" on page 3.

To enable it, the **lin_tape_as_sfmp** parameter must be set at /etc/modprobe.d/lin_tape.conf as follows:

```
options lin_tape alternate_pathing=1
options lin_tape lin_tape_as_sfmp=1
```

If **lin_tape** is already installed, follow the "Uninstallation procedure" on page 47.

Follow the "Installation procedure" on page 43 by using

```
-with sfmp at rpmbuild.
```

Primary and alternative paths

When **lin_tape** is loaded into kernel memory, the first logical medium changer device that **lin_tape** sees in the system is the primary path for that medium changer. The other logical medium changers that **lin_tape** attached for the same medium changer are configured as alternative paths. The device driver supports up to 16 physical paths for a single device. The primary and alternative path information can be obtained by the following command.

- `cat /proc/scsi/IBMchanger`

An example of a **/proc/scsi/IBMchanger** file:

- lin_tape version: 3.0.3
- lin_tape major number: 253

Table 8. Attached changer devices

Number	Model	SN	HBA	FO Path
0	03584L22	IBM1234567	qla2xxx	Primary
1	03584L22	IBM1234567	qla2xxx	Alternate
2	03584L22	IBM1234567	qla2xxx	Alternate

The labeling of a logical device as either a primary or alternative path is for information only, to

- Identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled as the primary path for each physical device. However, multiple logical devices can be labeled as an alternative path for the same devices.
- Provide information about which logical devices configured on the system have path failover support enabled.

When **lin_tape_as_sfmp** is set, *sg* paths can be queried through *pfo* paths as follows:

```
cat /sys/class/pfo/*/paths
```

Example output:

```
pfo10 sg=/dev/sg10 st=none sf=yes fo=no  wwnn=0000013400140405 type=changer
2:0:1:1  up   last -     -
3:0:1:1  -     -    -     -
```

There is only one *sg* device file name per device that uses all the paths for this device.

Querying primary and alternative path configuration

You can show the primary and alternative path configuration for all devices by reading the **/proc/scsi/**IBMchanger file, as explained in "Primary and alternative paths" on page 56.

Note: Show the primary and alternative path configuration for any device with tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

When you load the **lin_tape** device driver with the **alternate_pathing** parameter to be ON, by default, all the available paths for a physical device are enabled.

If it is necessary to disable a path and not run path failover (for example, because of maintenance), run commands to disable and then later enable the primary and alternative paths.

The commands to enable and disable primary and alternative paths are tape diagnostic and utility functions.

Note: See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Data Path failover and load balancing support for tape drives

Data path failover support is not enabled automatically when the device driver is installed. The Linux **lin_tape** device driver provides a driver parameter **alternate_pathing** for you to enable the data path failover.

To enable the failover support in the **lin_tape** device driver software, you must complete the following steps after the **lin_tape rpm** package is installed.

```
>lin_taped stop (stop the lin_taped daemon)
>rmmod lin_tape (unload the lin_tape driver from the memory
```

If you have IBM 3592 tape drives, add the following line in your **/etc/modprobe.conf** or **/etc/modprobe.conf.local** file (or, if you are running RHEL 6 or higher, in your **/etc/modprobe.d/lin_tape.conf** file).

```
options lin_tape alternate_pathing=1
```

If you have IBM LTO tape drives, the library must have a path failover feature code. The data path failover license keys are needed to enable the failover if you are running LTO2 drives or if you are running LTO3

drives with old levels of drive code. DPF keys do not need to be added if you are running the latest drive code on LTO3 or higher drives.

Add the following line in your **/etc/modprobe.conf** or **/etc/modprobe.conf.local** file (or, if you are running RHEL 6 or higher, in your **/etc/modprobe.d/lin_tape.conf** file).

```
options lin_tape alternate_pathing=1 dpf_keys="abcdefghijklmnop"
```

abckdefghijklmnop is an example of a data path failover feature key. If you have multiple libraries and multiple data path failover feature keys, input your keys as follows.

```
dpf_keys="key1;key2;..."
```

Save the file, then run the following commands.

```
>depmod
>modprobe lin_tape (re-load the lin_tape driver into memory)
>lin_taped (re-start lin_taped daemon)
```

You can ignore the Unresolved symbols in /lib/modules/<your kernel name>/drivers/ scsi/lin_tape.ko message after the **depmod** command. You can check whether the **lin_tape** driver recognized multiple paths for your tape drive by reading the **/proc/scsi/IBMtape** file.

```
>cat /proc/scsi/IBMtape
```

If your tape drive lists Primary or Alternate under F0 Path, you successfully enabled data path failover feature for your tape drive. If NA is listed under F0 Path, the data path failover is not enabled. After the path failover support is enabled, it remains set until the **lin_tape** driver is reloaded with the **alternate_pathing** driver parameter set to OFF. The path failover setting is retained even if the system is rebooted. If you want to turn off the data path failover feature in the **lin_tape** device driver, you can run the following steps.

```
>lin_taped stop
modprobe -r lin_tape

Only if sfmp was enabled unload stmp/sgmp:
modprobe -r stmp
modprobe -r sgmp

modprobe -r pfo
```

Delete the following line in your **/etc/modules.conf** file: options lin_tape alternate_pathing=1.

```
modprobe pfo
modprobe lin_tape

Only if sfmp was enabled load stmp/sgmp:
modprobe stmp
modprobe sgmp

>lin_taped start
```

Enabling path failover for *st* and *sg* interface

Through a collaboration effort that is named **join driver**, control path failover is planned to be supported through *st* and *sg* interfaces by using the latest **lin_tape** driver version on RHEL and SLES over Intel only.

Important: Review hardware and software requirements before path failover is enabled. See "Path failover and load balancing" on page 3.

To enable it, the **lin_tape_as_sfmp** parameter must be set at /etc/modprobe.d/lin_tape.conf:

```
options lin_tape alternate_pathing=1
options lin_tape lin_tape_as_sfmp=1
```

If **lin_tape** is already installed, follow the "Uninstallation procedure" on page 47.

Follow "Installation procedure" on page 43 by using

```
-with sfmp at rpmbuild.
```

Primary and alternative paths

When the **lin_tape** device driver is loaded into kernel memory with path failover support enabled, the first logic device that **lin_tape** sees always becomes the primary path. The other logical devices that **lin_tape** sees are configured as the alternative paths. The device driver supports up to 16 physical paths for a single device.

The primary and alternative path information can be obtained by the following command.

```
>cat /proc/scsi/IBMtape
```

The following is an example of a `/proc/scsi/IBMtape`:

```
lin_tape version: 3.0.3
lin_tape major number: 253
```

Table 9. Attached tape devices

Number	Model	SN	HBA	FO Path
0	03592	IBM1234567	qla2xxx	Primary
1	03592	IBM1234567	qla2xxx	Alternate

The labeling of a logical device as either a primary or alternative path is for information only to

- Identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled the primary path for each physical device. However, many (multiple) logical devices can be labeled as an alternative path for the same devices.
- Provide information about which logical devices configured on the system have path failover support enabled.

When **lin_tape_as_sfmp** is set, *st* and *sg* paths can be queried through *pfo* paths as follows:

```
cat /sys/class/pfo/*/paths
```

Example output:

```
pfo9  sg=/dev/sg9  st=/dev/st0  sf=yes fo=no  wwnn=500507630f04be07 type=tape
2:0:1:0  up   last -      wwpn=500507630f44be07
3:0:1:0   -     -    -      -
```

Only one *st* and one *sg* device file name per device can use all the paths for that device.

Querying primary and alternative path configuration

You can show the primary and alternative path configuration for all devices by reading the **/proc/scsi/IBMtape** file, as explained in "Primary and alternative paths" on page 59.

Note: Show the primary and alternative path configuration for any device with tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

If it is necessary to disable a path and not run path failover (for example, because of maintenance), run commands to disable and then enable the primary and alternative paths.

The commands to enable and disable primary and alternative paths are tape diagnostic and utility functions.

Note: See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Tape Reserve Type

This parameter causes **lin_tape** to issue SCSI-3 persistent reserves to a tape drive whenever a reservation is attempted. Persistent reserves are automatically issued if data path failover is used, and therefore setting the parameter is unnecessary. This parameter can be set only when **lin_tape** is installed. To set it, add the following line to **/etc/modprobe.conf** or **/etc/modprobe.conf.local** (or, if you are running RHEL 6 or higher, to **/etc/modprobe.d/lin_tape.conf**):

```
options lin_tape tape_reserve_type=persistent
```

If alternate pathing is not enabled persistent reserve is not issued automatically, so this parameter is needed only if you want to use persistent reserve with **alternate_pathing** disabled.

Open source device driver - lin_tape

The **lin_tape** device driver is the new device driver for the Linux 2.6 kernels to replace the closed-source driver IBMtape. In most respects, it behaves the same as the closed-source IBMtape device driver. This section covers significant differences between the IBMtape driver and the **lin_tape** driver.

Comparing IBMtape and lin_tape

Table 10 on page 60 compares the names for various components of the **IBMtape** and **lin_tape** device drivers.

Table 10. Comparing IBMtape and lin_tape		
Component	**IBMtape**	**Lin_tape**
Driver name	IBMtape	lin_tape
Module name	IBMtape.ko	lin_tape.ko
Special files	/dev/IBMtape0 /dev/IBMchanger0, and so on.	No change
Proc entry	/proc/scsi/IBMtape /proc/scsi/IBMchanger	No change
Daemon name	IBMtaped	lin_taped
Daemon configuration file	/etc/IBMtaped.conf	/etc/lin_taped.conf
Daemon trace files	/var/log/IBMtape.trace /var/log/IBMtape.errorlog	/var/log/lin_tape.trace /var/log/lin_tape.errorlog

Lin_tape **join driver** installs **pfo.ko**, an extra lin_tape module that is idle for non-sfmp configurations, and **blacklist-pfo.conf** at the location **/etc/modprobe.d** for pfo module load control.

Installation

Installation of the **lin_tape** driver is the same as for the **IBMtape** driver, except that **IBMtape** must be replaced with **lin_tape** in the installation instructions. Refer to "Installation and Configuration instructions" on page 41 for details.

The **lin_tape** driver cannot be installed if the **IBMtape** driver is already installed. If the **IBMtape** driver is installed, first uninstall the **IBMtape** driver, and then install the **lin_tape** driver. With RHEL4 and SLES10, driver removal also requires a reboot of the server, since the **IBMtape** driver module is "permanent" in these distributions.

Driver parameters and special device files

The driver parameters are not changed for the **lin_tape** driver. However, it is important that the module parameters, such as **alternate_pathing**and **dpf_keys**, must now be applied to the **lin_tape** module, instead of the **IBMtape** module. For example, in the **/etc/modprobe.conf** or **/etc/modprobe.conf.local** file (or, if you are running RHEL 6 or higher, the **/etc/modprobe.d/lin_tape.conf** file), add the following line for LTO library's path failover:

```
options lin_tape alternate_pathing=1 dpf_keys="abcdefghijklmnop"
```

abckdefghijklmnop is an example of a data path failover feature key.

The special device files for the **lin_tape** driver are the same as for the **IBMtape** driver. Refer to "Special files for the tape device" on page 52 and "Special files for the Medium Changer device" on page 52 for details on special device files.

Taking devices offline and completing maintenance

Input and output must be quiesced and all driver handles must be closed before a **lin_tape** device is taken offline. It is recommended to remove the **lin_tape** driver module and then the HBA driver module before maintenance is done or the physical topology of the tape drive or library environment is changed. **Lin_tape** can be removed by the following command at the shell prompt.

```
lin_taped stop
modprobe -r lin_tape

Only if sfmp was enabled unload stmp/sgmp:
modprobe -r stmp
modprobe -r sgmp

modprobe -r pfo
```

Likewise, the HBA module can be removed by the following command, where "HBA_driver" is your specific HBA driver.

```
rmmod <HBA_driver>
```

After the maintenance is complete and the environment is ready to issue input and output, the drivers must be reinstalled in reverse order. This procedure is typically done by

```
modprobe <HBA_driver>
modprobe pfo
modprobe lin_tape

Only if sfmp was enabled load stmp/sgmp:
modprobe stmp
modprobe sgmp

>lin_taped start
```

Path failover support

Path failover support in **lin_tape** is the same. However, with the **lin_tape** driver, failover support is provided through the lin_taped daemon. If the lin_taped daemon is not running, neither control path failover nor data path failover is attempted. The lin_taped daemon is started automatically when the **lin_tape** driver is loaded.

To check whether the lin_taped daemon is running, run the following command.

```
lin_taped status
```

This command indicates whether the lin_taped daemon is running. If the /proc/scsi/IBMtape and /proc/scsi/IBMchanger files indicate "NA" for "FO Path", this answer indicates that failover support for that device is not enabled. If all other settings are correct, but "FO Path" is incorrectly indicating "NA", confirm that the lin_taped daemon is running.

For details about path failover support, refer to "Control Path failover support for tape libraries" on page 55 and "Data Path failover and load balancing support for tape drives" on page 57.

lin_taped daemon

The lin_taped daemon uses the same command-line arguments as the IBMtaped daemon. The lin_taped configuration file is the same as the IBMtaped configuration file, but is renamed to **lin_taped.conf**. Refer to "Configuring and running the lin_taped daemon" on page 64 for information.

System-managed encryption

Configuring device drivers

Note: System-managed encryption (SME) on Linux requires that the lin_taped daemon is running.

The device driver SME settings can be set for all drives at once with the **default_sys_encryption_proxy** and **default_sys_encryption_write** module options.

If no options are specified in the registry, the driver uses the default values for the parameters.

- The default value for **default_sys_encryption_proxy** is 1.

  This value causes the device driver to handle encryption key requests, if the drive is set up for system-managed encryption. This value does not need to be changed. A value of 0 causes the device driver to ignore encryption key requests for system-managed encryption drives, and is not desirable.

- The default value for **default_sys_encryption_write** is 2.

  This value causes the device driver to leave the encryption write-from-BOP settings alone. It does not turn on or turn off encryption writing, but instead uses the settings that are already in the drive. If encryption is not set up previously, then the drive writes unencrypted data. A value of 0 causes the device driver to write unencrypted data. A value of 1 causes the device driver to write encrypted data.

The module options can be specified in the **/etc/modprobe.conf**, **/etc/modprobe.conf.local**, or **/etc/modprobe.d/lin_tape.conf** files, the same as other **lin_tape** module parameters.

For example, to turn on SME to write/read encrypted data,

1. Add the following line:

```
options lin_tape default_sys_encryption_write=1
```

2. Then, run the following commands.

```
>lin_taped stop
>modprobe -r lin_tape

Only if sfmp was enabled unload stmp/sgmp:
>modprobe -r stmp
>modprobe -r sgmp

>modprobe -r pfo
Wait at least 5 seconds
>modprobe pfo
>modprobe lin_tape

Only if sfmp was enabled load stmp/sgmp:
```

```
>modprobe stmp
>modprobe sgmp

>lin_taped start
```

The default settings are used to initialize the settings for all connected drives.

To modify the settings for individual drives, the settings are **sys_encryption_write** and **sys_encryption_proxy**. They have the same definitions and values as the similarly named "default" parameters, except that the settings apply only to individual drives.

These settings are available as part of the sysfs infrastructure. For each drive, there are two files, named **sys_encryption_write** and **sys_encryption_proxy**, in the `/sys/class/lin_tape/{DEVICE}/` directory, where: *{DEVICE}* is the device name, such as `IBMtape0`. The contents of these files indicate the current setting for the parameter for that particular drive. The setting can be changed by writing a different value for the parameter to the file.

For example, to change the **sys_encryption_write** setting for IBMtape0 to ON (which has a value of 1), enter the following at a command line.

```
echo 1">/sys/class/lin_tape/IBMtape0/sys_encryption_write
```

Note: The driver encryption parameters for individual drives are not persistent between loads of the **lin_tape** driver. If you remove the **lin_tape** driver, and then reload it, the individual settings for all drives are the same as the "default" settings in **/etc/modprobe.conf**, **/etc/modprobe.conf.local**, or **/etc/modprobe.d/lin_tape.conf**.

The **ibmekm.conf** file, which contains the configuration that the EKM servers use, is installed in the `/etc/` directory when **lin_tape** is installed. Instructions for modifying this file are found within the file itself.

Querying tape drive configuration

The following is an example of the output when the drive is configured for system-managed encryption, with encryption turned on.

```
issuing query encryption status...
encryption capable......Yes
encryption method.......METHOD_SYSTEM
encryption state........ON
```

Problem determination

A set of tools is provided with the device driver to determine whether the device driver and the tape device are functioning correctly.

Tracing driver modules

By default, the driver prints minimal kernel trace messages to the system log at `/var/log/messages`. The minimal information includes notification that a device is recognized or taken offline and also the most serious of error conditions. If a more verbose trace is wanted, the variable */sys/bus/scsi/drivers/lin_tape/lin_tape_debug* must contain the value 1. This procedure can be accomplished in one of two ways -

- Add the following line to **/etc/modprobe.conf**, **/etc/modprobe.conf.local**, or **/etc/modprobe.d/lin_tape.conf**.

```
options lin_tape lin_tape_debug=1
```

Then reinstall **lin_tape**. This action causes the *lin_tape_debug* variable to be set every time **lin_tape** is loaded.

- Issue the following command from the shell.

```
echo 1 > /sys/bus/scsi/drivers/lin_tape/lin_tape_debug
```

This action causes the *lin_tape_debug* variable to be set only until **lin_tape** is uninstalled or until the variable is set back to 0.

Configuring and running the lin_taped daemon

Starting with **lin_tape** version 1.2.5, the **lin_tape** device driver provides an error diagnostic daemon (lin_taped) which provides the following capabilities:

1. Error logging and tracing
2. When drive dumps, log sense data, or SIM/MIM error information is created by the tape drive, the daemon automatically retrieves that data and saves it to the hard disk drive on your Linux system.
3. Failover and load balancing
4. Encryption

Because lin_taped requires a minimal amount of system resource and because it provides these necessary diagnostic capabilities, IBM recommends that you leave the daemon always enabled.

Installing lin_taped

lin_taped is automatically installed at /usr/bin/lin_taped when you install the **lin_tape** device driver with the **rpm** or **tar** package. Refer to "Installation and Configuration instructions" on page 41 for instructions on installing the **lin_tape** device driver.

Configuring lin_taped

You can customize the operation of lin_taped by modifying its configuration file, which is at **/etc/ lin_taped.conf**. The daemon reads only the configuration file when it starts; so if you modify the configuration file, stop the daemon, and restart it so that your modifications are recognized by the daemon.

Tracing:

Three levels of tracing are supported for the lin_taped daemon. lin_taped tracing is a complement to, but is different from, tracing of the kernel module that is described in "Tracing driver modules" on page 63. The lin_taped tracing levels are defined as follows:

0   With tracing set to 0, lin_taped records minimal tracing.

1   With tracing set to 1, lin_taped records information that is associated with each *ioctl* called. If a device error occurs and SCSI sense data is obtained from the device, a subset of that sense data is also recorded. The default setting for tracing.

2   With tracing set to 2, lin_taped records tracing messages for each SCSI command. If a device error occurs and SCSI sense data is obtained form the device, all sense data is also recorded. This tracing level is used only when a specific problem is being diagnosed due to the potential for huge amounts of data that is generated.

Set the *lin_tapeTrace* variable in the **/etc/lin_taped.conf** file to 0, 1, or 2, depending on what level of tracing you want. If the *lin_tapeTrace* variable is set to an invalid number, the lin_taped daemon does not start.

Tracing information is written to a file named **/var/log/lin_tape.trace**, by default. Information is written into the file until it is 1 MB in size, by default. After 1 MB of information is written, the file is archived (using the Linux **ar** command) into file **lin_tape.a** in the same directory. In the archive, the file name is renamed to **lin_tape.trace.timestamp**, where *timestamp* reflects the time that the file was archived.

You can change the directory to which the tracing information is written or the default maximum size of the trace file by modifying settings in the **lin_taped.conf** file. Refer to the instructions in the **lin_taped.conf** file for details.

Error logging:

lin_taped records certain error messages from the **lin_tape** device driver in a file named **/var/log/lin_tape.errorlog**, by default. Information is written into the file until it is 1 MB in size, by default. After 1 MB of trace information is written, the file is archived (with the Linux **ar** command) into file **lin_tape.a** in the same directory. In the archive, the file name is renamed to **lin_tape.errorlog.timestamp**, where *timestamp* reflects the time that the file was archived.

You can change the directory to which the error logging information is written or the default maximum size of the error log file by modifying settings in the **lin_taped.conf** file. Refer to the instructions in the **lin_taped.conf** file for details.

Whenever the lin_taped daemon is running, error logging is enabled if tracing is enabled. Following is an example an error log record.

```
IBMtape0---E0001  Tue Sep 10 14:04:57 2002
  Scsi Path   :   03 00 00 00
  CDB Command :   01 00 00 00 00 00
  Status Code :   08 00 00 01
  Sense Data  :   70 00 04 00 00 00 00 58 00 00 00 00 00 FF 0B
                  C4 77 00 00 00 06 01 40 00 00 00 00 00 00 01 00
                  10 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Description :   Hardware Error
```

The first line indicates the tape device special file name and the device serial number, and the timestamp when the error message was recorded. "Scsi Path" is the SCSI path for this logical unit. It matches the order of the `scsi/Channel/Id/Lun` information in the **/proc/scsi/scsi file**. "CDB Command" is the command data block of the SCSI command. "Status Code" is the returned result from the Linux SCSI middle layer device driver (**scsi_mod.o**). The 4 bytes represent driver_byte, host_byte, msg_byte, and status_byte. "Sense Data" is the full SCSI sense data that is returned from the target. "Description" is a person-readable text string that is obtained by parsing the sense key field of the sense data.

The following circumstances are not logged in the **lin_tape.errorlog** file:

1. Sense key is 0, and the sense data indicates an overlength or an underlength read, or encountering a file mark or the end of data
2. Sense key is 2, and the ASC/ASCQ indicates that the device is becoming ready
3. Sense key is 6, indicating a unit attention
4. Sense key is 8, and the ASC/ASCQ indicates the end of data

Volume logging:

The lin_tape device driver retrieves the full log sense data from the tape drive whenever the drive reaches a log threshold, or a tape is unloaded from the drive, or the drive is reset through an application. This data is stored in binary in a file named **lin_tape.timestamp.log**, where: *lin_tapen* is the device special file (for example, lin_tape1, lin_tape2) and **timestamp** reflects the time that the file was created. Each time log sense data is obtained, it is written to a new file. Use the appropriate tape drive hardware reference manual to decode the log sense data.

The volume logging data is stored in the **/var/log** directory by default. You can specify another directory in the **/etc/lin_taped.conf** file.

There are two configuration parameters in the **/etc/lin_taped.conf** file that you can tailor to affect the number of log sense files that are kept on your system.

- **lin_tapeMaxLogSenseFiles**, which has a value of 0 or a positive decimal number.
- **lin_tapeAutoLogSenseFileOverWrite**, which has a value of 0 or 1.

By default, **lin_tapeMaxLogSenseFiles** is 0 and **lin_tapeAutoLogSenseFileOverWrite** is 1, which means that every time log sense data is created, it is written to a new file.

If **lin_tapeMaxLogSenseFiles** is 0, **lin_tapeAutoLogSenseFileOverWrite** is ignored, and each time log sense data is obtained, it is written to a new file.

If **lin_tapeMaxLogSenseFiles** is a positive number and **lin_tapeAutoLogSenseFileOverWrite** is 0, each time log sense data is created, lin_taped writes that data to a file until **lin_tapeMaxLogSenseFiles** is created. Then, lin_taped stops creating new files, even if new log sense data is produced.

If **lin_tapeMaxLogSenseFiles** is a positive number and **lin_tapeAutoLogSenseFileOverWrite** is 1, each time log sense data is created, lin_taped writes that data to a file until **lin_tapeMaxLogSenseFiles** is created. Then, when new log sense data is detected, lin_taped deletes the oldest log sense file and creates a new file with the newest log sense data. Thus, only the newest data is kept.

Automatically retrieving a drive dump:

If a condition occurs in the drive such that a drive dump is created, lin_taped retrieves the drive dump and saves it in a file named **lin_tapex.timestamp.dmp**, where *lin_tapen* is the device special file (for example, lin_tape1, lin_tape2) and **timestamp** reflects the time that the file was created. Each time a drive dump is obtained, it is written to a new file. The IBM service organization might request that you forward drive dumps to them for analysis.

The drive dumps are stored in the **/var/log** directory by default. You can specify another directory in the **/etc/lin_taped.conf** file.

There are two configuration parameters in the **/etc/lin_taped.conf** file that you can tailor to affect the number of drive dumps that are kept on your system.

- **lin_tapeMaxDumpFiles**, which can have a value of 0 or a positive decimal number.
- **lin_tapeAutoDriveDumpFileOverWrite**, which can have a value of 0 or 1.

By default, **lin_tapeMaxDumpFiles** is 0 and **lin_tapeAutoDriveDumpFileOverWrite** is 1, which means that every time a drive dump is obtained, it is written to a new file.

If **lin_tapeMaxDumpFiles** is 0, **lin_tapeAutoDriveDumpFileOverWrite** is ignored, and each time a drive dump is obtained, it is written to a new file.

If **lin_tapeMaxDumpFiles** is a positive number and **lin_tapeAutoDriveDumpFileOverWrite** is 0, each time a dump is obtained, lin_taped writes that data to a file until **lin_tapeMaxDumpFiles** is created. Then, lin_taped stops creating new files, even if new drive dumps are produced.

If **lin_tapeMaxDumpFiles** is a positive number and **lin_tapeAutoDriveDumpFileOverWrite** is 1, each time a dump is obtained, lin_taped writes that data to a file until **lin_tapeMaxDumpFiles** is created. Then, when a new drive dump is detected, lin_taped deletes the oldest drive dump file and creates a new file with the newest drive dump data. Thus, only the newest data is kept.

Automatically retrieving SIM/MIM data:

If a condition occurs in the drive such that a drive SIM/MIM data is created, lin_taped retrieves the data and save it in a file named **lin_tapex.timestamp.simmim**, where *lin_tapen* is the device special file (for example, lin_tape1, lin_tape2) and **timestamp** reflects the time that the file was created. Each time SIM/MIM data is obtained, it is written to a new file. The IBM service organization might request that you forward SIM/MIM data to them for analysis.

The SIM/MIM data is stored in the **/var/log** directory by default. You can specify another directory in the **/etc/lin_taped.conf** file.

There are two configuration parameters in the **/etc/lin_taped.conf** file that you can tailor to affect the number of SIM/MIM files that are kept on your system.

- **lin_tapeMaxSimMimDataFiles**, which can have a value of 0 or a positive decimal number.
- **lin_tapeAutoSimMimDataOverWrite**, which can have a value of 0 or 1.

By default, **lin_tapeMaxSimMimDataFiles** is 0 and **lin_tapeAutoSimMimDataOverWrite** is 1, which means that every time SIM/MIM data is obtained, it is written to a new file.

If **lin_tapeMaxSimMimDataFiles** is 0, **lin_tapeAutoSimMimDataOverWrite** is ignored, and each time SIM/MIM data is obtained, it is written to a new file.

If **lin_tapeMaxSimMimDataFiles** is a positive number and **lin_tapeAutoSimMimDataOverWrite** is 0, each time SIM/MIM data is obtained, lin_taped writes that data to a file until **lin_tapeMaxSimMimDataFiles** is created. Then, lin_taped stops creating new files, even if new SIM/MIM data is created.

If **lin_tapeMaxSimMimDataFiles** is a positive number and **lin_tapeAutoSimMimDataOverWrite** is 1, each time SIM/MIM data is obtained, lin_taped writes that data to a file until **lin_tapeMaxSimMimDataFiles** is created. Then, when new SIM/MIM data is detected, lin_taped deletes the oldest SIM/MIM file and creates a new file with the newest SIM/MIM data. Thus, only the newest data is kept.

Selective tracing:

Lin_tape provides facilities by which you can disable and enable tracing, error logging, auto-retrieving drive dumps, and auto-retrieving SIM/MIM data. You can selectively enable or disable them through an application program, which uses the STIOC_SETP *ioctl*. These settings persist until the device driver is restarted, or the host system is rebooted.

The parameters and their definitions are as follows -

trace
    This parameter is set to On by default, which enables **lin_tape** tracing of activities and error logging on a particular tape drive. Set this parameter to off to stop tracing and error logging.

logging
    This parameter is set to On by default and enables logging of log sense data. Setting this flag to Off suppresses volume logging for this device.

disable_sim_logging
    This parameter controls the logging of SIM/MIM data for a device. By default it is set to Off, which causes SIM/MIM data to be logged. Set this flag to On to suppress the logging of SIM/MIM records.

disable_auto_drive_dump
    This parameter controls the saving of drive dumps for a device. By default it is set to Off, which causes drive dumps to be saved. Set this flag to On to suppress the saving of drive dumps.

Running lin_taped:

If you are running the **lin_tape** device driver, version 1.4.1 or higher, after installing **lin_tape** lin_taped starts running even if your system does not have a tape device attached. If you add a new tape device into your Linux system, lin_taped automatically creates a special file under the **/dev** directory. If you are running the **lin_tape** device driver, version 1.3.x or less, lin_taped does not automatically start if there is no tape device attached. After you attach a new tape device, you must start the lin_taped daemon.

You can start lin_taped from the command line. lin_taped takes zero or more of the parameters as listed in the following command.

```
lin_taped [start stop restart status]
```

lin_taped or lin_taped start
    Starts the daemon. If there is already a lin_taped running, the new one is aborted. (Use **lin_taped restart** if lin_taped is already running.)

lin_taped stop
    Terminates the daemon and frees all the resources that are associated with the daemon. When the daemon is stopped, no information is saved.

lin_taped restart
    Terminates the currently running daemon and starts a new one. The new daemon reads the **/etc/ lin_taped.conf** file. This command is used after the **/etc/lin_taped.conf** file is modified while lin_taped is running.

lin_taped status
    Prints a message on **stdout** to indicate whether the daemon is running or not.

Note: If you run **rmmod lin_tape** command to remove the **lin_tape** device driver from the running kernel, you must stop the lin_taped daemon first; otherwise you get a **Device or Resource Busy** error.

Reservation conflict logging

When the device driver receives a reservation conflict on a tape drive command, it logs the conflict to the kernel debug buffer (which is typically echoed to `/var/log/messages`). Before the error is logged, the device driver determines whether a SCSI Persistent Reservation is active on the target tape drive. If it is, it gets the reserving host initiator WWPN (worldwide port name). If successful, the device driver posts the message

```
lin_tape: reserve held by xxxxxxxx
```

to the debug buffer. To prevent multiple identical entries in the error log, subsequent reservation conflicts from the same reserving host WWPN are not logged.

Devices not reported at /proc/scsi/IBMchanger or /proc/scsi/IBMtape

After **lin_tape** is installed, following the Installation and Configuration instructions, this command shows all tape devices and their device index:

```
cat /proc/scsi/IBM*
```

If any or some devices that are expected to show up are not there, confirm that they are attached to Linux SCSI layer by:

```
cat /proc/scsi/scsi
```

If the devices do not show up there, review your HBA configuration and device attachment. If they are there, make sure that they are supported devices at SSIC. See Hardware requirements.

If files **/proc/scsi/IBMchanger** and **/proc/scsi/IBMtape** do not exist, review Installation and Configuration instructions, and confirm **lin_taped** is running by using:

```
lin_taped status
```

and also that **lin_tape** is correctly installed on SLES and RHEL by using:

```
rpm -qa lin_tape
```

.

On Ubuntu:

```
apt list --installed | grep lin-tape
```

Chapter 5. Solaris Tape and Medium Changer Device Driver

This chapter provides an overview of the IBM SCSI Tape and Medium Changer Device Driver for Solaris, also known as **IBMtape**.

Purpose

This device driver product provides attachment for IBM Magnetic Tape and Library System products to Oracle SPARC and x64 Servers running the Solaris operating system.

It is designed specifically to take advantage of the features that are provided by IBM tape and library systems. It also includes control of the random access medium changer facility (move, element information, and inventory) present in some devices. The goal is to give applications access to the functions required for basic operations (such as backup and restore). The goal also includes the advanced functions that are needed by full tape management systems. Whenever possible, the device driver is designed to take advantage of the IBM tape system features transparent to the application.

Data flow

Both data and commands flow between the application program and the tape subsystem by way of **IBMtape**. shows the data flow between **IBMtape**, the application program, the SCSI adapter device driver, and the IBM tape system.
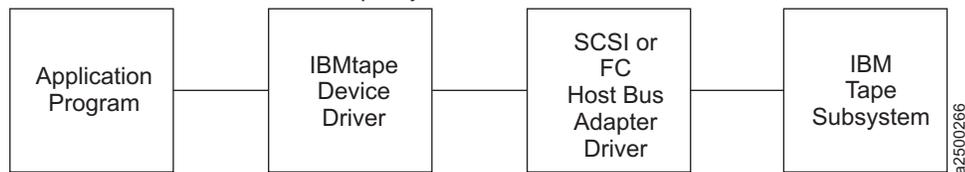
Figure 11. Data flow for Solaris Device Driver (IBMtape)

Product requirements

Hardware requirements

Refer to the "Hardware requirements" on page 1 for the latest hardware that is supported by the IBMtape device driver.

Note: For IBM Ultrium drives with the Fibre Channel attachment, the Oracle Solaris operating system requires that the Fibre Channel addressing mode of the drive be set to hard addressing.

Software requirements

For current software requirements, refer to the "Software requirements" on page 1.

Installation and configuration instructions

IBM SCSI Tape Drive and Medium Changer Device Driver for Solaris is an installable kernel module, which is supplied as a standard Solaris software package. When installed, its package name is **IBMtape**. The following sections describe installation, removal, configuration, and verification procedures for **IBMtape**. Refer to the Solaris documentation for general information about installable packages.

The **IBMtape** package consists of the device driver and a number of associated files and utilities. For components that are created during **IBMtape** installation, refer to Table 11 on page 70.

Table 11. Solaris: IBMtape components	
Component (Note)	**Description**
/etc/ibmekm.conf	SME configuration file, working version
/etc/tmd.conf	TMD configuration file, working version
/opt/IBMtape	Package subdirectory
/opt/IBMtape/diags_info	Diagnostic script
/opt/IBMtape/ibmekm.conf	SME configuration file, reference version
/opt/IBMtape/tapelist	Utility program
/opt/IBMtape/tmd	Tape Monitor Daemon (TMD) program
/opt/IBMtape/tmd.conf	TMD configuration file, reference version
/opt/IBMtape/IBMtape.conf	Configuration file, reference version
/opt/IBMtape/ztapelist	Shell script for Solaris zones use
/opt/IBMtape/tapedtrc	Dynamic tracing utility program
/usr/kernel/drv/IBMtape	Kernel module device driver
/usr/kernel/drv/IBMtape.conf	Configuration file, working version
/usr/include/sys/smc.h	Medium changer application programming interface (API) header file
/usr/include/sys/st.h	Tape drive API header file
/usr/include/sys/svc.h	Service aid API header file
/usr/include/sys/oldtape.h	Compatibility API header file
Note: When **IBMtape** is updated, the working copies of **IBMtape.conf**, **tmd.conf**, and **ibmekm.conf** are not overwritten by the package file contents. This action allows tape drive configuration options to be preserved across **IBMtape** updates. The reference copies of **IBMtape.conf**, **tmd.conf**, and **ibmekm.conf** are always installed in the **/opt/IBMtape** directory.	

Examples of installation commands and their results throughout this chapter use a percent sign (%) to indicate the shell prompt.

Preventing conflicts with other device drivers

IBMtape attempts to claim and operate only the devices that are described in "Hardware requirements" on page 69. However, the Solaris operating system includes a SCSI tape device driver named **st**, which claims any SCSI-compliant tape drive that it detects, including devices that **IBMtape** manages. To avoid conflicts between **IBMtape** and **st**, you must prevent **st** from claiming and attempting to operate **IBMtape**-owned devices. Likewise, other suppliers' SCSI tape device drivers that you installed must be prevented from claiming **IBMtape**-owned devices.

Note: To prevent more than one device driver from claiming **IBMtape**-owned devices, **IBMtape** must be also configured with the HBA correctly. Refer to the section of "Configuring IBM tape devices with Oracle FC and SAS HBAs" on page 78 for the details.

⚠️ **Attention:** Failure to prevent more than one device driver from operating the same tape drive might cause system panics or data loss on the tape drive.

The following installation and update steps describe how to prevent conflicts between **IBMtape** and other SCSI tape device drivers.

Preinstallation considerations

Follow these steps to install or update **IBMtape**. Before the step-by-step procedure is started, note the following general considerations.

- Differential SCSI-2 support must exist on the machine before **IBMtape** is installed. Install and configure one of the supported differential SCSI adapters first, then return to this section. Refer to the differential SCSI adapter documentation for instructions on installing the adapter and adapter driver.
- You must have *root* authority to install or remove **IBMtape**.
- You can restart the system as part of the **IBMtape** installation. Take appropriate precautions that this action does not adversely affect users or active processes on the system.
- As a consequence of installing or reinstalling **IBMtape**, device special file numbers under **/dev/rmt** might change. These numbers are assigned by Solaris during the driver attachment process, and the sequencing cannot be specified by the device driver or installer.

Note: At the time of this writing, Solaris IBMtape driver does not yet support LTO 7. Check the Fixlist on **FixCentral** for updates on LTO 7 support.

Installing and updating IBMtape

Several steps must be taken before **IBMtape** is installed or updated on your system to ensure correct installation and system integrity.

1. Notify users that system maintenance and a restart is completed.
2. Select a time when all system activity can be stopped to run the installation.
3. Log in to the target system as **root**.
4. Ensure that all user and tape drive activity on the system is halted.
5. If tape drives that are not owned by **IBMtape** are installed on the system, list the low-density device special files and find the SCSI addresses with which they are currently associated.

```
% ls -l /dev/rmt/*l
lrwxrwxrwx   1 root     root          72 Aug 26 15:47 /dev/rmt/5l ->
../../devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,10000/st@2,0:l
```

In the preceding example, /dev/rmt/5l and the related 5m, 5h, are controlled by the **st** device driver and are associated with the device at SCSI address 2, LUN 0. Record the device type, **/dev/rmt** special file number, owning driver, SCSI target address, and LUN. This information is required later in the installation.

For example, suppose that an installation has two non-IBM devices that are owned by **st** at SCSI addresses 2 and 8. The low-density devices are accessed as special files **/dev/rmt/5l** and **/dev/rmt/6l**. For the equipment listing after the device information is recorded, refer to Table 12 on page 71.

Table 12. Solaris: IBMtape install or update			
DEVICE	**Old special file**	**Old driver**	**SCSI address/LUN (Old)**
QIC	**/dev/rmt/5l**	st	2/0
QIC	**/dev/rmt/6l**	st	8/0

6. If **IBMtape** is updating, **IBMtape**-owned devices are already installed. In that case, list the primary device special files and find the SCSI addresses with which they are currently associated.

```
% ls -l /dev/rmt/*st /dev/rmt/*smc
lrwxrwxrwx   1 root     other        46 Aug 26 16:36 /dev/rmt/0st ->
../../devices/pci@6,4000/scsi@3/IBMtape@b,0:st

lrwxrwxrwx   1 root     other        47 Aug 26 16:36 /dev/rmt/1smc ->
../../devices/pci@6,4000/scsi@3/IBMtape@b,1:smc
```

Note: When the drive is configured with **Oracle** HBA driver, even though the hardware path shows as **st@w10000000c9848d68,0** the device special file still indicates that the drive is configured with **IBMtape** driver.

```
lrwxrwxrwx   1 root     root         80 Feb 22 05:12 /dev/rmt/0st ->
../../devices/pci@400/pci@0/pci@d/SUNW,emlxs@0/fp@0,0/
      st@w10000000c9848d68,0:st
```

The previous device special file is created by **IBMtape**. Refer to "Special files" on page 92 for detail.

In this example, **/dev/rmt/0st** (a SCSI tape drive) is controlled by **IBMtape** and is associated with the device at SCSI address b, LUN 0. The address is reported in hexadecimal format: The file **/dev/rmt/1smc** (a SCSI medium changer) is associated with the device at SCSI address b, LUN 1. Record the device type, **/dev/rmt** special file number, owning driver, SCSI target address, and LUN. This information is required later in the installation.

For example, suppose that an installation has only an **IBMtape**-owned device that is installed at SCSI address 8. The device consists of both a tape drive and SCSI medium changer. The tape drive is accessed as **/dev/rmt/2st**, and the medium changer as **/dev/rmt/3smc**. For a similar equipment listing after the device information is recorded, refer to Table 13 on page 72.

Table 13. Solaris Device Driver - IBMtape - equipment listing example 1			
DEVICE	**Old special fle**	**Old driver**	**SCSI address/LUN (Old)**
3592 drive	**/dev/rmt/2st**	IBMtape	8/0
TS3500 changer	**/dev/rmt/3smc**	IBMtape	8/1

7. Select one of the following methods to prevent conflicts between **IBMtape** and other SCSI tape device drivers, depending on the equipment that is attached to your system.

Note: To prevent more than one device driver from claiming **IBMtape**-owned devices, **IBMtape** must be also configured with HBA correctly. Refer to the section of "Configuring IBM tape devices with Oracle FC and SAS HBAs" on page 78 for the details.

⚠️ **Attention:** Failure to prevent more than one device driver from operating the same SCSI tape drive can cause system panics or data loss on the tape drive.

a. If the system has only **IBMtape**-owned devices that are attached, follow these steps to prevent **st** and other non-IBM SCSI tape device drivers from claiming the IBM devices.

1) Edit **/kernel/drv/st.conf**, and comment out all SCSI target entries by placing a number sign (#) in the first column of each target entry. The following example shows the entries for SCSI target addresses 0 and 1 commented out. Repeat this operation for all target entries.

```
#name="st" class="scsi"
#target=0 lun=0;

#name="st" class="scsi"
#target=1 lun=0;
```

2) For other non-IBM installed SCSI tape device drivers, remove the drivers if they are not needed. If a driver is for SCSI tape devices only, it is not needed. If a driver is for both tape and disk devices, follow the suppliers' instructions to disable its access to all SCSI tape devices.

b. If the system has a mixture of **IBMtape**-owned devices and other tape drives, follow these steps to configure **st** and other non-IBM SCSI tape device drivers so that they control a range of target addresses distinct from the range that **IBMtape** uses. These steps leave target addresses 7 and 15 unclaimed by all target device drivers because SCSI adapters typically use one of the two addresses.

1) Edit **/kernel/drv/st.conf**, and comment out SCSI target entries for addresses 7-15 by placing a number sign (#) in the first column of each target entry. In the following example, the entries for SCSI address 7 and 8 are commented out. Repeat this operation for all entries in the target address range 7-15.

```
#name="st" class="scsi"
 #target=7 lun=0;

 #name="st" class="scsi"
 #target=8 lun=0;
```

2) For other non-IBM installed SCSI tape device drivers, follow the suppliers' instructions to disable their access to all SCSI tape devices in the address range 7-15.

3) After the **IBMtape** package is installed, you must alter its configuration file so it does not use SCSI target addresses in the range 0-7 or address 15.

Now **st** and other non-IBM SCSI tape device drivers are configured to avoid a conflict with **IBMtape**.

8. Remove all special file entries under **/dev/rmt**. This action ensures that stale entries do not exist after the system is restarted. New entries are created when the system is restarted.

```
% rm /dev/rmt/*
```

9. Read the next section of "Configuring IBM tape devices with Fibre Channel and SAS HBAs" on page 77, and follow the instruction requirements for the selected HBA in the host machine before or after IBMtape is installed.

10. If you are updating the level of **IBMtape**, remove the currently installed **IBMtape** package. If this procedure is a new installation of **IBMtape**, skip this step.

a. Use **pkgrm** to remove the current level.

```
% /usr/sbin/pkgrm IBMtape
```

Respond to the **pkgrm** prompts.

b. Examine the results from **pkgrm**. If you see these messages, one or more **IBMtape**-owned tape drives or tape monitor daemon (TMD) were still in use. Identify the drives and TMD process ID (pid), and end the processes that are using them. If you cannot identify the processes, you must restart the system to free the tape drive, then continue with the installation from this point.

```
...
Device busy
Cannot unload module: IBMtape
Will be unloaded upon reboot.
...
```

11. Select one of the following methods to install the **IBMtape** package, depending on the package distribution medium and the location of system resources.

Note: If this procedure is a new installation of **IBMtape**, IBM devices are not yet attached to the system, pkgadd error messages similar to the following are output.

```
...
drvconfig: Driver (IBMtape) failed to attach
Warning: Driver (IBMtape) successfully added to system
but failed to attach
## The device driver was unable to detect any supported devices!
## Verify that the device(s) are properly connected and powered on.
## Ensure that the SCSI adapter device driver is installed/configured.
## Then try reinstalling the device driver as follows:
```

```
##   -enter the command: rem_drv IBMtape
##   -enter the command: add_drv -m '* 0666 bin bin' IBMtape
## If problems persist, contact your IBM service representative.
pkgadd: ERROR: postinstall script did not complete successfully
...
```

Later, after you cabled IBM drives to the system and restarted, the driver attaches normally.

If the distribution medium is a package file in a UNIX file system, complete the following steps. You might obtain a package file by downloading it from the IBM Fix Central website: http://www.ibm.com/support/fixcentral. For information, see Appendix A, "Accessing documentation and software online," on page 293. This example presumes a package file named **IBMtape.4.0.2.7** in the **/tmp** directory.

a. If necessary, FTP the package file to the target system. Use binary transfer mode. Place the package file in the target system's **/tmp** directory.

b. Use **pkgadd** to install the driver.

```
% /usr/sbin/pkgadd -d /tmp/IBMtape.4.0.2.7
```

12. If your system environment includes a mixture of **IBMtape**-owned devices and devices that are owned by **st** or another third-party SCSI tape device driver, you must first modify the configuration files for the non-IBM device drivers and restrict them to target addresses in the range 0-6.

Edit **IBMtape.conf**, in **/usr/kernel/drv/**, and comment out entries for SCSI target addresses 0-7 and 15. Place a number sign (#) in the first column of each line that makes up the entries. In the following example, the entries for address 0, LUN 0 and address 0, LUN 1 are commented out. Repeat the operation for all stanzas in the address range 0-7 and address 15. Each SCSI target address has a stanza for both LUN 0 and LUN 1.

```
#name="IBMtape" class="scsi"
#target=0 lun=0
#block_size=0
#buffering=1
#immediate=0
#trailer=0
#sili=0;
```

```
#name="IBMtape"      class="scsi"
#target=0 lun=1
#block_size=0
#buffering=1
#immediate=0
#trailer=0
#sili=0;
```

In SAN environment, the Fibre Channel HBA driver can map the SCSI target address out of the range 15 and LUN over the number 1. You create a new entry with the mapped SCSI target in **IBMtape.conf**. In the following example, the IBM tape device is mapped to the SCSI target 32 and LUN 15.

```
name="IBMtape" class="scsi"
target=32 lun=15
block_size=0
buffering=1
immediate=0
trailer=0
sili=0;
```

Alternatively, you can modify the configuration file or use the utility that is provided by the Fibre Channel HBA driver to persistently bind the tape device to the expected SCSI target address.

13. Shut down the system. One common method to complete a shutdown is shown here but use your installation's normal procedures.

```
% /usr/sbin/shutdown -y -g0 -i0
```

14. Address or readdress devices as determined by your installation.

a. If the system has only **IBMtape**-owned devices that are attached, you can select addresses in the range 0-6 or 8-14. Leave addresses 7 and 15 unused because these addresses are used typically by the SCSI adapter.

   1) For each device, refer to the appropriate IBM hardware reference for any special instructions about addressing. Then, set the address and record the device type, SCSI address, and LUN. For example, suppose that an installation has only **IBMtape**-owned devices attached. An IBM device with tape drive and medium changer is added. It is addressed at target 4 and the information is recorded. For the results, refer to

Table 14. Solaris Device Driver - IBMtape - equipment listing example 2				
DEVICE	**Old special file**	**Old driver**	**SCSI address/LUN (Old)**	**SCSI address/LUN (New)**
3592 drive	-	-	-	4/0
TS3500 changer	-	-	-	4/1

b. If you are using distinct address ranges to separate tape drives that are **IBMtape**-owned from devices that are owned by **st** or another supplier's driver, readdress the tape drives now.

   1) For each device that is owned by **st** or another SCSI tape device driver, refer to the manufacturer's hardware reference for any special instructions about readdressing. Then, readdress each device to an address in the range 0-6. For each tape drive that is readdressed, record the new SCSI address next to the special file number and old SCSI address that you recorded previously.

   2) Readdress all tape drives that are owned by **IBMtape** to addresses in the range 8-14. Refer to the appropriate IBM hardware references for any special instructions about readdressing. For each tape drive that is readdressed, record the new SCSI address next to the special file number and old SCSI address, if any, that you previously recorded.

For example, suppose that an installation has two non-IBM devices that are owned by **st** at SCSI addresses 9 and B (12 in decimal). An IBM device with tape drive and medium changer is added. To prevent conflicts between **IBMtape** and **st**, the non-IBM devices are all placed at addresses in the range 0-6. The new IBM device is addressed in the range 8-14, at address 10, or 0A. Depending on the addresses that are chosen for the non-IBM devices after device information is readdressed and recorded, refer to for the possible equipment listing.

Table 15. Solaris Device Driver - IBMtape - equipment listing example 3				
DEVICE	**Old special file**	**Old driver**	**SCSI address/LUN (Old)**	**SCSI address/LUN (New)**
QIC	**/dev/rmt/2l**	st	9/0	3/0
QIC	**/dev/rmt/3l**	st	b/0	5/0
3592 drive	-	-	-	a/0
TS3500 changer	-	-	-	a/1
Note: The SCSI target address of Fibre Channel tape device might be over 15.				

15. Cable the tape drives to the system, if not yet done. Refer to the manufacturer's hardware references for any special instructions about cabling. Ensure that each SCSI bus is terminated properly.

16. Start the system according to your installation's normal procedures.

17. Log on as **root** and list the device special files in **/dev/rmt** as you did earlier during the installation.

```
% ls -l /dev/rmt/*l
% ls -l /dev/rmt/*st /dev/rmt/*smc
```

Compare the SCSI addresses obtained from **ls** with the readdressed SCSI targets you recorded. Write the new device special file numbers and owning driver next to the matching new SCSI addresses.

For example, suppose that an installation previously had two non-IBM devices that are owned by **st** at SCSI addresses 2-8. An IBM device with tape drive and medium changer is added. To prevent conflicts between **IBMtape** and **st**, the non-IBM devices are all placed at addresses in the range 0-6. The new IBM device is addressed in the range 8-14. Depending on the addresses that are chosen after installation is completed and device information is recorded, refer to Table 16 on page 76 for the possible equipment listing entries.

DEVICE	Old special file	Old driver	SCSI address/LUN (Old)	SCSI address/LUN (New)	New driver	New special file (Note)
Table 16. Solaris Device Driver - IBMtape - equipment listing example 4						
QIC	**/dev/rmt/5l**	st	2/0	2/0	st	**/dev/rmt/0l**
QIC	**/dev/rmt/6l**	st	8/0	0/0	st	**/dev/rmt/1l**
3590-B11 drive	-	-	-	8/0	IBMtape	**/dev/rmt/2st**
3590-B11 changer	-	-	-	8/1	IBMtape	**/dev/rmt /3smc**

Note: Based on the listing, you can see that the tape drive accessed previously as **/dev/rmt/5** is now accessed as **/dev/rmt/0**, the new medium changer is accessible as **/dev/rmt/3smc**.

18. Complete validation of "configuration conflict" to avoid the device that is configured with more than one device driver.

   a. List the device special files in **/dev/rmt** and check if any unexpected device special file is created by non-**IBMtape** driver.

   b. Verify whether same SCSI address or WWNN is pointed to different device special files owned by the different device driver. For example, a same tape drive is configured by **st** driver with the special file of **/dev/rmt/0** and by **IBMtape** driver with **/dev/rmt/15st** at the same SCSI address (target 0 and LUN 0).

```
lrwxrwxrwx   1 root     root            49 Jul 28  2009 /dev/rmt/0 ->
../../devices/pci@81,2000/fibre-channel@1/st@0,0:
lrwxrwxrwx   1 root     sys             56 Jul 28  2009 /dev/rmt/15st ->
../../devices/pci@80,2000/fibre-channel@1/IBMtape@0,0:st
```

   c. Run the system command or other utility to verify whether the device can be opened by using both device special file names.

   With the device special files in above example, load the cartridge in the drive and run **# mt -f /dev/rmt/* stat** command

```
(1) IBMtape opens the drive.
# mt -f /dev/rmt/15stn stat
IBM_ULT3580-TD5  tape drive:
   sense key(0x0)= No Additional Sense   residual= 0   retries= 0
   file no= 0   block no= 0
```

```
(2) st opens the drive.
# mt -f /dev/rmt/0n stat
IBM_ULT3580-TD5  tape drive:
   sense key(0x0)= No Additional Sense   residual= 0   retries= 0
   file no= 0   block no= 0
```

```
(3) st fails to open the drive.
# mt -f /dev/rmt/0n stat
/dev/rmt/0n: No such file or directory
```

19. Verify operation of the newly installed or readdressed equipment.
20. Notify users of any changed device special files numbers.

Configuring IBM tape devices with Fibre Channel and SAS HBAs

Users might experience difficulty when an IBM tape device is attached to an IBM tape driver on a fibre network. The following sections describe how to configure IBM tape devices with QLogic, Emulex, Oracle, Brocade, and AMCC Fibre Channel HBAs.

-
-
-
-
-

Configuring IBM tape devices with QLogic FC HBAs

To configure an IBM tape device with a QLogic FC HBA, complete the following steps.

1. Run the **QLogic SANSurfer Control FX** utility to find and record the mapped target and LUN of the tape device.
2. Remove the comment at the beginning of the entry for the QLogic HBA in the **/usr/kernel/drv/IBMtape.conf** file.

   For example, the following command opens the entry for QLogic QLA2462 running QLogic HBA driver qla2300.

   ```
   name="IBMtape" parent="qla2300" target=0;  # for qla2300 only
   ```

3. Update the entry for the device in the **IBMtape.conf** file, if necessary. The current entry in the **IBMtape.conf** file is added to target 255 with LUN 0 and 1.

   For instance, the following command adds an entry for a mapped device with target 200 and LUN 3.

   ```
   name="IBMtape" class="scsi" target=200 LUN=3;
   ```

4. Unload and reload the **IBMtape** driver.

   ```
   # /opt/IBMtape/tmd -s
   # rem_drv IBMtape
   # add_drv -m '* 0666 bin bin' IBMtape
   # /opt/IBMtape/tmd
   ```

5. Display information on the configured devices by running **/opt/IBMtape/tapelist -l**.

To configure an IBM tape device with a QLogic FC HBA running with Oracle branded QLogic FC HBA driver (qlc), refer to the section .

Configuring IBM tape devices with Emulex FC HBAs

To configure an IBM tape device with an Emulex FC HBA, complete the following steps.

1. Run the **Emulex HBAnyware** utility to find and record the mapped target and LUN of the tape device.
2. For lpfc.6.30g or later, update the parameters setting in **/kernel/drv/lpfc.conf** and reboot the system.

   If **IBMtape** driver is used as a tape driver, change the parameter for **IBMtape**.

   ```
   target-tape="IBMtape
   ```

If **IBMtape** driver is used as a changer driver, modify the setting for **IBMtape**.

```
target-tapechanger="IBMtape"
```

3. Remove the comment at the beginning of the entry for the Emulex HBA in **/usr/kernel/drv/IBMtape.conf**:

```
name="IBMtape" parent="lpfc" target=0;
```

If this action fails to configure the changer, you might need to add the entries for LUN 0 and 1.

```
name="IBMtape" parent="lpfc" target=X lun=0;
name="IBMtape" parent="lpfc" target=X lun=1;
```

4. Update the entry for the device in the **IBMtape.conf** file, if necessary. The current entry in **IBMtape.conf** adds target 255 with LUN 0 and 1.

For instance, the following command adds an entry for a mapped device with target 200 and LUN 3.

```
name="IBMtape" class="scsi" target=200 lun=3;
```

5. Unload and reload the **IBMtape** driver:

```
# /opt/IBMtape/tmd -s
# rem_drv IBMtape
# add_drv -m '* 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

6. Display information on the configured devices by running **/opt/IBMtape/tapelist -l**.

To configure an IBM tape device with an Emulex FC HBA running with Oracle branded Emulex FC HBA (emlxs) driver, refer to the section .

Configuring IBM tape devices with Oracle FC and SAS HBAs

To configure an IBM tape device with an Oracle FC HBA, complete the following steps.

1. Attach the IBM tape devices on the host.
2. Install the appropriate patch for the Oracle HBA driver.
3. Run **# cfgadm -al** to display the configuration between the HBA and the tape device.

   Run **# cfgadm -al -o show_FCP_dev Ap_Id** to show the medium changer configuration with the FC HBA.

   Run **# cfgadm -c configure device** to configure the tape device with the HBA if needed.
4. Install the **IBMtape** tape driver by running the **# pkgadd -d IBMtape** command.
5. Enter the following appropriate lines in **/etc/driver_aliases**:

```
IBMtape "scsiclass,01.vIBM.pXXX" for tape drive.
IBMtape "scsiclass,08.vIBM.pXXX" for medium changer.
```

Where: *01* and *08* stand for the type of tape drive and medium changer and *XXX* is the product ID string in the standard inquiry data. For example, ULT3580-TD7 is the product ID of the IBM LTO7 drive. The following entry is added in the file for the IBM LTO7 drive.

```
IBMtape "scsiclass,01.vIBM.pULT3580-TD7"
```

The following is a list of the entries for the supported IBM tape devices.

For the tape drives

```
IBMtape "scsiclass,01.vIBM.pULT3580-TD4"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD4"
IBMtape "scsiclass,01.vIBM.pULT3580-HH4"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH4"
IBMtape "scsiclass,01.vIBM.pULT3580-TD5"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD5"
IBMtape "scsiclass,01.vIBM.pULT3580-HH5"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH5"
IBMtape "scsiclass,01.vIBM.pULT3580-TD6"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD6"
IBMtape "scsiclass,01.vIBM.pULT3580-HH6"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH6"
IBMtape "scsiclass,01.vIBM.pULT3580-TD7"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD7"
IBMtape "scsiclass,01.vIBM.pULT3580-HH7"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH7"
IBMtape "scsiclass,01.vIBM.pULT3580-TD8"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD8"
IBMtape "scsiclass,01.vIBM.pULT3580-HH8"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH8"
IBMtape "scsiclass,01.vIBM.p03592J1A"
IBMtape "scsiclass,01.vIBM.p03592E05"
IBMtape "scsiclass,01.vIBM.p03592E06"
IBMtape "scsiclass,01.vIBM.p03592E07"
IBMtape "scsiclass,01.vIBM.p03592E08"
IBMtape "scsiclass,01.vIBM.p0359255F"
```

For the medium changers

```
IBMtape "scsiclass,08.vIBM.p03584L32"
IBMtape "scsiclass,08.vIBM.p03584L22"
IBMtape "scsiclass,08.vIBM.pULT3582-TL"
IBMtape "scsiclass,08.vIBM.pULT3583-TL"
IBMtape "scsiclass,08.vIBM.pULT3581-TA"
IBMtape "scsiclass,08.vIBM.pULT3581-TA2"
IBMtape "scsiclass,08.vIBM.p03590B11"
IBMtape "scsiclass,08.vIBM.p03590E11"
IBMtape "scsiclass,08.vIBM.p03590H11"
IBMtape "scsiclass,08.vIBM.p3576-MTL"
IBMtape "scsiclass,08.vIBM.p3573-TL"
IBMtape "scsiclass,08.vIBM.p3572-L1U"
IBMtape "scsiclass,08.vIBM.p3572-TL"
IBMtape "scsiclass,08.vIBM.p3577-TL"
```

Note: The entry is also added running the **# update_drv** command on Solaris 8 (patch 111804-03 is required), Solaris 9, and later versions of the operating system. For example,

```
# update_drv -av -i '"scsiclass,01.vIBM.pULT3580-TD2"' IBMtape
```

6. Reboot the system by running **# reboot -- -r**.

7. Run **# /opt/IBMtape/tapelist -l** to display the configured tape device information.

   Note: All of the added entries are removed by the operating system automatically after **IBMtape** is unloaded from the kernel by running the **# pkgrm**, **rem_drv**, or **modunload** commands. It is recommended that you back up these entries in a file. Then, reenter the entries when you upgrade the **IBMtape** driver before the **#pkgadd** command is run.

Configuring IBM tape devices with AMCC FC HBAs

To configure an IBM tape device with an AMMC FC HBA, complete the following steps:

1. Modify and add the following parameters in **/kernel/drv/jnic146x.conf**.

```
CmdTaskAttr=1;
lun_throttle=1;
tape-device="IBMtape";
tape-changer="IBMtape";
```

2. Update the change in **jnic146x.conf**.

3. Run the **EZ Fibre** utility to find and record the mapped target and LUN of the tape device.

4. Remove the comment from the beginning entry for AMCC HBA in **/usr/kernel/drv/IBMtape.conf**.

```
name="IBMtape" parent="jnic146x" target=0;
```

5. Update the entry for the device in **IBMtape.conf** if necessary. The current entry in **IBMtape.conf** adds target 255 with LUN 0 and 1. For instance, use the following command to add an entry for a mapped device with a target 200 and LUN 3.

```
name="IBMtape" class="scsi" target=200 lun=3;
```

6. Unload and reload the **IBMtape** driver.

```
# /opt/IBMtape/tmd -s
# rem_drv IBMtape
# add_drv -m '* 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

7. Display information on the configured devices by running **/opt/IBMtape/tapelist -l**.

Configuring IBM tape devices with Brocade FC HBAs

To configure an IBM tape device with a Brocade FC HBA, complete the following steps.

1. Attach IBM tape devices on the host.

2. Install the appropriate version of Brocade HBA driver and its utilities.

3. Run Brocade HCM (Host Connectivity Manager) to display the configuration.

4. Install the **IBMtape** tape driver by running **# pkgadd** command.

5. Enter the following appropriate lines in **/etc/driver_aliases**:

```
IBMtape "scsiclass,01.vIBM.pXXX"  for tape drive.
IBMtape "scsiclass,08.vIBM.pXXX" for medium changer.
```

Where: *01* and *08* stand for the type of tape drive and medium changer and *XXX* is the product ID string in the standard inquiry data. For example, ULT3580-TD7 is the product ID of the IBM LTO7 drive. The following entry is added in the file for the IBM LTO7 drive,

```
IBMtape "scsiclass,01.vIBM.pULT3580-TD7"
```

The following is a list of the entries for the supported IBM tape devices.

For the tape drives

```
IBMtape "scsiclass,01.vIBM.pULT3580-TD4"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD4"
IBMtape "scsiclass,01.vIBM.pULT3580-HH4"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH4"
IBMtape "scsiclass,01.vIBM.pULT3580-TD5"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD5"
IBMtape "scsiclass,01.vIBM.pULT3580-HH5"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH5"
IBMtape "scsiclass,01.vIBM.pULT3580-TD6"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD6"
IBMtape "scsiclass,01.vIBM.pULT3580-HH6"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH6"
IBMtape "scsiclass,01.vIBM.pULT3580-TD7"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD7"
IBMtape "scsiclass,01.vIBM.pULT3580-HH7"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH7"
IBMtape "scsiclass,01.vIBM.pULT3580-TD8"
IBMtape "scsiclass,01.vIBM.pULTRIUM-TD8"
IBMtape "scsiclass,01.vIBM.pULT3580-HH8"
IBMtape "scsiclass,01.vIBM.pULTRIUM-HH8"
```

```
IBMtape "scsiclass,01.vIBM.p03592E05"
IBMtape "scsiclass,01.vIBM.p03592E06"
IBMtape "scsiclass,01.vIBM.p03592E07"
IBMtape "scsiclass,01.vIBM.p03592E08"
IBMtape "scsiclass,01.vIBM.p0359255F"
```

For the medium changers

```
IBMtape "scsiclass,08.vIBM.p03584L32"
IBMtape "scsiclass,08.vIBM.p03584L22"
IBMtape "scsiclass,08.vIBM.pULT3582-TL"
IBMtape "scsiclass,08.vIBM.pULT3583-TL"
IBMtape "scsiclass,08.vIBM.pULT3581-TA"
IBMtape "scsiclass,08.vIBM.pULT3581-TA2"
IBMtape "scsiclass,08.vIBM.p03590B11"
IBMtape "scsiclass,08.vIBM.p03590E11"
IBMtape "scsiclass,08.vIBM.p03590H11"
IBMtape "scsiclass,08.vIBM.p3576-MTL"
IBMtape "scsiclass,08.vIBM.p3573-TL"
IBMtape "scsiclass,08.vIBM.p3572-L1U"
IBMtape "scsiclass,08.vIBM.p3572-TL"
IBMtape "scsiclass,08.vIBM.p3577-TL"
```

Note: The entry is also added running the **# update_drv** command on Solaris 8 (patch 111804-03 is required), Solaris 9, and later versions of the operating system. For example,

```
# update_drv -av -i '"scsiclass,01.vIBM.pULT3580-TD2"' IBMtape
```

6. Reboot the system by running **# reboot -- -r**.

7. Run **# /opt/IBMtape/tapelist -l** to display the configured tape device information.

Configuring limitations

The subsequent limitations are applied for the **IBMtape** driver that runs on a Solaris host.

Maximum supported number of tape devices	1024
Maximum supported number of HBA ports	56
Maximum supported number of paths for a device (DPF/ CPF)	16/16
Maximum LUN size per target for FC HBA	256 (Oracle, QLogic, Brocade FC HBAs)
	128 (Emulex FC HBA running with lpfc HBA driver)

Every opened tape device uses a certain amount of resources. The user must also consider other resources such as physical memory and virtual space on the system before you attempt to reach the limits.

Solaris Zones support

The Solaris Zones partitioning technology on Solaris 10 is used to virtualize operating system services and provide an isolated and secure environment for running applications. Every Solaris system contains a global zone with ID 0, where the **IBMtape** driver is installed. Zones that are hosted by a global zone are known as *non-global zones*, which have their own node name, virtual network interface, and storage assignment.

The **IBMtape** driver supports the Solaris Zones environment. To install **IBMtape** on the system with the virtualized zones, run the **pkgadd** system command from the global zone.

```
#pkgadd -G -d IBMtape.x.x.x.x
```

The **IBMtape** installation script installs the driver in the global zone and installs some of **IBMtape** utilities that run a non-root user in all zones.

Since the tape devices in non-global zones are configured from the global zone, a script program that is called **ztapelist** was developed to help the user display the IBM tape devices. And, it dynamically assigns or removes IBM tape devices in non-global zones without the non-global zone reboot requirement. The utility (available in **IBMtape** 4.1.5.2 or later) is installed on Solaris 10 and runs in the global zone only.

Use the **ztapelist** utility on the command line as follows.

Synopsis

```
/opt/IBMtape/ztapelist [-l] [-c] [-z zonename] [-a] [-d] [-h]
```

Options and usage

ztapelist recognizes the following options.

-l	Displays IBM tape device information with the column headers for all zones
-c	Displays IBM tape device information without the column headers for all zones
-z zonename	Shows IBM tape devices in a zone
-a	Dynamically adds IBM tape devices to each non-global zone without additional arguments

> **zonename inst#_1 inst#_2 inst#_3 ...**
> Dynamically sets IBM tape devices not greater than 7 in a non-global zone.
>
> **zonename all**
> Dynamically sets all IBM tape devices on the system in a non-global zone.

-d	Removes the IBM tape device from a non-global zone
-h	Displays help information

The **ztapelist** command displays all of the IBM tape devices in the global zone and the tape devices in the non-global zones as shown in the following example. An option of ztapelist -z zonename is also provided to show all of the assigned tape devices in a particular zone.

```
# /opt/IBMtape/ztapelist -l
Running in global zone ...
Inst#    Special File  Device        Serial No        TGT/LUN    Ucode      World Wide NN    World
Wide PN
------- -------------- ---------- ---------------- ------------ ---------- ----------------
-----------------
193    /dev/rmt/27st   03592E05(e/e)  000001365066     2/0       1A38    500507630019F016
500507630059F016
194    /dev/rmt/28smc  03584L22       0000000T003904E5  2/1      805r         N/A
N/A
200    /dev/rmt/29st   ULT3580-TD4(e)  1300000044       4/0      82F0    500507630019F009
500507630059F009
201    /dev/rmt/30smc  03584L32       0000000T00390401  4/1      805r                 N/
A          N/A
206    /dev/rmt/31st   ULT3580-TD3     1210003557       7/0      73P5    500507630019F007
500507630059F007
38     /dev/rmt/32smc  03584L32       0000000T00390401  7/1      805r                 N/
A          N/A


Running in non-global zone camshaft ...
Inst#    Special File  Device        Serial No        TGT/LUN    Ucode      World Wide NN    World
Wide PN
------- ------------- ---------------- ----------------- -------- ---------- -------------
-------------
200     /dev/rmt/29st   ULT3580-TD4(e)  1300000044        4/0      82F0    500507630019F009
500507630059F009
201     /dev/rmt/30smc  03584L32        0000000T00390401  4/1      805r         N/A         N/
A

Running in non-global zone softail ...
Inst#    Special File  Device        Serial No        TGT/LUN  Ucode   World Wide NN     World
Wide PN
------- ------------- -------------   -----------      ---------- -------- --------------
-----------------
193    /dev/rmt/27st   03592E05(e/e) 000001365066      2/0      1A38    500507630019F016
500507630059F016
194    /dev/rmt/28smc  03584L22        0000000T003904E5  2/1     805r         N/A
N/A
```

To add the tape devices in non-global zones, run **# /opt/IBMtape/ztapelist -a**, as shown in the following example.

Note: Due to operating system limitations, this option is supported on Solaris 10, 11.0, and 11.2, and not on 11.1.

```
# ztapelist -a
Issuing this function will assign the tape devices in non-global zone
Do you wish to continue? [y/n]: y
Inst#   Special File      Device        Serial No        TGT/LUN     Ucode     World Wide NN
World Wide PN
------- ---------------   -----------   --------------   ----------- --------- ----------------
--------------
193     /dev/rmt/27st     03592E05(e/e) 000001365066      2/0        1A38      500507630019F016
500507630059F016
194     /dev/rmt/28smc    03584L22      0000000T003904E5  2/1        805r         N/
A               N/A
200     /dev/rmt/29st     ULT3580-TD4(e) 1300000044       4/0        82F0      500507630019F009
500507630059F009
201     /dev/rmt/30smc    03584L32      0000000T00390401  4/1        805r         N/
A               N/A
206     /dev/rmt/31st     ULT3580-TD3   1210003557        7/0        73P5      500507630019F007
500507630059F007
38      /dev/rmt/32smc    03584L32      0000000T00390401  7/1        805r         N/
A               N/A

Enter Instance Number (Inst #) of a device to be added: 200

  ID NAME             STATUS          PATH
   0 global           running          /
   1 camshaft         running         /zones/zone1
   2 softail          running         /zones/zone2
Enter the zonename  where the device will be added: camshaft
Inst#   Special File      Device          Serial No      TGT/LUN   Ucode    World Wide NN    World
Wide PN
------- ---------------   ---------------  ---------------  --------- -------  ---------------
---------------
200     /dev/rmt/29st     ULT3580-TD4(e)   1300000044      4/0      82F0     500507630019F009
500507630059F009

Do you wish to continue to add the devices? [y/n]: y
Enter Instance Number (Inst #) of a device to be added: 193
Enter the zonename  where the device will be added: softail
Inst#   Special File      Device          Serial No      TGT/LUN   Ucode    World Wide NN    World
Wide PN
------- ---------------   ---------------  ---------------  --------- -------  ---------------
---------------
193     /dev/rmt/27st     03592E05(e/e)    000001365066    2/0      1A38     500507630019F016
500507630059F016

Do you wish to continue to add the devices? [y/n]: n
#
```

The **ztapelist** command also allows the user to remove all or some assigned tape devices from the non-global zone, as shown in the following example.

```
# /opt/IBMtape/ztapelist -d
Issuing this function will remove the tape devices from non-global zone
Do you wish to continue? [y/n]: y
Do you want to remove the tape devices from all of non-global zones? [y/n]: n
  ID NAME             STATUS         PATH
   0 global           running          /
   1 camshaft         running          /zones/zone1
   2 softail          running          /zones/zone2

Enter the zonename where the devices will be removed: camshaft
Do you want to remove all of the tape devices from this zone? [y/n]: n
Inst#    Special File      Device          Serial No        TGT/LUN    Ucode     World Wide NN
World Wide PN
-------  ---------------  -------------   ----------------  ----------  --------  -----------------
-----------------
200     /dev/rmt/29st    ULT3580-TD4(e)   1300000044           4/0       82F0    500507630019F009
500507630059F009
201     /dev/rmt/30smc   03584L32         0000000T00390401     4/1       805r        N/A
N/A

Enter Instance Number (Inst #) of a device to be removed: 201
Removing this tape device /dev/rmt/30smc for this zone camshaft ...
Inst#    Special File      Device          Serial No        TGT/LUN    Ucode     World Wide NN
World Wide PN
-------  --------------   ----------------  ----------------  ----------  --------  ------------------
-----------------
200     /dev/rmt/29st    ULT3580-TD4(e)    1300000044           4/0       82F0    500507630019F009
500507630059F009

Do you wish to continue to remove the devices from this zone? [y/n]: n
Do you wish to continue to remove the devices from other zone? [y/n]: y
  ID NAME             STATUS         PATH
   0 global           running          /
   1 camshaft         running          /zones/zone1
   2 softail          running          /zones/zone2

Enter the zonename where the devices will be removed: softail
Do you want to remove all of the tape devices from this zone? [y/n]: y
Removing all of tape devices for this zone softail ...
Inst#     Special File       Device         Serial No        TGT/LUN  Ucode   World Wide NN
World Wide PN
-------  ------------------  --------------  ----------------  ---------  --------  --------------
------------------
Do you wish to continue to remove the devices from other zone? [y/n]: n
```

Configuration parameters

When devices controlled by **IBMtape** are used, certain device characteristics, such as the default block size, can be controlled through the device driver configuration file. The **IBMtape** configuration file is named **IBMtape.conf**. The working copy of this file is in the /usr/kernel/drv directory.

During installation of **IBMtape**, the working copy of **IBMtape.conf** is preserved, if it exists. During removal of **IBMtape**, the working copy of **IBMtape.conf** is not deleted. These conventions allow configuration settings to remain across updates of **IBMtape**. A reference copy of **IBMtape.conf** with factory default settings is always installed in the /opt/IBMtape directory.

Note: IBM requires that the Solaris native SCSI tape device driver `st is configured so that it does not attempt to support SCSI targets that are controlled by IBMtape. Refer to "Preventing conflicts with other device drivers" on page 70 for information about multiple driver access to a device.

⚠️ **Attention:** Failure to prevent more than one device driver from operating the same tape drive can cause system panics or data loss on the tape drive.

Configuration settings are applied only at start time, or when **IBMtape** is unloaded manually from, then reloaded into, memory. If you change configuration settings in **IBMtape.conf**, you can make the changes effective by restarting the system. As an alternative to restarting, ensure that no **IBMtape**-owned devices are in use, then issue the following command.

```
% /opt/IBMtape/tmd -s   for IBMtape.4.0.9.2 and later
% /usr/sbin/rem_drv IBMtape
```

```
% /usr/sbin/add_drv -m '* 0666 bin bin' IBMtape
% /opt/IBMtape/tmd        for IBMtape.4.0.9.2 and later
```

Default settings in **IBMtape.conf** can be overridden for a particular device (and only while the device is kept open) with the *ioctl* application programming interface (API) of the device driver. The parameter settings that are made through the API revert to the default values in **IBMtape.conf** the next time the device is opened. Refer to the *IBM Tape Device Drivers: Programming Reference* for information about changing configuration parameters under program control.

IBMtape.conf contains one stanza for each SCSI target address/LUN pair that is owned by **IBMtape**. The reference **IBMtape.conf** file that is supplied with the package contains a stanza for every possible SCSI target and LUN combination that is supported by IBM tape systems.

The following example shows the stanza for target 0, LUN 0, with **IBMtape**'s default configuration parameter values. The parameter **immediate** is disabled, which means that SCSI commands **Write FM**, **Locate**, **Load-Unload**, **Erase**, and **Rewind** complete before status is returned.

```
name="IBMtape" class="scsi"
target=0 lun=0
block_size=0
buffering=1
immediate=0
trailer=0
sili=0;
```

The following example shows the stanza for target 0, LUN 0, with **IBMtape**'s default configuration parameter values and the rewind immediate mode set On. This action causes the **SCSI rewind** command to return control to the application program before the command completes on the tape drive.

```
name="IBMtape" class="scsi"
target=0 lun=0
block_size=0
buffering=1
rew_immediate=1
trailer=0
sili=0;
```

If immediate is set to 1 and rew_immediate is set to 0, the setting of rew_immediate is ignored.

The *name* variable identifies **IBMtape** as the device driver, and *class* identifies the type of device that is supported as SCSI.

The *target* and the *lun* variables determine the target address and LUN of IBM devices that are controlled by that stanza. On systems with multiple SCSI adapters, a single target/LUN stanza controls the configuration settings for all devices that are addressed with that target address and LUN. Thus, two or more supported IBM devices on the system that have the same target and LUN settings but are attached to different SCSI buses are all affected by the configuration parameters of the single stanza with that target address and LUN.

After installation of the **IBMtape** package is complete, you can eliminate unnecessary probing for devices by commenting out unused target/LUN pairs. In this example, the stanzas for target 0, LUN 0 and target 0, LUN 1 are commented out. Those address/LUN combinations are not probed. This action saves time during a restart or manual reload of **IBMtape**. However, if an IBM device is addressed at target 0, LUN 0 or target 0, LUN 1, it is not detected.

```
#name="IBMtape" class="scsi"
#target=0 lun=0
#block_size=0
#buffering=1
#immediate=0
#trailer=0
#sili=0;

#name="IBMtape"  class="scsi"
#target=0 lun=1
#block_size=0
#buffering=1
#immediate=0
```

```
#trailer=0
#sili=0;
```

The remaining five configuration parameters specifically affect the behavior of the IBM device or devices that are associated with that stanza (target and LUN). All of these parameters are specific to tape drive device operation only and have no effect on medium changer device behavior. The default configuration parameters are adequate for most purposes. However, the values in the configuration file can be modified to suit the specific requirements of the application or the user.

Modifying a value in the configuration file determines the value of the parameter at device open time. When the device is open, the value of a parameter can be altered with an *ioctl* function call. But the change is effective only while the device remains open. Working configuration parameters revert to the default values (established by the configuration file) when the device is closed and reopened. Refer to the *IBM Tape Device Drivers: Programming Reference* for information about changing configuration parameters through program control.

Table 17 on page 87 lists and describes the set of configuration parameters that are recognized by the IBMtape device driver.

Table 17. Solaris: configuration parameters recognized by IBMtape

Parameter	Values	Description
block_size	(0=variable length)	This option specifies the device block size that is established with the **SCSI Mode Select** command during an open function call. Until this value is changed, it is the working block size. Variable block size is established with a value of zero. Any other positive value represents a fixed block size. The maximum supported block size varies for each tape device. Refer to the appropriate hardware reference manual for information.
		Note: IBMtape does not allow odd-byte-count fixed block reads or writes. For instance, a fixed block size of 4096 or 4098 is allowed, but 4097 is not. If you attempt to read or write with an odd-byte-count fixed block size, the read or write returns **-1**, with errno set to 22, invalid argument. If you must read or write odd-byte-count blocks, set block size to 0 (variable block size), then transfer one block's worth of data per read or write.
buffering	(0=Off, 1=On)	When a **Write** command is processed, the data is either directly stored on the physical tape or buffered in device hardware. Buffering can be turned On and Off with this option. If buffering is disabled, the effective performance of the device can be degraded seriously. The tape devices cannot take advantage of their buffering optimization. Buffer flushing (or committing data to the tape) can be controlled by the application through the STIOC_SYNC_BUFFER *ioctl* function.
immediate	(0=Off, 1=On)	If immediate is set to 0, the SCSI commands **Write FM**, **Locate**, **Load-Unload**, **Erase**, and **Rewind** return with status when the command actually completes on the tape drive. If immediate is set to 1, these commands returns with status before the command actually completes.

Table 17. Solaris: configuration parameters recognized by IBMtape (continued)		
Parameter	**Values**	**Description**
reserve_key	(A string of 1-8 character ASCII alphanumeric key such as "key12345". If fewer than 8 characters are used, the remaining characters are set to 0x00(NULL).	The user specifies the Persistent Reservation key that is used by the device driver when the Persistent Reservation is used. The reserve key is assigned by the driver by default.
reserve_type	(1=reserve(6), 2=reserve(10), 3=persist_reserve)	This parameter specifies the SCSI Reservation type that is used by the device driver, either a **SCSI Reserve(6)** command or a **SCSI Persistent Reserve** command. The **SCSI Reserve(10)** command is unsupported recently. The reserve type 1 is set by default. **Note:** This parameter is not used if the Data Path Failover is supported.
rew_immediate	(0=Off, 1=On)	If rew_immediate is set to 0, the **SCSI Rewind** command returns with status when the command actually completes on the tape drive. If it is set to 1, the **Rewind** command returns with status before the command actually completes. If immediate is set to 1, the setting of rew_immediate is ignored.
trailer	(0=Off, 1=On)	If a tape drive encounters logical end-of-tape (EOT) during a write operation, it returns a check condition status. The driver returns 0 bytes written to notify the application of this EOT situation. A check condition is also returned by the tape drive for every subsequent write operation when past EOT. If trailer is enabled, writing records past EOT is allowed by the device driver. Following the first time the write operation notifies the application of EOT. All subsequent EOT notifications are suppressed by the driver, and the actual number of bytes written is returned. When physical end of media is reached, all write operations fail with a return code of **-1**, regardless of the trailer setting. When trailer is enabled, managing the media past EOT is the application's responsibility.
sili	(0=Off, 1=On)	Normally, during a read operation, if a larger block of data is requested than is read from the tape, the tape device raises a check condition. The IBMtape device driver must complete error handling procedures, which add overhead to the read operation. The IBMtape driver does not surface this issue as an error condition to the application and ultimately returns the actual number of bytes read. However, this driver error processing results in less than optimum read performance in some scenarios. When SILI mode is enabled, the tape device is forced to Suppress Illegal Length Indication during read operations. This action eliminates the error processing that is run by the driver and results in improved read performance for some scenarios. The actual number of bytes read is still returned to the application in SILI mode.

Table 17. Solaris: configuration parameters recognized by IBMtape (continued)		
Parameter	**Values**	**Description**
max_busy_retry	a positive integer	When a SCSI command is returned as a BUSY status, IBMtape retries this SCSI command up to 3002 or this user-defined time in each interval of 1/10 second.

Dynamic Runtime Attributes

This parameter determines whether dynamic runtime attributes are attempted on open for supported drives. Default is 1 (On) meaning that the driver automatically attempts to set dynamic runtime attributes on open. This action can be changed to 0 (Off) in the configuration file before the **IBMtape** is loaded. It is recommended to keep dynamic runtime attributes On unless it produces an unexpected problem in the environment.

The dynamic runtime attributes setting is retained even if the system is rebooted. Follow the steps to enable or disable the **Dynamic Runtime Attributes** parameter.

1. To enable the support on all currently configured devices, add the entry `Dynamic_Runtime_Attribute =1` at the beginning of the **IBMtape.conf** file.
2. Stop the TMD (tape monitor daemon) running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

3. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

1. To disable the support on all currently configured devices, add the entry `Dynamic_Runtime_Attribute = 0` at the beginning of the **IBMtape.conf** file.
2. Stop the TMD (tape monitor daemon) running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

3. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

Removing IBMtape

All active processes that use IBM devices that are supported by the IBM SCSI Tape and Medium Changer Device Driver for Solaris must be stopped for the removal procedure to complete successfully.

Use the **pkgrm** command to remove the **IBMtape** package from the system.

```
% /usr/sbin/pkgrm IBMtape
```

Adding or removing devices

To add support for a new IBM tape system or to remove support for a previously attached IBM tape system, complete the following steps.

1. Edit the **IBMtape.conf** file in the /usr/kernel/drv directory to reflect the change in IBM device support. Either add a stanza to provide support for a device that is to be added, or remove (comment out) a stanza for a device that is no longer supported.

2. When support for a new device is added, ensure that the target and LUN values in the configuration file stanza match the target and LUN settings of the IBM device. Refer to "Configuration parameters" on page 85 for information about the **IBMtape.conf** configuration file.

3. Shut down and power Off the host system.

4. Plug the new device into the SCSI bus or unplug the existing device from the bus. Pay particular attention to correct SCSI cabling and termination.

5. Power On and start the host system.

   Note:

   a. It is possible to reinitialize the **IBMtape** device driver without restarting the system. This procedure is done by first unloading the device driver, then reloading the device driver into kernel memory.

   b. For the version of **IBMtape**.4.0.9.2 and later, the TMD daemon must be stopped. Run the **/opt/IBMtape/tmd -s** command to unload the **IBMtape** driver from the kernel. Running the **/opt/IBMtape/tmd** command restarts the daemon afterward to reload the device driver.

   The commands to unload the device driver are

   ```
   % /opt/IBMtape/tmd -s        for IBMtape.4.0.9.2 and later
   % /usr/sbin/rem_drv IBMtape
   ```

   The commands to reload the device driver are

   ```
   % /usr/sbin/add_drv -m '* 0666 bin bin' IBMtape
   % /opt/IBMtape/tmd           for IBMtape.4.0.9.2 and later
   ```

   When the **IBMtape** device driver is reloaded, it reads the **IBMtape.conf** file and acknowledge changes that are made in the file. This method can be used to modify configuration parameters.

   Note: It is suggested that the host system and all devices that are attached to the SCSI bus be powered Off before devices are added or removed from the SCSI bus. Hot plugging SCSI devices can cause hardware damage and disruption of reliable system operation

Unconfiguring tape devices

In some special situations, the user cannot modify **IBMtape.conf** to unconfigure some tape devices with **IBMtape** driver. This issue occurs when more than one device is configured with the same target address, or the tape devices are attached on the FC or SAS HBA running with Oracle HBA driver.

In **IBMtape**.4.1.9.2 and later, a configuration parameter defined **exclude_dev_list** is introduced to allow users to exclude some devices from the configuration with **IBMtape**.

Unconfigure the tape device with the following steps.

1. Add the entry of `exclude_dev_list` in **IBMtape.conf** in `/usr/kernel/drv`.

   ```
   exclude_dev_list="sn1,sn2,sn3,..." ;
   ```

   Where: *sn* is the serial number of the excluded device, 10-characters long for LTO drive, 12-characters long for 359x drive and 16-characters long for changer.

   The serial number can be found by running the following command.

   ```
   /opt/IBMtape/tapelist -l
   ```

2. Reinstall **IBMtape** driver or reboot the system to allow **IBMtape** to update the configuration.

Tapelist Utility Program

A Tapelist Utility Program that is called **tapelist** is installed in the `/opt/IBMtape` directory as part of the **IBMtape** package. The tapelist utility provides the user a listing of tape, medium changer, and SAN data gateway devices that are configured with the **IBMtape** driver. It also displays the information of HBA with

IBM tape drive attachment and the status of load balancing. The following is an example of a Tapelist Utility Program output.

```
# tapelist
Instance : 697
Special File : /dev/rmt/6st
Device : 03592E05(e/e)
Serial Number : 000001300168
TGT/LUN : 7/0
Ucode : 04C4
World Wide NN : 5005076302000127
World Wide PN : 5005076302400127
Dev Phy Path : /devices/pci@1f,2000/QLGC,qla@1/IBMtape@7,0:st
Path Type : N/A

# tapelist -t
hba_index  hba_inst  hba_driver  reg_count  usage_count   HBA Path
---------  --------  ----------  ---------  -----------  --------------------------
  0          0         qla2300     4          1            /devices/pci@4,2000/fibre-channel@1
  1          2         lpfc        4          2            /devices/pci@6,2000/pci@1/fibre-channel@4
  2          3         lpfc        1          0            /devices/pci@6,2000/pci@1/fibre-channel@5
```

A new feature is added in **tapelist** to display the drive information in the library that is running **/opt/IBMtape/tapelist -L**.

```
# tapelist -L
Addr  Inst#  Special File   Device       Serial No          TGT/LUN Ucode  World Wide NN    World Wide
PN
----- -----  -------------  -----------  ----------------- ------- ----- ---------------
---------------
Library (/dev/rmt/5smc) Info:
      2894   /dev/rmt/5smc 03584L22      0000000T003904E5  3/1     806c   N/A             N/A
274   2893   /dev/rmt/13st 03592E05(e/e) 000001365066      3/0     1D10   500507630019F016
500507630059F016
276   2914   /dev/rmt/14st 03592E06(e/e) 000001326803      14/0    2444   500507630019F019
500507630059F019

Library (/dev/rmt/7smc) Info:
      2899   /dev/rmt/7smc 03584L32      0000000T00390401  6/1     806c   N/A             N/A
265   2898   /dev/rmt/6st  ULT3580-TD4(e) 1300000044       6/0     82F0   500507630019F009
500507630059F009

Library 3494 Info:
      322    /dev/rmt/10st 03592J1A      000001300147      1/0     0464   5005076300000000
5005076300400000
```

The following is a definition of the fields and headers that appear in the previous screens.

```
Inst #          The instance number of the particular device.
Special File    The device special file used to access this device.
Device          A string indicating the device model and encryption information
                (e/e: encryption capable/encryption enable).
                Serial No: The serial number of the device.
TGT/LUN         The SCSI target and LUN of the device.
Ucode level     The current microcode (firmware) loaded on the device.
World Wide NN   A number indicating Fibre Channel World Wide Node Name of the device.
World Wide PN   A number indicating Fibre Channel World Wide Port Name of the device.
Dev Phy Path    A string indicating the device path in the device tree.
Path Type       A primary or alternate path used for failover.
hba_index       The index number of the particular HBA in the HBA list.
hba_inst        The instance number of the particular HBA assigned by the
                Solaris system.
hba_driver      The HBA driver name with IBM tape drive attachment.
reg_count       The number of IBM tape drives attached on the HBA.
usage_count     The number of IBM tape drives currently using the HBA.
HBA Path        A string indicating the HBA device path in the device tree.
Addr            The element address where the drive is located in the library.
e/e             The first and second instances of "e" stand for encryption
                capable and encryption enable.
```

The usage of the **tapelist** program is as follows.

```
-l  Print for all of the configured devices with the column headers in long list
-L  Display the tape drives information in the tape library
    (IBMtape supported Libraries ONLY)
-c  Don't print column headers in long list for all of the configured devices
-t  Display HBA information and current load balancing status
-f  Print the list for a particular file only
-A  List the tape devices by HBA
-a  Print out the info of all of FC HBAs
-h  Help menu
```

Running **tapelist** without any options displays the device information line by line for all of the configured devices.

Special files

After the **IBMtape** driver is installed, a set of special files is available for completing input/output (I/O) operations to each supported device. The device special file names that are created by the **IBMtape** device driver are similar to the SCSI tape special files used on Solaris systems.

Each tape instance has a set of minor numbers that provides access to the same physical device. But, each minor number provides a different function or behavior for the tape subsystem. These minor numbers are accessed through variations of the special file name for that device. The special files are created in the /dev/rmt directory. These special files are symbolic links to files created within the /devices subdirectory hierarchy.

Issuing the **ls -la /dev/rmt** command gives useful information about these device special files. The following example shows entries that are returned by this command for a single IBM tape subsystem. This listing is system-dependent, so entries vary slightly in format, depending on the operating system and SCSI adapter support. Entries might be included for other devices that are not supported by the **IBMtape** device driver.

```
lrwxrwxrwx root other 79 Aug 26 18:54 0smc   ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:smc
lrwxrwxrwx root other 78 Aug 26 18:54 0st    ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:st
lrwxrwxrwx root other 79 Aug 26 18:54 0stb   ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stb
lrwxrwxrwx root other 80 Aug 26 18:54 0stbn  ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stbn
lrwxrwxrwx root other 79 Aug 26 18:54 0stc   ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stc
lrwxrwxrwx root other 80 Aug 26 18:54 0stcb  ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stcb
lrwxrwxrwx root other 81 Aug 26 18:54 0stcbn ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stcbn
lrwxrwxrwx root other 80 Aug 26 18:54 0stcn  ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stcn
lrwxrwxrwx root other 79 Aug 26 18:54 0stn   ->
 /devices/iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,
 10000/IBMtape@2,0:stn
```

These entries show the device hierarchy that is established to support I/O for an IBM SCSI tape system. The attachment path of the device special files spans from the system board, through the S-bus, to the Oracle F/W SCSI adapter (supported by the QLGC, isp SCSI adapter device driver), to the IBM device at SCSI target 2 and LUN 0 (supported by the **IBMtape** device driver). All nine of these special files are associated with the same IBM device (device number 0).

Device behaviors

Certain device behaviors are determined by which special file in the set is opened for device access. The **smc** special file controls only the medium changer portion of the device and accepts only medium changer operations by way of the *ioctl* entry point. The **smc** special file does not support the read and write entry points. Only one **st** type special file for a particular device can be opened at any one time. The **smc** special file can be opened concurrently with any one of the **st** special files.

The **IBMtape** device driver decides which types of special files to create during installation, which is based on the IBM device type that is configured. For the IBM 3490E Magnetic Tape Subsystem, only the eight **st** type special files are created. For other IBM tape drives, all nine special files that are shown previously are created. For IBM tape libraries and autoloaders, only a single **smc** special file is created.

With the information from the previous command, issuing the **ls -la /devices/ iommu@f,e0000000/sbus@f,e0001000/QLGC,isp@3,10000** command presents further information about the same special files, as shown in the following example. Again, the actual path information that is specified in the command varies from system to system.

```
crw-rw-rw- 1 bin bin 109,1696 Aug 26 18:54 IBMtape@2,0:smc
crw-rw-rw- 1 bin bin 109,1664 Aug 26 18:56 IBMtape@2,0:st
crw-rw-rw- 1 bin bin 109,1728 Aug 26 18:54 IBMtape@2,0:stb
crw-rw-rw- 1 bin bin 109,1732 Aug 26 18:54 IBMtape@2,0:stbn
crw-rw-rw- 1 bin bin 109,1688 Aug 26 18:54 IBMtape@2,0:stc
crw-rw-rw- 1 bin bin 109,1752 Aug 26 18:54 IBMtape@2,0:stcb
crw-rw-rw- 1 bin bin 109,1756 Aug 26 18:54 IBMtape@2,0:stcbn
crw-rw-rw- 1 bin bin 109,1692 Aug 26 18:54 IBMtape@2,0:stcn
crw-rw-rw- 1 bin bin 109,1668 Aug 26 18:54 IBMtape@2,0:stn
```

These entries show the *major* and *minor* numbers that are associated with each special file. Here, the major number is 109 and identifies to the system that the **IBMtape** device driver is in support of these special files. Major numbers are assigned by the system at the time the driver is installed and vary from system to system. The nine different minor numbers are specific to the special file names. They are used by the device driver to determine which special file was used to access the device and control the device behavior accordingly. For example, the minor number 1696 indicates to the driver that the device was opened by way of the **smc** special file. For information on device special files and major and minor numbers, consult the Solaris **mtio** man pages.

File naming conventions

Table 18 on page 93 shows the special file naming convention and the associated device attributes recognized by the **IBMtape** device driver.

Table 18. IBM SCSI Tape/Medium Changer special files for Solaris			
Special file name	BSD compatibility (Note 1)	Rewind on Close (Note 2)	Compression (Note 3)
/dev/rmt/[0–255]smc (Note 4)	N/A	N/A	N/A
/dev/rmt/[0–255]stn (Note 5)	No	No	No
/dev/rmt/[0–255]stcn (Note 5)	No	No	Yes
/dev/rmt/[0–255]st (Note 5)	No	Yes	No
/dev/rmt/[0–255]stc (Note 5)	No	Yes	Yes
/dev/rmt/[0–255]stbn (Note 5)	Yes	No	No

Table 18. IBM SCSI Tape/Medium Changer special files for Solaris (continued)			
Special file name	**BSD compatibility (Note 1)**	**Rewind on Close (Note 2)**	**Compression (Note 3)**
/dev/rmt/[0–255]stcbn (Note 5)	Yes	No	Yes
/dev/rmt/[0–255]stb (Note 5)	Yes	Yes	No
/dev/rmt/[0–255]stcb (Note 5)	Yes	Yes	Yes

Note:

1. The **BSD (b)** device special file modifies **close** behavior for non-rewind devices. If the device is opened for **no rewind on close** in **non-BSD** mode, and if the last command before the device was closed was a read, then the tape is positioned after the filemark immediately following the last block read. If the device is opened for **no rewind on close** in **BSD** mode, and if the last command before the device was closed was a read, the tape is left positioned exactly where it was following the last block read. If the device is opened for **rewind on close** the **BSD** mode is not relevant.

2. The **no rewind on close (n)** device special file does not rewind the tape during a **close** operation. Otherwise, the tape is rewound when the device is closed. If the last operation before the device was closed was a write or write filemark, then enough filemarks is written so that two filemarks follow the data.

   For the non-rewind special files, the tapes are positioned between the trailing filemarks before closing. If the device is then reopened and more data is written, it is separated by a single filemark from the previous data.

3. The **compression (c)** device special file determines whether the tape device uses built-in hardware compression while data is stored on the tape. The compression mode of the device can also be set to the wanted state programmatically through the **STIOC_SET_PARM** *ioctl*, regardless of the default compression mode that is established by the special file that is originally used to open the device.

4. The **smc** special file is created only for IBM tape systems that provide medium changer capability. For IBM tape libraries and autoloaders, the **smc** special file is the only file that is created because the **IBMtape** device driver supports only the medium changer portion. It does not support the tape drive portion of these devices. For the IBM 3490E Magnetic Tape System, there is no **smc** special file created.

5. Only one **st** special file can be opened at one time. The **smc** special file can be opened by itself or with one of the **st** type files. The **smc** special file accepts only medium changer commands. Tape drive commands that are issued to the medium changer fail, with **errno** set to 22, invalid argument.

   Aside from the normal configuration with the medium changer that answers as a distinct target/LUN pair, some supported devices can be configured with a nonstandard integrated medium changer that reports at the same target and LUN as the tape drive. In such a case, both **st** and **smc** special files accept a limited subset of medium changer commands. If you want to use this nonstandard mode, consult the appropriate hardware reference to determine whether the drive supports such a configuration.

Persistent Naming Support

The device special file names are created by the **IBMtape** driver in the order that the tape devices are presented by the Solaris system. Each device special file name is maintained with the same logical name across reboots, even when an existing device is powered off or not connected.

However, the logical names of devices can be changed because of the swapping of connecting cables, HBA mapping changes, tape device driver updates, or other reasons.

The user can rename the logical name by editing the **/etc/devlink.tab** system file for the persistent name binding and reloading the **IBMtape** driver as follows.

1. Before the persistent name binding, make sure that the IBM tape devices are configured at the different target and LUN addresses if the devices are attached on more than one HBA.

   The Ultrium 3 tape drive is connected to two Emulex HBAs with the same address of target 3 and LUN 0 through a switch in the following example. You must use the HBA utility, follow HBA vendor instructions, or both to persistently bind the tape devices at the different mapped target and LUN.

```
# tapelist -l
Inst#  Special File    Device        Serial No     TGT/LUN    Device Physical Path
------ --------------- ------------- ------------ ---------  --------------------------------------
454    /dev/rmt/2st    ULT3580-TD3   1210003557   3/0        /devices/pci@6,2000/pci@1/fibre-channel@5/
IBMtape@3,0
582    /dev/rmt/8st    ULT3580-TD3   1210003557   3/0        /devices/pci@1f,2000/pci@1/fibre-channel@5/
IBMtape@3,0
```

   The tape drive is mapped at target 3, LUN 0 on HBA 1 and target 24, LUN 0 on HBA 2 after device persistent binding.

```
 # tapelist -l
Inst#  Special File    Device       Serial No     TGT/LUN     Device Physical Path
------ --------------- ----------- ---------   ----------  -----------------------------------------
454    /dev/rmt/4st    ULT3580-TD3  1210003557    3/0        /devices/pci@6,2000/pci@1/fibre-channel@5/
IBMtape@3,0
1136 /dev/rmt/7st      ULT3580-TD3  1210003557    24/0       /devices/pci@1f,2000/pci@1/fibre-
channel@5/IBMtape@18,0
```

   Note: Device persistent binding is not provided on Oracle HBAs, so this persistent name approach cannot be used with the same physical drive that is attached to multiple Oracle HBA ports.

2. Start persistent name binding. In this example, the user renames 4st and 7st to 10st and 11st.

   a. Create the entry for persistent naming. Determine the target address from the Device Physical Path in the output of **tapelist -l** and add the planned device special file name in the entry. Here, 4st and 7st drives are at 3,0 (target 3, LUN 0) and 18,0 (target 24 (0x18), LUN 0) at the device physical paths of /devices/pci@6,2000/pci@1/fibre-channel@5/IBMtape@3,0 and /devices/pci@1f,2000/pci@1/fibre-channel@5/IBMtape@18,0. Add the address and device file name into the entries:

   ```
   type=ddi_byte:tape;addr=3,0;    rmt/10\M0
   type=ddi_byte:tape;addr=18,0;  rmt/11\M0
   ```

   Note:

   1) A tab is entered between addr=3,0; and rmt/10\M0.

   2) The 0 in the entry is the zero in M0.

   3) To avoid conflicts with the current device special files assigned by the system automatically, be sure to assign a higher number for the persistent name.

   4) The address is w500507630059f007,0 for the tape drive on the Oracle HBA with the path of /devices/pci@1,0/pci1022,7450@1/pci1077,141@1/fp@0,0/tape@w500507630059f007,0.

   .

   b. Add the entry into the **/etc/devlink.tab** system file.

   c. Remove existing links that are created by the **IBMtape** driver from **/dev/rmt** by running the **# rm** command.

   d. Run the **# devfsadm** command without any options to enable **IBMtape** to create the new device special file name as defined in the entries in **/etc/devlink.tab**. A system reboot is also required if the tape device is attached on Oracle HBA.

   e. Run **tapelist** to list the device special files.

```
# tapelist -l
Inst#  Special File    Device      Serial No    TGT/LUN   Device Physical Path
------ -------------  -----------  -----------  --------- -------------------------
454    /dev/rmt/10st  ULT3580-TD3  1210003557    3/0      /devices/pci@6,2000/pci@1/fibre-channel@5/
IBMtape@3,0
1136 /dev/rmt/11st    ULT3580-TD3  1210003557   24/0      /devices/pci@1f,2000/pci@1/fibre-channel@5/
IBMtape@18,0
```

Control Path failover support for libraries

Configuring and deconfiguring Path Failover support

Control path failover (CPF) support is enabled automatically by default when the **IBMtape** device driver is installed on Solaris system. The Solaris **IBMtape** device driver provides a driver configuration parameter failover for you to enable or disable the library control path failover support. To enable the CPF support for all of the paths, no action is required. To disable the CPF support for all of the paths or a particular path, use the following steps.

1. To disable CPF support for all the paths, add and set the failover parameter to off at the beginning of **IBMtape.conf** file in the directory of `/usr/kernel/drv`.

2. To disable a particular path, add and set the failover parameter to Off in the path entry in **IBMtape.conf** file. For example, `name="IBMtape" class="scsi" target=3 lun=1 failover=0;`

3. Stop the TMD (tape monitor daemon) from running on the system and unload the **IBMtape** driver module from the current kernel.

   ```
   # /opt/IBMtape/tmd -s
   ```

   ```
   # /usr/sbin/rem_drv IBMtape
   ```

4. Reload the **IBMtape** driver module in the kernel and start the daemon.

   ```
   # /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
   ```

   ```
   # /opt/IBMtape/tmd
   ```

Primary and alternative paths

When the device driver configures a logical device with path failover support enabled, the first device that is configured always becomes the primary path. When a second or more logical device is configured with path failover support enabled for the same physical device, it configures as an alternative path. The device driver supports up to 16 physical paths for single a device.

The primary and alternative path information can be obtained in the field of "Path Type" running the **/opt/IBMtape/tapelist** command output and is similar to the example in .

Table 19. Solaris: Example of Control Path failover support command output

```
#tapelist -1
Inst# Special File  Device  Serial No  TGT/LUN Ucode WWNN WWPN  Device Physical Path        Path
Type
------------------------------------------------------------------------------------------------
------
686 /dev/rmt/12smc 03584L32 0000000T0039  1/1  402j  N/A  N/A  /devices/pci@If,2000/QLGC,qla@1/
IBMtape@1,1 Primary
688 /dev/rmt/14smc 03584L32 0000000T0039  2/1  402j  N/A  N/A  /devices/pci@If,2000/QLGC,qla@1/
IBMtape@2,1 Alt_path_1
694 /dev/rmt/26smc 03584L32 0000000T0039  5/1  402j  N/A  N/A  /devices/pci@If,2000/QLGC,qla@1/
IBMtape@5,1 Alt_path_2
```

The labeling of a logical device as either a primary or alternative path is for information only; it is used to

1. Identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled the primary path for each physical device. However, multiple logical devices can be labeled as an alternative path for the same devices.

2. Provide information about which logical devices that are configured on the system have path failover enabled.

Querying primary and alternative path configuration

You can display the primary and alternative path configuration for all devices with the **tapelist** utility.

Note: Display the primary and alternative path configuration for any device by using tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

When you install the **IBMtape** device driver, by default all the available paths for a physical device are enabled.

Note: Display the primary and alternative path configuration for any device by using tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Data Path failover and load balancing support for tape drives

Note: The tape drive failover feature code must be installed before the DPF for IBM Ultrium tape drive is enabled in the Solaris **IBMtape** device driver. Refer to "Automatic failover" on page 3 to determine which feature code is required for your machine type.

Configuring and deconfiguring Path Failover support

Path failover support for tape drives is enabled automatically when the device driver with the version of **IBMtape**.4.2.1.0 or later is installed. It is disabled by default at the previous version. When path failover support is enabled for a logical device, it remains set until the device is deleted or the support is deconfigured. The path failover setting is retained even if the system is rebooted. Path failover support can be enabled on all configured devices at one time, or it can be enabled or disabled selectively by logical device. It might be desirable at times to configure some, but not all, logical paths to a device with the support enabled. Follow the steps to enable the DPF support:

1. To enable the support globally on all currently configured devices, add an entry of **dpf_support=1** at the beginning of the **IBMtape.conf** file, such as

   ```
   dpf_support=1;
   ```

2. Or, to enable a particular path, add the parameter **dpf_support** and turn it on in the path entry in the **IBMtape.conf** file. For example,

```
name="IBMtape" class="scsi" target=3 lun=0 dpf_support=1;
```

3. For the IBM Ultrium tape drive, you must enter the DPF feature keys in the parameter **dpf_keys** at the beginning of the **IBMtape.conf** file in the directory /usr/kernel/drv. For example,

```
dpf_keys="A729E60F7B119411, C7A0B9ef2c1a4360, a729e60f7b118460";
```

   Note:

   a. The parameter **dpf_keys** is in the format "key1, key2, key3, ... ". Each key is 16 characters long with a comma "," and a space " ". The **IBMtape** driver supports up to 36 dpf keys.

   b. DPF keys do not need to be added in **IBMtape.conf** if you are running the latest drive code on Ultrium 3 and Ultrium 4 drives.

4. Stop the TMD (tape monitor daemon) running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

5. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
#  /opt/IBMtape/tmd
```

This action deconfigures all devices to add the parameter **dpf_support=0** in the **IBMtape.conf** file, and reboot the system or deconfigure and reconfigure all devices. For example,

1. To disable the support globally on all currently configured devices, add the entry **dpf_support=1** at the beginning of the **IBMtape.conf** file.

```
# dpf_support=0;
```

2. Stop the TMD (tape monitor daemon) from running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

3. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
#  /opt/IBMtape/tmd
```

To disable the support on a single logical device, follow these steps.

1. To enable the support globally on all currently configured devices, add an entry **dpf_support=1** at the beginning of the **IBMtape.conf** file, such as

```
dpf_support=1;
```

2. To disable a particular path, add the parameter **dpf_support** and turn it off in the path entry in the **IBMtape.conf** file. For example,

```
name="IBMtape" class="scsi" target=3 lun=0 dpf_support=0;
```

3. Stop the TMD (tape monitor daemon) running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

4. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
#  /opt/IBMtape/tmd
```

Primary and alternative paths

When the device driver configures a logical device with path failover support enabled, the first device that is configured always becomes the primary path. When a second logical device is configured with path failover support enabled for the same physical device, it configures as an alternative path. A third logical device is configured as the next alternative path, and so on. The device driver supports up to 16 physical paths for a single device.

For example, if 0st (port 0 of 3592) is configured first, then 5st (port 1), 18st (port 1), and 21st (port 0) to the two HBAs through a switch (here, WWPN 5005076302400127 from port 0 and 5005076302800127 from port 1), the **/opt/IBMtape/tapelist** command output is similar to the example in Table 20 on page 99.

Table 20. Example of Data Path failover support command output

```
#tapelist -1
Inst# Special File   Device   Serial No    TGT/LUN  Ucode    WWNN             WWPN
  Device Physical Path                             Path Type
--------------------------------------------------------------------------------------------------
685   /dev/rmt/0st  03592J1A 000001300168   1/0    04CE   5005076302000127    5005076302400127
   /devices/pci@1f,2000/QLGC,qla@1/IBMtape@1,0     Primary
697   /dev/rmt/5st  03592J1A 000001300168   7/0    04CE   5005076302000127    5005076302800127
   /devices/pci@1f,2000/QLGC,qla@1/IBMtape@7,0     Alt_path_1
666   /dev/rmt/18st 03592J1A 000001300168   1/0    04CE   5005076302000127    5005076302800127
   /devices/pci@1f,4000/JNI,FCR@2/IBMtape@1,0      Alt_path_2
670   /dev/rmt/21st 03592J1A 000001300168   3/0    04CE   5005076302000127    5005076302400127
   /devices/pci@1f,4000/JNI,FCR@2/IBMtape@3,0      Alt_path_3
```

The labeling of a logical device as either a primary or alternative path is for information only, to

1. Be able to identify the actual number of physical devices that are configured on the system and a specific logical device that is associated with them. Only one logical device is labeled the primary path for each physical device. However, many (multiple) logical devices might be labeled as an alternative path for the same devices.

2. Provide information about which logical devices configured on the system have path failover support enabled.

Querying primary and alternative path configuration

You can display the primary and alternative path configuration for all devices with the **tapelist** utility.

Note: Display the primary and alternative path configuration for any device by using tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

When you enter the parameter **dpf_support** in the **IBMtape.conf** file and install the **IBMtape** device driver, all the available paths for a physical device are enabled.

1. Add the parameter of **dpf_support** and turn it off in the path entry in **IBMtape.conf** file. For example,

```
name="IBMtape" class="scsi" target=3 lun=0 dpf_support=0
```

2. Stop the TMD (tape monitor daemon) from running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s # /usr/sbin/rem_drv IBMtape
```

3. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

To enable a path from a disabled state, you can run the following steps.

1. Add the parameter of **dpf_support** and turn it off in the path entry in **IBMtape.conf** file. For example,

```
name="IBMtape" class="scsi" target=3 lun=0;
```

2. Stop the TMD (tape monitor daemon) from running on the system and unload the **IBMtape** driver module from the current kernel.

```
# /opt/IBMtape/tmd -s
# /usr/sbin/rem_drv IBMtape
```

3. Reload the **IBMtape** driver module in the kernel and start the daemon.

```
# /usr/sbin/add_drv -m ' 0666 bin bin' IBMtape
# /opt/IBMtape/tmd
```

System-managed encryption

Device driver configuration

System-Managed Encryption can be set on global or a specific tape drive in **IBMtape.conf** in `/usr/kernel/drv`. There are two new configuration parameters added for encryption.

- **sys_encryption_proxy** "ON/OFF" Use System Encryption FCP Proxy Manager
- **sys_encryption_write** "OFF/ON/CUSTOM" System Encryption for Write Commands at BOP

The **sys_encryption_proxy** parameter enables device driver system-managed encryption for a tape drive by setting the value to ON (default set).

The **sys_encryption_write** parameter controls if the device driver can set the tape drive to encryption enabled for write commands. When set to **OFF**, the tape drive uses encryption for read operations; write operations do not use encryption. When set to **ON**, the tape drive uses encryption for both read/write operations. When set to **CUSTOM**, the device driver does not modify current tape drive setting. The custom setting is intended for applications by using system-managed encryption to control write encryption without device driver intervention. The parameter is set to "CUSTOM" by default.

Note: If **sys_encryption_write** is set to **ON**, an application cannot open a tape drive by using the append mode.

To make a global setting to enable SME in **IBMtape.conf**:

```
sys_encryption_write=1;    # System Encryption for Write Commands at BOP
```

To enable SME for a particular target

- name="IBMtape"
- class="scsi"
- target=0
- lun=0
- block_size=0

- buffering=1
- immediate=0
- trailer=0
- sili=0
- sys_encryption_write=1;

To disable SME in a particular target

- name="IBMtape"
- class="scsi"
- target=0
- lun=0
- block_size=0
- buffering=1
- immediate=0
- trailer=0
- sili=0
- sys_encryption_proxy=0;

Querying tape drive configuration

Querying tape drive configuration is a tape diagnostic and utility function. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Testing data encryption configuration and connectivity

A data encryption test is available to validate the **ibmekm.conf** file server entries and test tape drive to server connectivity operations.

This test is a tape diagnostic and utility function. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Field support information

When encryption failures require field support or development analysis, run the **/opt/IBMtape/ diags_info** script to generate a file of **diags.out**. Tape drive dumps and EKM server logs might be needed in addition to this information.

Problem determination

The following sections describe the service and diagnostic aids that are part of the IBM SCSI Tape and Medium Changer Device Driver for Solaris package. Procedures for verifying correct installation of the device, basic problem determination guidelines, and outlines of the utility program included with the **IBMtape** package are included.

Functional verification

If you wish to verify that the installation of the IBM SCSI Tape and Medium Changer Device Driver for Solaris package was successful, follow these steps.

1. Enter this command to verify that installation was successful.

```
/usr/bin/pkginfo IBMtape
```

The following information must be displayed.

system IBMtape IBM SCSI Tape & Medium Changer Device Driver x.x.x.x where
x.x.x.x is the version of the device driver.

2. To verify that device driver support for a specific IBM tape system that is attached to the system is
functioning correctly, enter the following command.

```
/opt/IBMtape/tapelist -f /dev/rmt/nst
```

substituting for **n** the number that is associated with the device special file assigned to the IBM tape
system that you want to check. Listing the contents of the /dev/rmt directory (by using the **ls**
command) can be helpful in determining the correct special file name. For medium changer devices,
the special file name **/dev/rmt/nsmc** must be used.

The following information is displayed.

```
IBM Tape Device Information :
        Instance : 202
    Special File : /dev/rmt/13st
          Device : ULT3580-TD5(fh)
   Serial Number : 1013000306
         TGT/LUN : 5/0
           Ucode : z1B8
    World Wide NN : 500507630019F00B
    World Wide PN : 500507630059F00B
     Dev Phy Path : /devices/pci@6,2000/fibre-channel@1/IBMtape@5,0
        Path Type : N/A
        Path Type : N/A
```

3. To verify that the **IBMtape** device driver is loaded in kernel memory, enter the following command.

```
/usr/sbin/modinfo | /usr/bin/grep IBMtape
```

The following information is displayed.

```
165 f5f10000  15c0s 109   1  IBMtape (IBM SCSI Tape/Medium Changer DD)
```

The first five fields that are shown probably do not match your specific output. The fields indicate the ID,
load address, size, major number, and revision for the **IBMtape** device driver and vary from machine to
machine

Sense data logging

When the tape drive responds with a CHECK CONDITION status and associated sense keys of 0x1
(Recovery Error), 0x3 (Medium Error), 0x4 (Hardware Error), and 0xB (Aborted Command) for a hardware
or medium error, the sense data is logged in to the system log file (typically /var/adm/messages).

Installation problems

If you are experiencing problems with installation of the IBM SCSI Tape and Medium Changer Device
Driver for Solaris package, the following information might help. If you cannot solve the problems after the
following is checked, contact the appropriate IBM service representative.

- If you receive the following message during installation,

```
drvconfig: System call 'modctl_modconfig' failed:
  No such device or address.
Warning: Driver (IBMtape) configuration failed.
  System could not install driver.
```

it indicates that the **IBMtape** device driver was not loaded because it did not detect the presence of any
supported IBM devices on the SCSI bus. Verify that SCSI adapter device driver support is installed and
configured correctly. Verify that the IBM tape subsystem is connected properly to the SCSI bus, which is
powered On, and online. It is not necessary for the tape drive to have a cartridge that is loaded to be
recognized by the **IBMtape** device driver.

- If you cannot open an IBM device, verify that you are using the correct special file. The IBM tape special
files are of the form ***st*** in the /dev/rmt directory. The IBM medium changer special files are of the

form ***smc** in the /dev/rmt directory. Ensure that the Solaris native tape device driver (**st**) is not contending for the same IBM device. Consult the **st.conf** file in the /kernel/drv directory and comment out conflicting stanzas.

Tape monitor daemon (tmd)

The Tape Monitor Daemon is introduced in the version of **IBMtape**.4.0.9.2 or later. It is designed to run concurrently with the **IBMtape** driver. It automatically retrieves and stores the IBM tape drive diagnostic information (drive dump) into the /var/opt/IBMtape directory. The daemon is automatically started when the driver is installed, even when no tape device is attached on the system. An entry name="IBMtape" parent="pseudo" instance=16383; is also entered into the configuration file of **/usr/kernel/drv/IBMtape.conf** automatically for the daemon during the **IBMtape** driver installation.

The following options can be used to configure the tape monitor daemon, running it on the command line. Most options can also be specified in the **/etc/tmd.conf** configuration file. However, the command line options override any configuration file options.

```
-s   Stop any currently running instance of the tape monitor daemon.
-r   Restart the tape monitor daemon and reload all configuration settings.
-d   Turn on drive error diagnostic retrieval and storage.
     This option is enabled by default.
-D   Turn off drive error diagnostic retrieval and storage.
-p   <directory>  Specify an alternate directory for the storage of
     drive diagnostic information. Default directory is /var/opt/IBMtape
-l   <filename>  Specify a file for writing daemon related log messages.
     By default, the tmd only writes status information to the syslog file of
     /var/adm/messages.
-y   Turns off writing log messages to syslog.
-z   Turn off compression.  By default, the tmd will use a form of file compression
     to reduce the size of stored diagnostic information.
```

The file name of dump presents some useful information. An example of the dump file is

```
IBMtape.000001300148.2004-04-09-14:54:14.dump.gz
```

Here, 000001300148 represents the serial number of the tape device, 2004-04-09-14:54:14 is the time stamp for the dump retrieval.

A message is also logged in the syslog file of /var/adm/messages after a drive dump is retrieved by tmd. For example,

```
Apr  9 14:54:21 Java tmd[3279]: Drive dump saved to /var/opt/IBMtape
    IBMtape.000001300148.2004-04-09-14:54:14.dump.
```

Tracing facility

IBMtape incorporates a tracing facility that is useful for completing problem determination. The tracing facility logs diagnostic information to **/var/adm/messages** based on the control variable *IBM_trace*. Refer to "Setting the IBM_trace level for static tracing" on page 105 for instructions on how to set the trace value.

IBM_trace values range from 0-13 and result in posted messages as shown in Table 21 on page 104. Postings are cumulative, so trace level 3 also posts items for levels 2, 1, and 0. A trace value of 2 or 3 is suitable for most normal production environments, with little or no degradation of throughput. *IBM_trace* values of 4 and higher increasingly degrade performance and generally is used only when directed by IBM support personnel.

Table 21. Solaris: tracing facility	
Trace level	**Items traced**
0	Severe error conditions only. For installations with small **/var** file systems, this setting can prevent filling the file system unexpectedly. However, this setting might be at the cost of not recording messages that are related to serious device or system environment errors.
1	Device sense data. Sense data can help in diagnosing the source of unexpected error conditions.
3	Device opens and closes, Decoded SCSI command, sense key, ASC and ASCQ for sense data.
4–13	Increasingly verbose tracing information. These tracing levels are useful only to **IBMtape** developers.
Note: IBMtape earlier than Version 4.0.2.7 had only *IBM_trace* values 0–4. Message content and selection differed significantly from current **IBMtape** versions.	

By default, system error messages, including **IBMtape** trace messages, are placed in /var/adm/ messages. If your installation modified **/etc/syslog.conf** to redirect system error messages, **IBMtape** tracing is handled as other kernel messages. Refer to the **syslog.conf** man page and the comments in **syslog.conf** for information about the system logging operation. Changes made to **syslog.conf** take effect after the next system restart.

The following shows trace level 2 output, with system date and time stamps removed. Device instance 390 is opened on the first line. The device minor number 12450 is decoded and shows that the SCSI medium changer (**smc**) special file was opened.

The second line decodes selected fields from the sense data that follows it. The decoded information shows that sense data was generated during a **Move Medium** command. Looking up the decoded Sense Key/ASC/ASCQ combination in the 3590 hardware reference, we find that the command failed because the move from location was empty. The actual sense data follows the decoded fields.

Note: Solaris, rather than printing multiple 16-byte lines of hexadecimal zeros, prints only the first such line, followed by a repeat count.

```
IBMtape(390) _open: 374 Inst 390, Minor 12450 (smc), Flags 0x5,
          TL 2/0/0, 4.0.2.8
IBMtape(390) check_sense: cmd 0xa5(move_medium), key/asc/ascq 0x5/3b/e,
          defer 0, retry 0, rc 22
IBMtape(390) 03590B11 SENSE DATA:
IBMtape(390)  70  0  5  0  0  0  0 58  0  0  0  0 3b  e ff  2
IBMtape(390)   0 20  1 40  a  9  1  0  0  0  0  0  0 a5  0
IBMtape(390)   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
last message repeated 1 time
IBMtape(390)   0  0  0  0  0  0  0  0 36 33 39 20 20 20 20  0
IBMtape(390)   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
IBMtape(390) _close: Inst 390, Minor 12450 (smc), Flags 0x5, exit(0)
```

In the next example, the device open line shows that a tape drive (**drv**) device special file was opened. The sense data for device instance 292 was generated during a space operation. The Sense Key/ASC/ ASCQ shows that a filemark was encountered during the space.

```
IBMtape(292) _open: 554 Inst 292, Minor 9412 (drv), Flags 0x5,
          TL 2/0/0, 4.0.2.8
IBMtape(292) check_sense: cmd 0x11(space), key/asc/ascq 0x0/0/1,
          defer 0, retry 0, rc 5
IBMtape(292) 03570B02 SENSE DATA:
IBMtape(292)  f0  0 80  0  0  0  1 48  0  0  0  0  0  1 ff  a
IBMtape(292)  c4 b1  0 20  0  5  1 91  0 34  0  0  0  0 11  0
IBMtape(292)   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  6
IBMtape(292)  6f 28  0 ad 73 32  0  0  0  0  0  0  0  0  0  0
```

```
IBMtape(292)  0  0  0  0  0  0 20  0 31 42 41 20 20 20 20  0
IBMtape(292) _close: Inst 292, Minor 9412 (drv), Flags 0x5, exit(0)
```

Finally, the sense data for device instance 230, a tape drive, occurred during a test unit ready and
indicates that no tape is loaded in the drive.

```
IBMtape(230) _open: 728 Inst 230, Minor 7366 (drv), Flags 0x5,
             TL 2/0/0, 4.0.2.8
IBMtape(230) check_sense: cmd 0x0(test_unit_ready),
             key/asc/ascq 0x2/3a/0, defer 0, retry 0, rc 5
IBMtape(230) 03570B02 SENSE DATA:
IBMtape(230) 70  0  2  0  0  0  0 48  0  0  0  0 3a  0 ff  2
IBMtape(230) c4  8  0 30  0  6  1 40  0  0  0  0  0  0  0  0
IBMtape(230)  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
last message repeated 1 time
IBMtape(230)  0  0  0  0  0  0  0  0 31 42 41 20 20 20 20  0
IBMtape(230) _close: Inst 230, Minor 7366 (drv), Flags 0x5, exit(0)
```

You can match an instance number with its corresponding device special file in two steps.

1. Find the instance number in **/etc/path_to_inst**.

   ```
   $ grep 292 /etc/path_to_inst
   "/pci@6,4000/scsi@2,1/IBMtape@2,0" 292 "IBMtape"
   ```

2. List **long** the contents of **/dev/rmt** and search for the path name you found in the previous step.

   ```
   $ ls -l /dev/rmt | grep "/pci@6,4000/scsi@2,1/IBMtape@2,0"
   lrwxrwxrwx   1 root     other        48 Aug  26 11:49 8st ->
      ../../devices/pci@6,4000/scsi@2,1/IBMtape@2,0:st
   lrwxrwxrwx   1 root     other        49 Aug  26 11:49 8stb ->
      ../../devices/pci@6,4000/scsi@2,1/IBMtape@2,0:stb
   ```

In this example, /dev/rmt/8st, /dev/rmt/8stb, and so on, are symbolic links to the device special
files that are associated with device instance 292.

Dynamic tracing utility

A dynamic tracing utility named **tapedtrc** is introduced in the **IBMtape**.4.1.6.0 or later driver. It is used to
dynamically set, reset, start, stop, and query **IBMtape** tracing at any time for debugging use. The program
is in the /opt/IBMtape directory, with the tracing level set to 0 by default.

Use the **tapedtrc** program from the command line as follows.

```
/opt/IBMtape/tapedtrc  [option]
    options:
        [set]               - Set IBMtape trace level and/or start the tracing
        [set] level         - Set trace to a particular trace level
        [get]               - Query the current IBMtape trace level
        [start]             - Start IBMtape tracing
        [stop]              - Stop IBMtape tracing without the trace level reset
        [clean]             - Stop the IBMtape tracing and reset IBMtape trace
                              level to 0
        [help]              - IBM tapedtrc help menu
```

Setting the IBM_trace level for static tracing

The user can still enable or disable static **IBMtape** tracing and set the IBM trace level in **/etc/system** or
run the **adb** system command. The host is required to reboot to enable or disable the tracing when the
trace level is set in **/etc/system**. The **IBMtape** driver must be loaded in the kernel. If the tracing is
enabled or disabled by using the **adb** command, the tracing starts or stops at the next device open.

The default value for *IBM_trace* is zero (0). You can define another *IBM_trace* value by placing an entry
in **/etc/system** so that *IBM_trace* is set at each restart. For example, this entry in **/etc/system** sets
IBM_trace to 2 at each restart.

```
set IBMtape:IBM_trace = 2
```

When *IBM_trace* is set in **/etc/system**, it affects tracing during driver loading, initialization, and operation.

You can also set or modify the *IBM_trace* value manually in an **adb** session. Because the driver must already be loaded and initialized before this method is used, the trace value that is set is active only during driver operation.

In this sample session, ksh> is a shell prompt, and adb> is the **adb** session prompt. Commands that you enter are in **boldface**. Explanatory comments follow number signs (#) or exclamation and number sign pairs (!#). Text lines without a prefix are **adb** session responses to commands.

```
#
#  Start adb session and set session prompt.
ksh> adb -P "adb> " -k -w /dev/ksyms /dev/mem
physmem 7c5e
!#
!#  Set default for input values to base 10.
adb> a$d
radix=10 base ten
!#
!#  Display current IBM_tape value as unsigned decimal integer.
adb> IBM_trace/u
IBM_trace:
IBM_trace:      0
!#
!#  Set new IBM_trace value.
!#  adb will confirm the old and new values.
adb> IBM_trace/w 2
IBM_trace:      0       =       2
!#
!#  Quit session.
adb> $q
#
#  Back to the shell.
ksh>
```

Running the diags_info script

Run the **diags_info** script in the /opt/IBMtape directory. This script detects the problems on the configuration files, gathers important system HBAs, and configuration information. The script must be run as root. If not run as root, the information must be labeled as such, but the value of the information is degraded when run as a non-root user.

To facilitate capture of data, the script places information in a file that is called **diags.out** in the directory where the script is. Send the output file to the location identified by your IBM service representative.

iostat command

IBMtape driver supports the **iostat** system command, which reports I/O statistics for the supported tape drives in **IBMtape**.4.1.2.7 and later versions. Refer to **man (1M) iostat** for the command usage.

Reservation conflict logging

When the device driver receives a reservation conflict during open or after the device is opened, it logs a reservation conflict in the Solaris system log of /var/adm/messages. Before the error is logged, the device driver issues a **Persistent Reserve In** command to determine whether a SCSI Persistent Reservation is active on the reserving host. It gets the reserving host initiator WWPN (worldwide port name) and reserve key. If successful, the device driver logs this information in the detail data. After the reserving host WWPN is logged, subsequent reservation conflicts from the same reserving host WWPN and reservation key are not logged. This action prevents multiple entries in the system log until either the reserving host WWPN or reservation key is different from the one initially logged. Or, the device driver reserved the device and then another reservation conflict occurs.

The log examples

1. The information is logged when the drive is reserved with a Persistent Reservation.

```
log_reserve: Reserving host key 46E48C49413E6EB1   WWPN 210000E08B118BB1
```

2. The information is logged when the drive is reserved with an SCSI-2 Reserve.

```
log_reserve: Reservation Conflict: read full status failure (rc 16)
```

3. The information is logged when the drive is reserved but the host reservation information is not available.

```
log_reserve: Reservation Conflict: No reserving host information is available.
```

Note: To disable reservation conflict logging, add the entry `log_reserve = 0` at the beginning of **IBMtape.conf**, then reload the Tape Monitor Daemon and the driver.

Chapter 6. Windows Tape and Medium Changer device driver

This chapter describes the hardware requirements, software requirements, and installation notes for the Microsoft Windows device drivers for IBM tape devices.

Purpose

The Windows tape and medium changer device driver is designed to take advantage of the features that are provided by the IBM tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape operations (such as backup and restore) and medium changer operations (such as mount and unmount the cartridges), and to the advanced functions needed by full tape management systems. Whenever possible, the driver is designed to take advantage of the device features transparent to the application

Data flow

The software that is described here covers the Windows device driver and the interface between the application and the tape device.

Figure 12 on page 109 illustrates a typical data flow process.
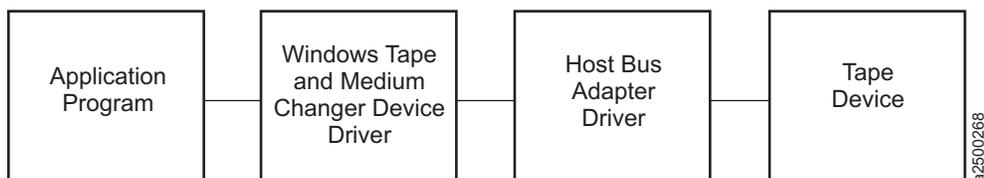
Figure 12. Data flow for Windows device driver (IBMmag)

Product requirements

Hardware requirements

Refer to the "Hardware requirements" on page 1 for the latest hardware that is supported by the IBM tape device driver.

Software requirements

For current software requirements, refer to the "Software requirements" on page 1.

Note: Limited support for customers who have Microsoft Windows Server 2008 extended support from Microsoft only.

Installation and configuration instructions

This section includes instructions for installing and configuring the Windows tape and medium changer device driver on Windows Server 2008, 2012, 2016, and 2019.

The recommended procedure for installing a new version of the device driver is to uninstall the previous version (see "Uninstalling the device drivers" on page 113).

Windows Server 2008, 2012, 2016, and 2019 instructions

This section describes how to install, remove, and uninstall the Windows tape and medium changer device drivers on Windows Server 2008, 2012, 2016, and 2019.

Installation overview

The installation process consists of the following steps:

1. Verify that the hardware and software requirements are met.
2. Install the host bus adapters and drivers.
3. Shut down the system.
4. Connect the tape and medium changer devices to the host bus adapters.
5. Power® on the tape and medium changer devices.
6. Restart the system.
7. Log on as **Administrator**.
8. Install and configure the devices and device drivers with the installation application.

Installation procedures

These procedures make the following assumptions:

- No other driver is installed that claims the tape and medium changer devices.
- If you are updating the device driver from a Microsoft certified version to an uncertified version, you must first uninstall the certified driver. Refer to "Uninstalling the device drivers" on page 113.
- The host bus adapter is installed, configured properly, and is running supported microcode and driver levels.
- Device drivers are installed with Windows Server 2012 or 2012R2, with V6.2.5.3 or later; Windows Server 2016, with V6.2.6.0 or later; or Windows Server 2019, with V6.2.6.8 or later.

   Note: The latest driver level to include support for Windows Server 2008 is V6.2.5.2

- Different registry keys are created to configure different parameters. They can be at `System\CurrentControlSet\Services\` and the subkeys are created depending on the Windows Server version. With Windows Server 2008 they are:
  - ibmcg2k8
  - ibmtp2k8
  - ibmtpbs2k8

   With Windows Server 2012 they are:
  - ibmcg2k12
  - ibmtp2k12
  - ibmtpbs2k12

   With Windows 2016, they are:
  - ibmcg2k16
  - ibmtp2k16
  - ibmtpbs2k16

   With Windows 2019, they are:
  - ibmcg2k19
  - ibmtp2k19
  - ibmtpbs2k19

Refer to this list when in doubt of the registry key's name and instructions that involve modifying the registry. Caution and a backup are advised due to the registry's nature.

- Drivers are identified by the following conventions, where *nnnn* refers to a version of the driver. If there is more than one version, use the current one.

  – Windows Server 2019 for extended 64-bit architectures (Intel EM64T and AMD64),

  ```
  IBMTape.x64_w19_nnnn.zip
  ```

To install the device drivers, follow this procedure.

1. Log on as **Administrator**.

2. Download the appropriate driver. Refer to<u>Appendix A, "Accessing documentation and software online," on page 293</u>.

3. Extract the driver package to a hard disk drive directory of your choice, other than the root directory.

4. Ensure that the tape and medium changer devices are connected to your host bus adapter and configured properly by locating the devices in Device Manager.

5. Double-click either **install_exclusive.exe** or **install_nonexclusive.exe**.

   - **install_exclusive.exe** The driver issues automatic reserves on open. It also prevents multiple open handles from the host to a drive from existing at the same time, as is required by applications such as Tivoli Storage Manager. This driver is also required for the failover feature to work as it uses persistent reservation (by default).

   - **install_nonexclusive.exe** The driver permits open handles from the host to a drive to exist at the same time, as is required by applications such as Microsoft Data Protection Manager (DPM).
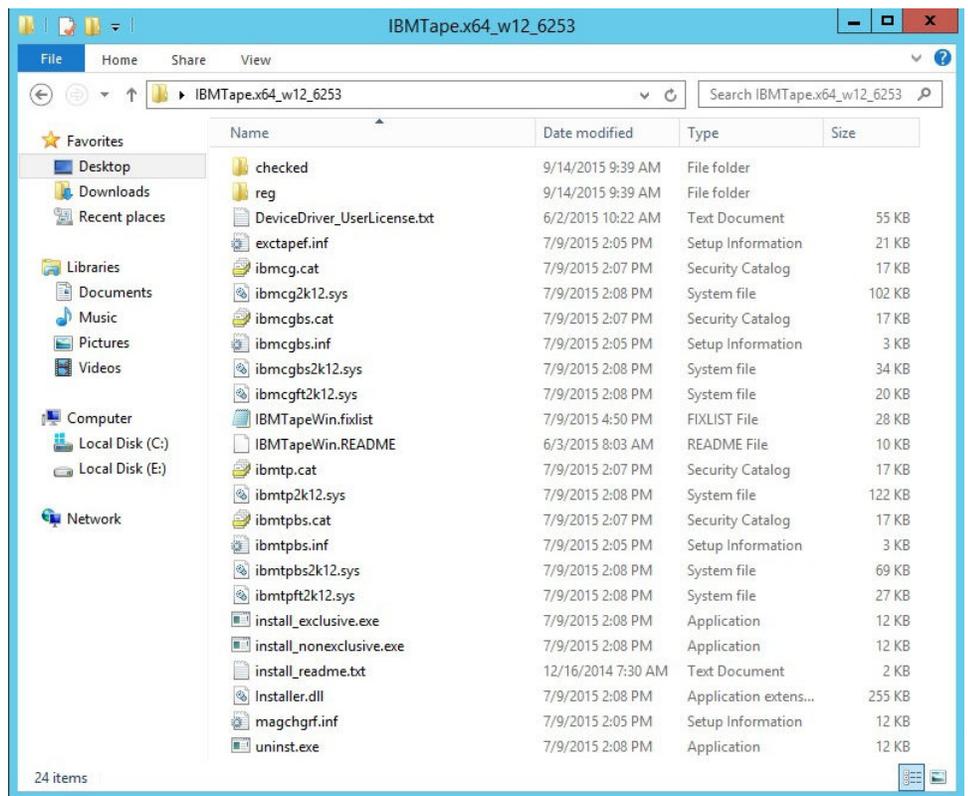
Figure 13. Installation application in Windows Explorer

Note:

a. More installation features are available through the command prompt interface (CLI), which include

- Installing only the tape or medium changer device drivers (**-t** or **-c**)
- Running in debug mode, which creates the file **debug.txt** in the driver package directory (**-d**)
- Running in silent mode, which suppresses messages that require user intervention, but only with Microsoft-certified IBM drivers (**-s**)
- Disabling DPF from installation (**-f**), available in driver packages v6.2.0.1 and later
- Enabling Persistent Reserve from installation if DPF is disabled (**-p**), available in driver packages v6.2.0.6 and later.
- Disable Media Polling (**-m**).
- Disable Dynamic Runtime Attributes (**-a**).
- Exclude devices from being claimed by the driver (**-e**), available in driver packages v6.2.5.3 and later.

  To install the device drivers with any of these features, instead of double-clicking the installation executable file, open a command prompt window and cd to the driver package directory. For the usage information, type `install_exclusive.exe -h` or `install_nonexclusive.exe -h` at the prompt.

  b. If the Windows **Found New Hardware Wizard** begins during installation, cancel the wizard. The installation application completes the necessary steps.

6. If you are installing a Windows Server 2008, Windows Server 2012, 2016, or 2019 driver that is not certified by the Microsoft Windows Hardware Quality Laboratories (WHQL), it likely has a VeriSign digital signature. During installation, you might be presented with a prompt to install the software. Mark the **Always trust software from IBM Corporation** check box and click **Install**. You see this screen the first time that you install the drivers, provided you click the **Always trust software** box.

   Note: Starting with Windows Server 2016 release 1607, non-WHQL signed kernel drivers might not load on a production server, per Microsoft documentation:

   "What are the exact exceptions? Are cross-signed drivers still valid? Enforcement happens only on fresh installations, with Secure Boot on, and applies only to new kernel mode drivers:

   - PCs upgrading from a release of Windows before Windows 10 Version 1607 still permit installation of cross-signed drivers.
   - PCs with Secure Boot OFF still permit installation of cross-signed drivers.
   - Drivers that are signed with an end-entity certificate issued before 29 July 2015 that chain to a supported cross-signed CA continues to be allowed.
   - To prevent systems from failing to boot properly, boot drivers are not blocked, but they are removed by the Program Compatibility Assistant. Future versions of Windows block boot drivers.

   To summarize, on non-upgraded fresh installations of Windows 10, version 1607 with Secure Boot ON, drivers must be signed by Microsoft or with an end-entity certificate issued before 29 July 2015 that chains to a supported cross-signed CA."

   All drivers that are released by IBM went through a complete test to ensure that they are stable and conform to specified requirements.

   Go to https://blogs.msdn.microsoft.com/windows_hardware_certification/2016/07/26/driver-signing-changes-in-windows-10-version-1607/ for details.

Figure 14. Windows logo testing screen

7. To verify that the tape and medium changer devices and drivers are installed correctly, follow the instructions in Appendix B, "Verifying correct attachment of your devices," on page 297.

Device removal or disable procedure

If you must remove a device, or if you are altering the hardware configuration, you must uninstall or disable the device first.

1. Right-click **My Computer**, select **Manage** to open the Computer Management Console, and click **Device Manager**.
2. Right-click the device that you want to uninstall and select **Uninstall ...**. If you want to disable the device without uninstalling it, you can select **Disable**.
3. You are prompted to confirm the uninstallation. Click **OK**.
4. In Device Manager, under **System devices**, right-click **Changer Bus Enumerator** and select **Uninstall**.
5. In Device Manager, under **System devices**, right-click **Tape Bus Enumerator** and select **Uninstall**.

Note: This removal procedure removes the device from the device tree, but it does not uninstall the device driver files from your hard disk.

Uninstalling the device drivers

To uninstall the device drivers from the system, which includes deleting the system files and deallocating other system resources, complete the following steps.

1. Quiesce all activity on the tape and medium changer.
2. Double-click **uninst.exe** in the driver package.

   Note: This action removes all the files in the system directories that were created during the installation of the device driver. It does not delete the compressed file or the files that were extracted from the compressed file. If you want to remove these files, you must delete them manually. For v.6.2.5.3 and later, it is not required to manually remove the devices at the Device Manager.
3. Restart the system.

Configuring limitations

The driver limitation for the supported number of tape devices is 1024. Every installed device uses a certain amount of resources. The user must also consider other resources, such as physical memory and virtual space on the system before you attempt to reach the limits. Also, be aware of Microsoft limitations. One known article is http://support.microsoft.com/kb/310072 (ID: 310072). Be aware of any Windows specific version limitations.

Windows Tape and Medium Changer device driver **113**

Persistent Naming Support on Windows Server 2008, 2012, 2016, and 2019

The Windows tape driver has an option for enabling device object names that persist across restarts of the operating system. For example, if your tape drive has the name **\.\tape4801101** and the persistent naming option is used, then **\\.\tape4801101** is reserved for use by that device after an operating system restart.

Complete the following steps to enable this feature.

1. Add a DWORD value to the registry called **PersistentNaming** and assign it a value 1

   - On Windows Server 2008: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtp2k8
   - On Windows Server 2012: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtp2k12
   - On Windows Server 2016: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtp2k16
   - On Windows Server 2019: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtp2k19

   .

2. Restart your system. Then, the system writes information to the registry to associate the Worldwide Node Name from Inquiry p. 0x83 with the persistent name used by the operating system.

   - If the Worldwide Node Name is unavailable, or the drive is a virtual (that is, emulated) drive, then the device serial number is used rather than the Worldwide Node Name.
   - If the **PersistentNaming** option is not specified in the registry, then your devices might not be able to claim the same device name after restart or driver initialization.

You can find registry subkeys with persistent naming information.

- On Windows Server 2008: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtpbs2k8
- On Windows Server 2012: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtpbs2k12
- On Windows Server 2016: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtpbs2k16
- On Windows Server 2019: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ibmtpbs2k19

Alternately, you can use the Windows Device Manager to examine the device number to determine that persistent naming is enabled on your host. Persistent names contain tape device numbers that are based at 4801101 (which is the decimal equivalent of hexadecimal 0x49424D and ASCII "IBM").

If two physical paths exist to a drive and different Windows device names are required (which happens, for example, when two different HBAs are connected to the drive and Data Path failover is disabled), the first discovered path claims the persistent device name. Any subsequent paths that connect to the same device receive names according to the order in which they are discovered by the Windows Device Manager.

Note: Persistent naming is not set by default. For disabling it, set the **PersistentNaming** value to 0 and restart the system.

Control Path failover support for tape libraries

To take advantage of Windows Control Path failover (CPF) support, the appropriate feature code must be installed. Refer to "Automatic failover" on page 3 for what feature code might be required for your machine type.

Configuring and unconfiguring Control Path failover support

Control Path failover is enabled automatically when the device driver is installed by default (install_exclusive.exe). It can be disabled from installation with the -f CLI option. Or, it can be disabled or reenabled for the entire set of attached medium changers by modifying the registry.

1. Open the **reg** folder of the driver package.
2. Double-click **DisableCPF.reg** or **EnableCPF.reg**.
3. Reboot the system. This action is necessary for any registry modification to take effect.

Querying primary and alternative path configuration

To check whether the control path failover is enabled in the device driver and show the primary and alternative paths, use the tape diagnostic and utility tool.

Note: Show the primary and alternative path configuration for any device with tape diagnostic and utility functions. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Checking disablement of Control Path failover setting

If you disabled the control path failover in the device driver's setting by double-clicking the **DisableCPF.reg** file and rebooting your system, you can go into the registry by issuing the Windows `regedit` command to confirm that CPF is disabled. Look for a line like

- On Windows Server 2008: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmcg2k8
- On Windows Server 2012: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmcg2k12
- On Windows Server 2016: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmcg2k16
- On Windows Server 2019: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmcg2k19

This line indicates that CPF is disabled in the driver. This setting takes effect only after your system is rebooted.

Data Path failover support for tape drives

To take advantage of Windows Data Path failover (DPF) support, the appropriate feature code must be installed. Refer to "Automatic failover" on page 3 for what feature code might be required for your machine type.

Configuring and unconfiguring Data Path failover support

Data Path failover is enabled automatically when the device driver is installed by default (install_exclusive.exe). It can be disabled from installation with the -f CLI option. Or, it can be disabled or reenabled for the entire set of attached drives or medium changers by modifying the registry.

1. Open the **reg** folder of the driver package.
2. Double-click **DisableDPF.reg** or **EnableDPF.reg**.

3. Reboot the system. This action is necessary for any registry modification to take effect.

For latest LTO generation 3 code and later LTO generation tape drives, a license key feature for the library hardware is required.

Note: For LTO generation 3 or lower, or for tape drives that require a data path license key on the host side to enable DPF, the device driver looks for a file that is called `%system_root%:\IBM_DPF.txt` for the key. `%system_root%` is the drive letter where Windows is installed, typically C (for example, `C:\IBM_DPF.txt`). The file contains the key on a single line, with no spaces and no other text on the line. If multiple keys are required, place each key in the file on its own line. The driver looks for this file at initialization. If the file contains a valid DPF license key, the DPF feature is enabled and any eligible devices have multi-path support.

Reserve Type if DPF is disabled

If DPF is disabled, SCSI-2 reserve is used by default to handle the reservation on tape drives. If Persistent Reserve is wanted rather than SCSI-2 reserve, **ReserveTypePersistent.reg** enables it (`ReserveTypeRegular.reg` disables it and then SCSI-2 reserve is used). Or,-p CLI option installation (only if **-f** was used to disable DPF) enables Persistent Reserve from installation.

Note: If DPF is not disabled, Persistent Reserve is used.

Querying primary and alternative path configuration

To check whether the data path failover is enabled in the device driver and show the primary and alternative paths, you can use the tape diagnostic and utility tool.

Note: Show the primary and alternative path configuration for any device with the tape diagnostic and utility functions. Refer to .

Checking disablement of Data Path failover setting

If you disabled the data path failover in device driver's setting by double-clicking the **DisableDPF.reg** file and rebooting your system, you can go into the registry by issuing the Windows **regedit** command to confirm that DPF is disabled. Look for a line

- On Windows Server 2008: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k8`
- On Windows Server 2012: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k12`
- On Windows Server 2016: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k16`
- On Windows Server 2019: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k19`

This line indicates that DPF is disabled in the driver. This setting takes effect only after your system is rebooted.

If you enabled Persistent Reserve on DPF disabled, look for a line

- On Windows Server 2008: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k8`
- On Windows Server 2012: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k12`
- On Windows Server 2016: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k16`
- On Windows Server 2019: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k19`

If you use **ReserveTypeRegular.reg**, then the `ReserveType` value is set to 0.

System-managed encryption

Device driver configuration

System-managed encryption parameters on Windows are placed in the registry under the key for the device driver. The parameters are populated in user-created subkey that contains the serial number of the device. The registry keys (**sys_encryption_proxy** and **sys_encryption_write**) are used to determine SME enablement and invocation of the EKM proxy on write.

Note: Leading zeros in the serial number must be excluded. For example, if the serial number of the encryption-capable tape drive were 0123456789, the user creates the following registry:

- On Windows Server 2008: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k8`
- On Windows Server 2012: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k12`
- On Windows Server 2016: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k16`
- On Windows Server 2019: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k19`

Under this key, the user creates DWORD values that are called **sys_encryption_proxy** or **sys_encryption_write**, and assigns them values that correspond with the wanted behavior.

The device driver SME settings can be set for all drives at once by placing the **sys_encryption_proxy** and **sys_encryption_write** registry options under the device driver key, found at:

- On Windows Server 2008: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k8`
- On Windows Server 2012: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k12`
- On Windows Server 2016: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k16`
- On Windows Server 2019: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ibmtp2k19`

When this option is chosen, the settings that are established for all drives are overridden by the serial-number specific settings described the previous paragraph.

If no options are specified in the registry, the driver uses the default values for the parameters.

- The default value for **sys_encryption_proxy** is 1.

  This value causes the device driver to handle encryption key requests, if the drive is set up for system-managed encryption. This value does not need to be changed. A value of 0 causes the device driver to ignore encryption key requests for system-managed encryption drives, and is not desirable.

- The default value for **sys_encryption_write** is 2.

  This value causes the device driver to leave the encryption write-from-BOP settings alone. It does not turn on or turn off encryption writing, but instead uses the settings that are already in the drive. If encryption is not set up previously, then the drive writes unencrypted data. A value of 0 causes the device driver to write unencrypted data. A value of 1 causes the device driver to write encrypted data.

Changes to the registry require a reboot before the settings are able to be viewed. However, during new installations of the driver, if the old driver is not uninstalled, the old settings remain in place and no reboot is required.

Configuration file

The file **%system_root%:\IBMEKM.conf** is used to store the IP address of the EKM server and other network-related parameters. The phrase *%system_root%* refers to the drive letter where the Windows installation is located, typically C (for example `C:\IBMEKM.conf`).

The format for the EKM server parameters is

```
Server<tab>Timeout<tab>IPAddress:Port
```

For example, if the Windows installation is installed at `c:\`, the EKM server is named **ekmtest**, the wanted timeout is 10 seconds, and the IP address is 127.0.0.1 at port 4242. Then, create a line in `C:\IBMEKM.conf` as follows.

```
ekmtest<tab>10<tab>127.0.0.1:4242
```

Querying tape drive configuration settings

An ITDT command is used to query the encryption settings of a tape drive. In ITDT-SE this procedure can be done by using either the"Standard Edition - Scan menu commands" on page 135 section or the **Tapeutil** menu commands with command "[35] Query Encryption Status" on page 157.

In ITDT-GE, it can be accomplished by using the **Diagnostic/Maintenance** tab (see "Encryption" on page 199) or by "Query Encryption Status" on page 215 on the **Tapeutil** tab.

Problem determination

There is a debug version of the device driver that can be used if you encounter problems. The debug version of the driver issues `DbgPrint` messages at various places during device driver execution. To capture these messages, you must start a debugger or use a tool like **Debug View** from Sysinternals Suite, available from http://technet.microsoft.com/sysinternals/.

Windows Server 2008, 2012, 2016, and 2019 instructions

Windows 2008, 2012, 2016, and 2019 instructions

1. Quiesce all activity on the tape and medium changer.
2. Exit all applications that are using the tape and medium changer devices.
3. If the driver is installed, complete the **Uninstall the devices** procedure that is described in a previous section.
4. Locate the **\checked** folder for the device driver level that you are running. This folder is in the highest level directory of the driver package. It contains checked versions of the tape and medium changer device drivers, **ibmtp*xx*yyy.sys**, and **ibmcg*xx*yyy.sys**, where

    - *xx* = **ft** for the filter driver, **bs** for the bus driver, or **blank** for the base driver
    - *yyyy* = **2k8**. It also has the **.inf** and **.cat** files on Windows Server 2008.
    - *yyyy* = **2k12**. It also has the **.inf** and **.cat** files on Windows Server 2012.
    - *yyyy* = **2k16**. It also has the **.inf** and **.cat** files on Windows Server 2016.
    - *yyyy* = **2k19**. It also has the **.inf** and **.cat** files on Windows Server 2019.
5. Copy all the files from the **\checked** folder to the highest level directory of the driver package, overwriting the files in there. A previous backup of the files or having a copy of the original driver package is recommended.

6. Start **Dbgview.exe** to capture debug messages. **Dbgview** can be downloaded from the Microsoft website. Make sure that **Capture Kernel**, **Enable Verbose Kernel Output**, and **Capture Events** are checked at the **Capture** menu.

7. Complete the Installation procedure.

8. Issue commands to the driver. You see debug messages on **Dbgview** from IBMTpBus, IBMCgBus, tape, or mcd. For example, you might see **IBMTpBus: ENT:** tag output. If you do not see something similar, an error might have happened during the checked driver installation or no driver activity might have occurred.

Restoring the non-Debug version

To restore the non-debug version of the driver, complete the following steps.

1. Quiesce all activity on the tape and medium changer devices.

2. Exit all applications that are using the tape and medium changer devices.

3. Uninstall the debug driver version, which can be accomplished by running **uninst.exe**, within the driver's package folder.

   Note: For v.6.2.5.3 and later, there is no need to manually remove the devices at Device Manager.

4. Restart the system.

5. When the system is back, install the non-debug driver version.

Reservation conflict logging

When the device driver receives a reservation conflict during open or after the device is opened, it logs a reservation conflict in the Windows eventlog. Before the error is logged, the device driver issues a `Persistent Reserve In` command. This action determines whether a SCSI Persistent Reservation is active on the reserving host to get the reserving host initiator WWPN (worldwide port name). If successful, the device driver logs this information as follows.

```
Reserving host key: kkkkkkkk WWPN: xxxxxxxx
```

Where *kkkkkkkk* is the actual reserve key and *xxxxxxxx* is the reserving host initiator WWPN.

After initially logging the reserving host WWPN, subsequent reservation conflicts from the same reserving host WWPN are not logged. This action prevents multiple entries in the error log until the reserving host WWPN is different from the one initially logged. Or, the device driver reserved the device and then another reservation conflict occurs.

Max retry busy

Complete the following steps to enable this feature.

1. Add a DWORD value to the registry called **MAXBusyRetry** and assign it a value between 1 and 480 at:

   - On Windows Server 2008: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmtp2k8
   - On Windows Server 2012: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmtp2k12
   - On Windows Server 2016: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmtp2k16
   - On Windows Server 2019: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services \ibmtp2k19

2. Reboot your system. Then, when a device gets the **device busy** error, the command is retried up to *MAXBusyRetry* times.

Checking if Data Path failover is enabled

If the tape diagnostic utility is not available, you can confirm that Data Path failover is enabled by installing the Debug version of the device driver. Refer to "Problem determination" on page 118 or "Old releases: V6.2.5.2 and prior releases" on page 120. While the Debug device driver is installing, look for the message: `tape.CreateTapeDeviceObject: DPF INSTALLED`.

Checking if Control Path failover is enabled

If the tape diagnostic utility is not available, you can confirm that Control Path failover is enabled by installing the Debug version of the device driver. Refer to "Problem determination" on page 118 or "Old releases: V6.2.5.2 and prior releases" on page 120. While the Debug device driver is installing, look for the message: `FtlValidateCpfKey`and confirm that the status is `True`.

Old releases: V6.2.5.2 and prior releases

Installing the Device Drivers

The last driver level to include support for Windows 2000 is V6.1.4.8.

The last driver level to include support for Windows 2003 is V6.2.1.7.

The last driver level to include support for Windows 2008 is V6.2.5.2.

Subsequent levels include support for Windows Server 2012; support for Windows Server 2016, starting with level 6.2.6.0; and support for Windows Server 2019, starting with level 6.2.6.8..

Windows Server 2008 - 2019 instructions

1. Refer to "Installation and configuration instructions" on page 109. The same installation instructions for Windows Server 2019 apply to Windows Server 2012 and Windows Server 2008.

Uninstalling the Device Drivers

1. Complete the steps under "Device removal or disable procedure" on page 113 to remove the tape and medium changer devices.
2. Double-click **uninst.exe** in the driver package.

   Note: This action removes all the files in the system directories that were created during the installation of the device driver. It does not delete the compressed file or the files that were extracted from the compressed file. If you want to remove these files, you must delete them manually.

3. Restart the system.

Installing the Debug version

Windows Server 2008 - 2019 instructions

1. Quiesce all activity on the tape and medium changer.
2. Exit all applications that are using the tape and medium changer devices.
3. If device drivers are installed, uninstall the device drivers first. Refer to "Uninstalling the Device Drivers" on page 120.
4. Locate the **\checked** folder in the driver package.
5. Copy the files from the **\checked** folder to the highest level directory of the driver package, overwriting the files there. A previous backup of the files or having a copy of the original driver package is recommended.
6. Complete the Installation procedure.

Restoring the non-Debug version

To restore the non-debug version of the driver, complete the following steps.

Windows Server 2008 - 2019 instructions

1. Quiesce all activity on the tape and medium changer.
2. Exit all applications that are using the tape and medium changer devices.
3. Uninstall the device drivers first. Refer to "Uninstalling the Device Drivers" on page 120.
4. Restart the system.
5. If a backup of device drivers package was done, complete the installation by using backup. Otherwise, download the same device driver level again and complete the installation. When the driver starts and commands are issued to it, the driver no longer produces debug output.

Chapter 7. IBM Tape Diagnostic Tool (ITDT)

This chapter describes the IBM Tape Diagnostic Tool.

Purpose

The IBM Tape Diagnostic Tool (ITDT) is available in two versions:

- Standard Edition (ITDT-SE) - The command line version.
- Graphical Edition (ITDT-GE) - The GUI version for the following platforms:
  - Microsoft Windows operating systems
  - Linux operating systems

Both versions provide the user with a single diagnostic program for tapeutil applications. Both SE and GE contain tapeutil functions with SE also providing scripting capability.

Note: The term *tapeutil* is a synonym for the tool that is delivered with the device driver. For example, this tool is named **tapeutil** on UNIX operating systems; it is named **ntutil** on Microsoft Windows operating systems.

ITDT supports IBM tape and library devices claimed by the IBM Tape Device Driver and devices that use the generic Operating System driver. By default the IBM Tape Device Driver is used but only if the IBM Tape Device Driver is not installed or the device is not claimed by the IBM Tape Device Driver. The generic Operating System driver is used when available.

The available advanced operations that are provided by the IBM Tape Diagnostic Tool are completed on tape drives and tape libraries. By using this function, you can complete maintenance tasks and run diagnostic tasks to determine tape drive issues. This action reduces product downtime and increases productivity.

The IBM Tape Diagnostic Tool is designed to

- Run quick or extended diagnostic tests on tape drives.
- Start tape library self-test operations.
- Retrieve dumps from tape drives and libraries.
- Run a firmware update on tape drives or libraries.
- Online Check for Firmware updates for tape drives or libraries (ITDT-GE).
- Test the performance of the environment by completely writing a cartridge and measuring performance.
- Verify tape drive compression.
- Measure system performance.
- Retrieve and display cartridge usage information.
- Verify the encryption environment.

  This test is used to verify whether data on the cartridge was written encrypted.
- Scan the system to discover all supported tape and library devices.
- Run a connection test (scan).

  This test is used to verify that all devices are attached properly.
- Run a standard test to check whether the tape device is defective and output a pass/fail result.

  Note: When this test is completed, all data on the cartridge is overwritten.
- Run a full write function.

This function writes the entire cartridge, overwriting all previous data with a selectable block size that contains either compressible or incompressible data and then outputs performance data.

Note: When this test is completed, all data on the cartridge is overwritten.

- Run a system test.

  Write different block sizes with compressible and incompressible data and then outputs performance data.

  Note: When this test is completed, all data on the cartridge is overwritten.

- Run a tape usage function to retrieve statistical data and error counters.
- Run HD-P functions like discovery.
- Physical Copy/Data migration and verification of cartridges.
- Log and Dump File analysis.

ITDT-SE provides the most important functions of the previous tapeutil tools. As an extension of the current tapeutil variants, the set of operations and functions available with ITDT-SE is identical across all supported operating systems (unless a function is not available on a particular system).

Dedicated device drivers for tapes and libraries can be installed on the target system and an application is installed that uses the tape/library devices. When this configuration exists, ITDT-SE can coexist with the application so that when the application disables the device internally, ITDT-SE can run the diagnostic tests on that device.

Accessing ITDT

IBM maintains the latest levels of the ITDT tool chain and documentation on the Internet at http://www.ibm.com/support/fixcentral.

One option to access ITDT is through Appendix A, "Accessing documentation and software online," on page 293. When an IBM driver is downloaded, there is a corequisite to download ITDT.

This portal gives access to the download area where the following procedure guides you to the correct download:

1. In the **Product Group** menu select **Storage Systems**.
2. In the **Product Family** menu select **Tape Systems**.
3. In the **Product Type** menu select **Tape device drivers and software**.
4. In the **Product** menu select **Tape Diagnostic Tool (ITDT)**.
5. Select your platform and press **Continue**.

Supported systems

ITDT is developed to support various versions of different platforms and tape products. For the latest support, refer to Chapter 1, "Introduction," on page 1 and Inter-operation Center website product support at http://www.ibm.com/systems/support/storage/config/ssic/.

IBM Tape Diagnostic Tool - Standard Edition

Installing ITDT - Standard Edition

This section describes the installation procedures for the Standard Edition of ITDT in various operating systems.

Before the IBM Tape Diagnostic Tool Standard Edition (ITDT-SE) is used with the IBM Tape Device Driver, we recommend upgrading to the latest available IBM Tape Device Driver level.

In a System Managed Encryption setup, the Encryption test [E] always exits with NO DRIVER SPECIAL FILE when ITDT-SE is started with **-force-generic-dd**.

Installing ITDT-SE on Microsoft Windows operating systems

To install ITDT-SE on Microsoft Windows operating systems, complete the following steps.

Note: ITDT-SE can be used only by a user with administrator rights.

1. Download **install_itdt_se_Windows<arch>_<version>.exe** where *<arch>* can be

   - AMD64 (64-bit Intel EM64T or AMD servers)
   - X86 (32-bit Intel-compatible servers)

   to a directory of your choice.

2. Run the following command:

   ```
   install_itdt_se_Windows<arch>_<version>.exe
   ```

Installing ITDT-SE on i5/OS operating systems

ITDT-SE for i5/OS or IBM i is installed with a graphical installer based on the InstallAnywhere installation software. This software must be run on a Microsoft Windows system and installs the software onto the remote i5/OS system. The installer generates installation information on the local Microsoft Windows system. So, the program can be removed from the remote i5/OS system by running the uninstaller on the local Microsoft Windows system.

To install ITDT-SE on i5/OS operating systems, complete the following steps.

Note: ITDT-SE on i5/OS requires a Microsoft Windows PC with a Java™ run time 1.4.2 or higher.

1. Start the installer **installi5OS_ITDT_SE_<version>.exe**.
2. Read through the welcome and license screens.
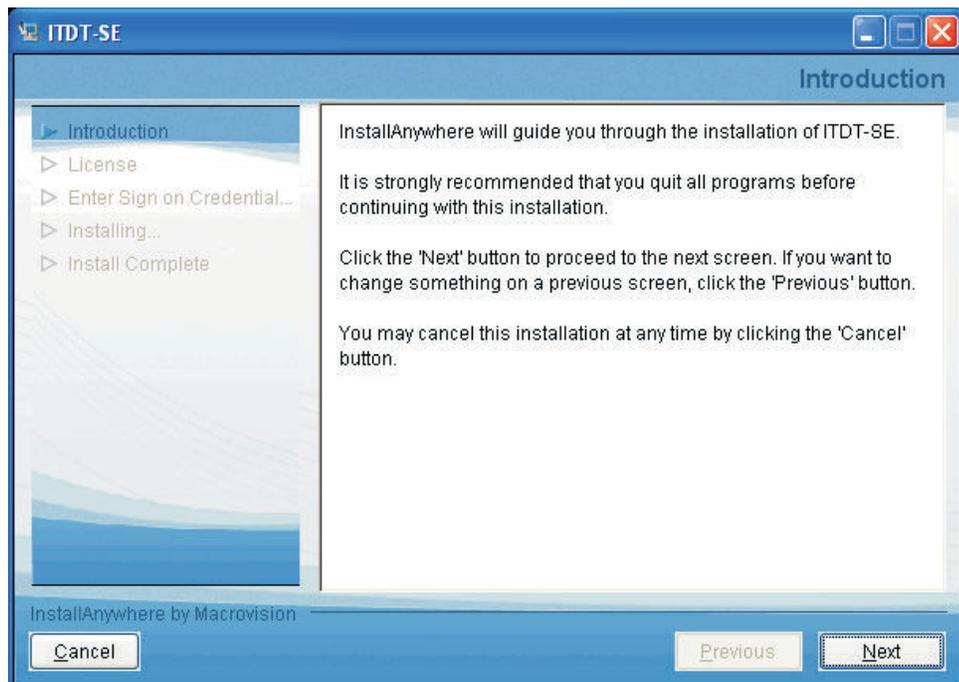
Figure 15. Welcome/Startup screen

3. Accept the License Agreement, then click **Next**.
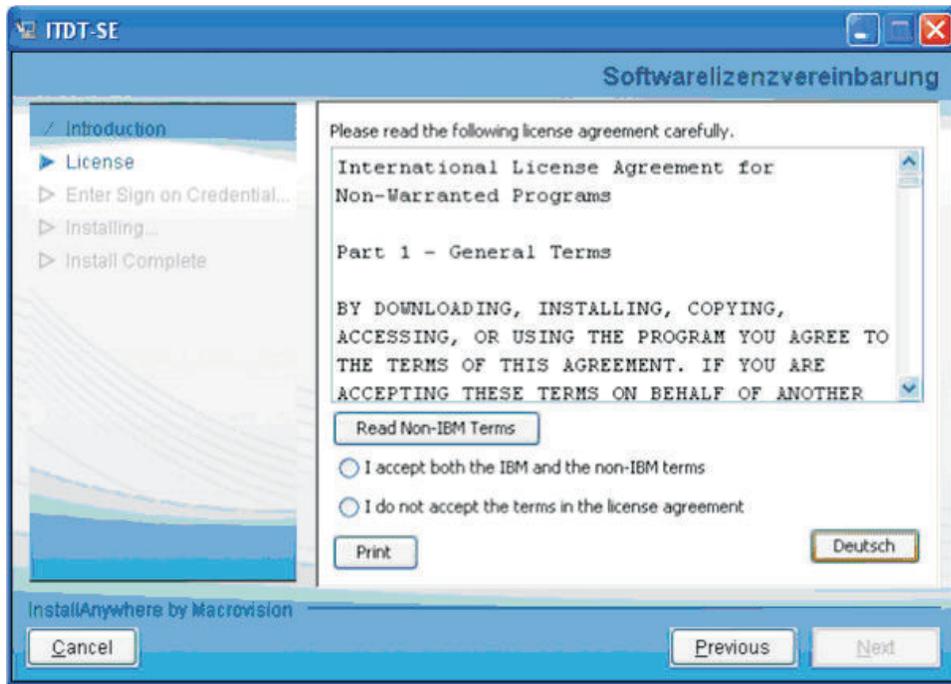
Figure 16. License screen

4. Enter your i5/OS system host name or IP address and administrator credentials. Start the installation by pressing **Install**. Click **Done** when the installation is complete.

   Note: The user name must be **QSECOFR**.
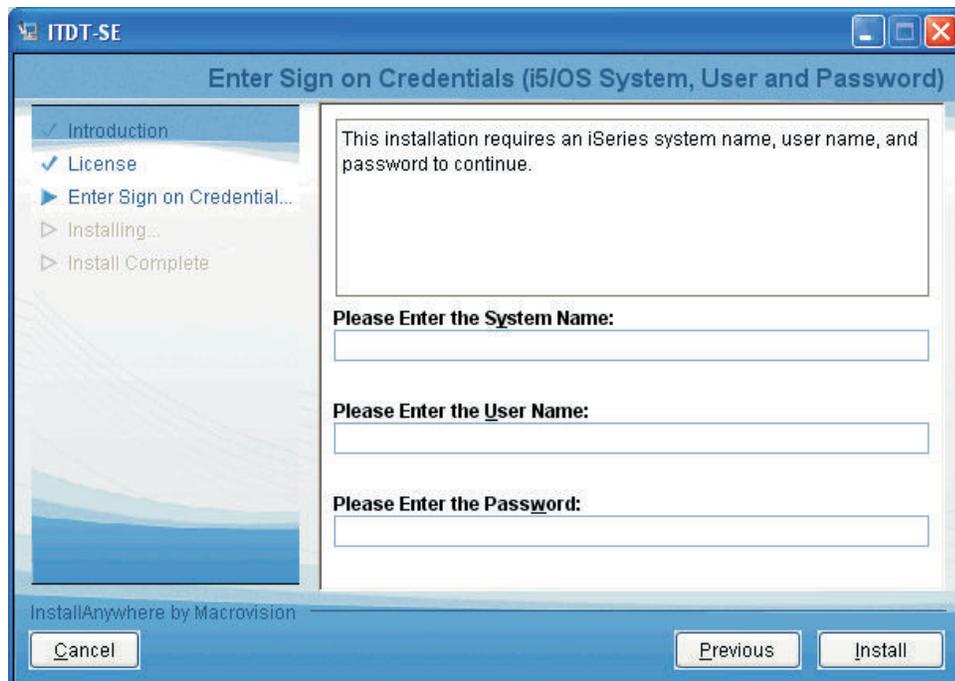
Figure 17. Machine credentials screen
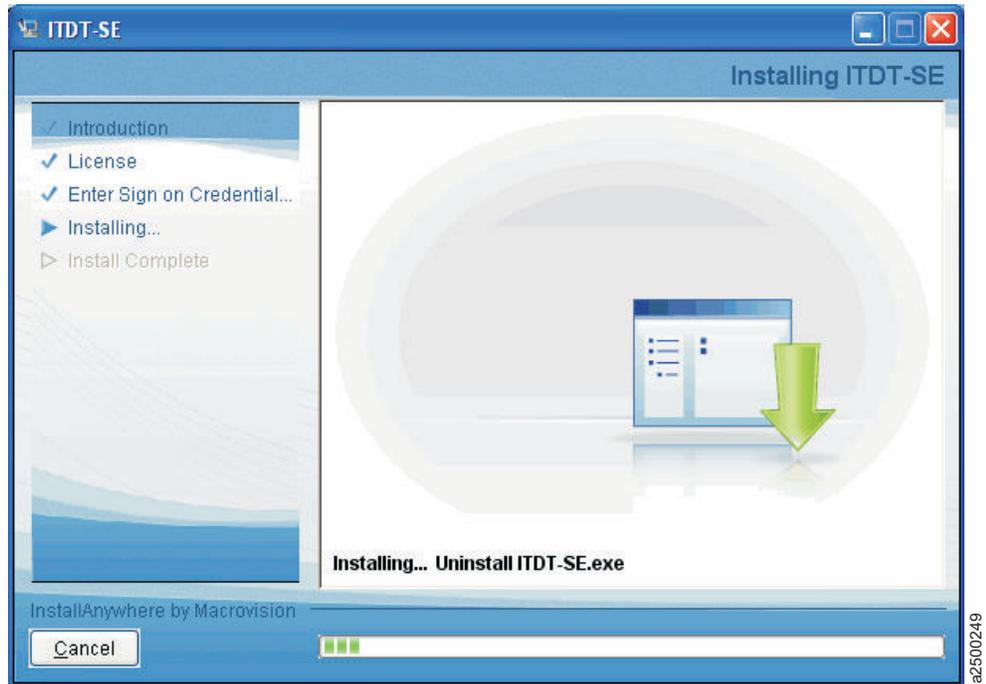
Figure 18. Installation progress screen
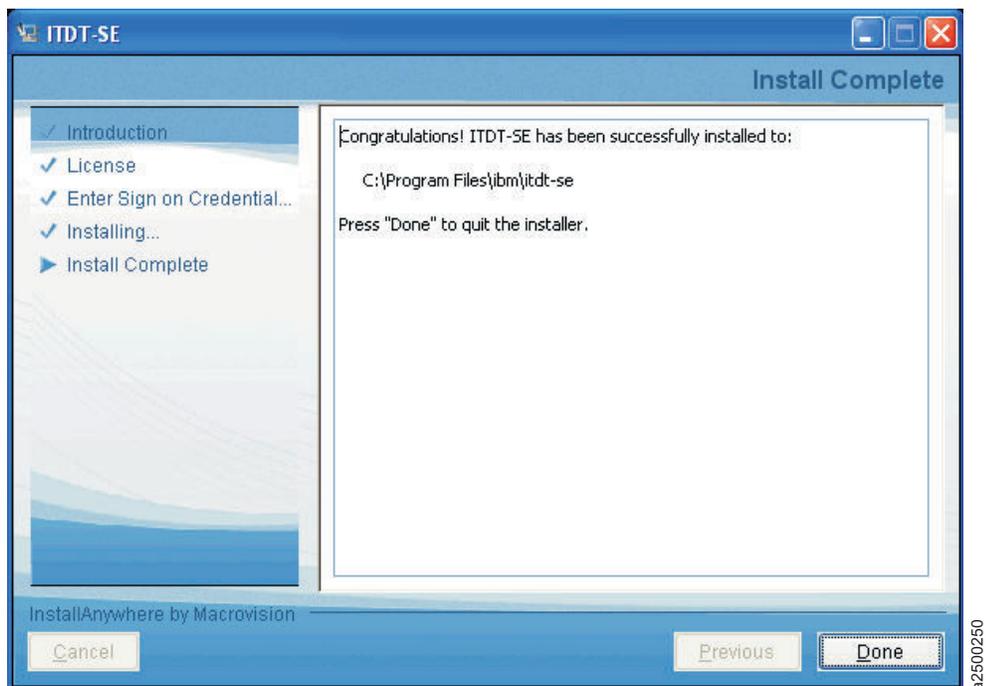
Figure 19. Installation complete screen

Installing ITDT-SE on other supported operating systems

To install ITDT-SE on other supported operating systems, complete the following steps.

Note: ITDT-SE can be used only by a user with root access rights, except for the Mac OS, which requires the user to have the minimum of read/write access to the device file.

1. Download **install_itdt_se_<OS>_<version>** to a directory of your choice.

   • **install_itdt_se_Aix_<version>** is for AIX operating systems

- **install_itdt_se_Linuxi386_<version>** is for Linux operating systems on X86 hardware
- **install_itdt_se_Linuxx86_64_<version>** is for Linux operating systems on X86_64 hardware
- **install_itdt_se_Linuxpowerpc64_<version>** is for Linux operating systems on pSeries
- **install_itdt_se_Linuxpowerpc64le_<version>** is for Linux operating systems on pSeries Little Endian.
- **install_itdt_se_Linuxs390x_<version>** is for Linux operating systems on zSeries
- **install_itdt_se_Hpux_<version>** is for HP-UX operating systems.
- **install_itdt_se_MacOS_<version>** is for Mac OS operating systems.
- **install_itdt_se_SolarisX86_64_<version>** is for Solaris X86_64 operating systems.
- **install_itdt_se_Solaris_<version>** is for Solaris SPARC operating systems.

2. Run the following command to make **install_itdt_se_<OS>_<version>** executable.

```
chmod 700 install_itdt_se_<OS>_<version>
```

3. To run without parameters, run the following command

```
install_itdt_se_<OS>_<version>
```

or

```
./install_itdt_se_<OS>_<version>
```

depending on your operating system.

Optionally you can use these parameters:

- **-h** [--help] Show help message
- **-v** [--verbose] Print the extracted files
- **-p** [--path] Path for extraction (default is current directory)
- **-t** [--test] Show package content

Starting ITDT - Standard Edition

This section describes the startup procedures for the Standard Edition of ITDT in various operating systems.

Starting ITDT-SE on Solaris operating systems

1. If the IBM Tape Device Driver is not used, if it is not installed, or you want to be able to run **-force-generic-dd**, configure the *sgen* driver.

   A script **sgen_solaris_conf.sh** is included in the ITDT-SE package. This script allows you to configure the *sgen* generic SCSI driver that is shipped with Solaris.

   ITDT-SE requires that the *sgen* device driver is configured so that the devices you want to work with can be found.

   Note: For system security reasons, always reset the *sgen* device driver settings after you finish working with ITDT-SE, by using the sgen_solaris_conf.sh script.

   To configure the *sgen* driver, start the **sgen_solaris_conf.sh** script with root access.

   The following command-line options are available on the *SGEN* driver configuration screen:

   - 1. Check driver: This option checks if the driver **/kernel/drv/sgen** is available.
   - 2. List driver settings: This option shows the current activated devices.
   - 3. New driver configuration: This option shows the screen that is used to create a new driver configuration (see Step 2).
   - 4. Stop *sgen* driver: This option stops the driver (that is, rem_drv sgen).

- 5. Start *sgen* driver: This option stops and starts the sgen driver.
- 6. Exit program: This option closes the shell script.

2. Enter option 3 to create a new driver configuration.

   The following command-line options are available on the **New Configuration** screen. Use these options to configure the *sgen* driver:

   - 1. List targets: This option shows the targets in current configuration.
   - 2. Define device types: This option defines drive and changer types.
   - 3. or 5. Add targets: This option adds targets to the list.

     Note: Option 3 allows for the addition of individual devices one at a time. Option 5 allows for the addition of a range of devices, eliminating the need to add many devices one by one.

   - 4. or 6. Remove targets: This option removes targets from the list.

     Note: Option 4 allows for the removal of individual devices one at a time. Option 6 allows for the removal of a range of devices, eliminating the need to remove many devices one by one.

   - 7. Save configuration: This option saves the modifications.
   - 8. Back to Main Menu: This option returns to the main menu.

3. After the *sgen* driver is configured, enter command-line option 8 to go back to the main menu.

4. On the *SGEN* driver configuration screen, enter command-line option 5. This option starts the *sgen* driver. New devices are found by using the definitions that are completed in Step 2.

5. After the new devices are found, enter option 6 to exit the **sgen_solaris_conf.sh** script.

Note: For Fibre Channel Host Bus Adapters (HBAs), special handling is required. Attached devices must be configured with their WWPN in the **sgen.conf** file. This task must be done manually. It is not completed by using the sgen_solaris_conf.sh script.

The following code is an example how to add those devices:

```
Run the command "cfgadm -al" to get the WWPN number(s).
  ......
  c4                              fc-private   connected    configured
  c4::5005076302401924            tape         connected    configured
  .....
  Add the WW-PN number(s) into the sgen.conf file.
    name="sgen" parent="fp" target=0 lun=0 fc-port-wwn="5005076302401924";
    name="sgen" parent="fp" target=0 lun=1 fc-port-wwn="5005076302401924";

  If you have finished the editing, the sgen driver has to be restarted.
  Please enter "update_drv sgen".
```

The **Read Attribute** command is 16-byte CDB. On Solaris 10, IBMtape can detect what maximum CDB length is supported from HBA attributes and set the supported CDB. For Solaris 9, CDB16 must be enabled for ITDT-SE to work correctly. This procedure can be done by adding the entry of

```
cdb16_support=1
```

at the first line in

```
/usr/kernel/drv/IBMtape.conf
```

and reload the IBMtape driver again.

To start ITDT-SE, run the following command:

```
./itdt
```

At first start, read the User License Agreement.

- Press **Enter** to scroll the license screens forward or b followed by **Enter** to go back.
- Type i if you agree to the terms of license or q followed by **Enter** to quit the application.

During the initial program start, the input and output directories are created.

- Input directory: default directory for firmware files during Firmware Update
- Output directory: directory that contains the result files, dump files, and log files after tests are run

ITDT-SE does not make changes outside the installation directory.

Starting ITDT-SE on Windows operating systems

At first program start, the license text is displayed and the input and output directories are created. Start ITDT by running the following command from the directory "ITDT" that was created during the installation (confirm to run with administrator rights):

```
itdt.exe
```

Read the User License Agreement.

- Press **Enter** to scroll the license screens forward or b followed by **Enter** to go back.
- Type i, if you agree to the terms of license or q followed by **Enter** to quit the application.

ITDT-SE does not create any registry entries or make changes outside the installation directory.

During installation a subdirectory "ITDT" was created which contains the ITDT program file and 2 subdirectories initially:

- "License" directory with license files in different languages.
- "Scripts" directory for extra scripts.

When the program is run for the first time, two more subdirectories are created in the "ITDT" folder:

- "Input" directory for firmware files to be uploaded to devices.
- "Output" directory for generated log and dump files.

To remove ITDT from your system, erase the ITDT directory. Any log and dump files in the subdirectories are also erased when you do so.

Starting ITDT-SE on i5/OS operating systems

To use ITDT-SE to update firmware or pull dumps from a tape drive inside a tape library, make sure that the drives are varied online in STANDALONE MODE by completing the following steps.

1. Issue the command **WRKMLBSTS**. Identify the library and drives you want to work with. Note their names (for example, TAPMLB01, TAP01, TAP02).
2. Deallocate the corresponding drives by using option 6.
3. Vary OFF the TAPMLB by using option 2.
4. Enter the following command:

   ```
   WRKCFGSTS *DEV TAP*
   ```

   Identify the drives that were noted in Step 1 (for example, TAPMLB01, TAP01, TAP02) and vary them ON by using option 1.
5. Start the iSeries Qshell environment with the following command:

   ```
   QSH
   ```

6. Change to the folder /home/ITDT with the following command:

   ```
   cd /home/ITDT
   ```

7. Start ITDT with the following command.

   ```
   ./itdt
   ```

8. Update Firmware and pull dumps. See "Firmware Update" on page 142 and "Dump" on page 141.

9. When firmware updates and dumps are complete, enter the following command:

```
WRKCFGSTS *DEV TAP*
```

10. Vary off the TAPs that you worked with by using option 2.
11. Issue the command **WRKMLBSTS**. Identify the library and drives you worked with.
12. Vary on the TAPMLB by using option 1.
13. Press **F5** to refresh the screen. The TAPs belonging to the TAPMLB shows up.
14. Allocate the TAPs back to the TAPMLB by using option 4 or 5.

Starting ITDT-SE on other supported operating systems

To start ITDT-SE, run the following command

```
./itdt
```

At first start, read the User License Agreement:

- Press **Enter** to scroll the license screens forward or b followed by **Enter** to go back.
- Type i, if you agree to the terms of license or q followed by **Enter** to quit the application.

During the initial program start, the input and output directories are created.

- Input directory: default directory for firmware files during Firmware Update
- Output directory: directory that contains the result files, dump files, and log files after tests are run

ITDT-SE does not make changes outside the installation directory.

Generic Operating System driver with ITDT-SE

When the IBM Tape Device Driver cannot be used, ITDT-SE can be forced to use generic Operating System driver devices with the parameter **-force-generic-dd**.

The parameter is supported in the interactive and scripting mode of ITDT-SE.

For information, go to:

- "Standard Edition - Program options" on page 162
- "Device file names - device addressing" on page 153
- "Scan" on page 137

Standard Edition - known issues and limitations

This section describes the known issues and limitations of the ITDT-SE program.

AIX operating systems

The following are the known scan limitations:

- Only devices that have the device state "available".

For FC and SAS devices, ID and LUN greater than 999 are not displayed; they are shown as ###.

When logged in through telnet, backspace might not work - an escape sequence is inserted and the input is ignored after **Enter** is pressed.

HP-UX operating systems

Verify that the following patches are installed before ITDT-SE is started.

- PA-Risc: At least these patches:
  - ld and linker tools cumulative patch
  - libc cumulative patch

- Itanium/IA-64: All regular patches and the following patches:
  - VxVM 3.5~IA.014 Command Patch
  - VxVM 3.5~IA.014 Kernel Cumulative Patch
  - Aries cumulative patch
  - linker + fdp cumulative patch

Note: ITDT-SE is emulated by Aries (a binary emulator that transparently emulates 32-bit and 64-bit HP-UX PA-RISC applications on HP-UX IA-64 machines).

On HP-UX11.iV3 systems, tape libraries that are operated through the drive's control path (no control path failover) might disappear from the Device List after a **[F] Firmware Update** on the controlling drive. It is recommended to complete repeated **[S] Scan** operations to make the library reappear in the device list.

Linux operating systems

ITDT-SE on Linux requires `glibc 2.2.5` or later.

Note: On an SLES9 s390x (64 bit) configuration, you might experience a SCSI CMD TIMEOUT when the [T] option is run with the IBM Tape Device Driver.

For SUSE SLES9 on zSeries, ensure that the kernel update SUSE-SA:2007:035 is installed.

Solaris operating systems

Rescan might take 6-8 minutes, depending on the numbers of host adapters and devices attached.

The known scan limitations: SCSI ID 0-255, LUN 0-10.

If the IBM Tape Device Driver is not installed on Solaris 10, tape devices might not be found during scan although they are configured in `sgen.conf`. When this event occurs, complete the following steps to configure the devices:

1. Check the current driver bindings for IBM tape drives and changers by entering the following commands:

   ```
   # egrep "scsiclass,01" /etc/driver_aliases        (for drives)
   # egrep "scsiclass,08" /etc/driver_aliases        (for changers)
   ```

2. Modify the `/etc/driver_alias` file to comment all lines not starting with sgen and containing identification of your drives and changers. Examples:

   ```
   #st "scsiclass,01"                     (all tape drives)
   #st "scsiclass,01.vIBM.pULT3580-TD4"   (IBM tape drive model ULT3580-TD4)
   #st "scsiclass,08"                     (all changers)
   #st "scsiclass,08.vIBM.p3573-TL"       (IBM changer model 3573-TL)
   ```

3. Check that the configured drives are not configured for st driver by entering the following command:

   ```
   # cfgadm -al
   ```

   If the tape drive is claimed by st device driver, an entry with `cxx:rmt/y`, is displayed, for example:

   ```
   c11::rmt/0          tape           connected    configured    unknown
   ```

4. Add sgen driver aliases with one of the following commands:

   ```
   # update_drv -a -i '"scsiclass,01.vIBM.pULT3580-HH4"' sgen
     (adds sgen alias for IBM drive, model ULT3580-HH4)

   # update_drv -a -i '"scsiclass,01"' sgen
     (adds sgen alias for all drives attached to the system)

   # update_drv -a -i '"scsiclass,08.vIBM.pULT3581-TA2"' sgen
     (adds sgen alias for IBM changer, model ULT3581-TA2)

   # update_drv -a -i '"scsiclass,08"' sgen
     (adds sgen alias for all changers attached to the system)
   ```

5. Check that the drives and changers are now configured with the following command:

```
# cfgadm -al
```

6. If the drives or changers are not listed in the output of 'cfgadm -al', reboot the system and verify the list of configured devices with the command:

```
# cfgadm -al
```

Windows operating systems

After a firmware update, devices might disappear. This issue is a known Windows problem.

Repeated **Scan** operations can help to rediscover the device.

When applications are turned on Windows while ITDT-SE is running, an extra ESC character might appear on the input line. When this issue occurs, the input is ignored after **Enter** is pressed.

If you are using Adaptec SCSI Host Bus adapters, ensure that you are using the latest Adaptec Host Bus Adapter Drivers instead of the drivers that are shipped with the Windows operating system.

On Microsoft Windows systems where the maximum transfer size is limited to less than 64 kB, the **Dump** and **Firmware Update** operations do not work.

i5/OS operating systems

The Tape Drive must be varied online. If the tape drive is operated through a tape library, the library must be varied offline. See "Starting ITDT-SE on i5/OS operating systems" on page 130 for details.

As the library is varied offline, the Encryption Test does not deliver decrypted data in a Library Managed Encryption environment.

IO adapters without a dedicated IOP do not support commands with 16 bytes. These adapters are called IOP-less and can be identified with the command; **WRKHDWRSC *STG**. Adapters where the CMBxxx and DCxxx resource names are the same (like both 5774) are IOP-less. If it is IOP, then the CMBxxx is a different type from the DCxxx.

Therefore, the following ITDT commands and test sequences can fail on IOP-less adapters attached devices.

- Encryption Verification Test
- Physical Copy with more than one partition
- **Erase** command
- **Change Partition** command
- **Read/write -attribute** command

ITDT-SE on i5/OS V5R4 requires the following PTF installed.

- PTF: SI25023 Release: 540 Abstract: OSP-MEDIA-TAPE-THREADS-MSGCEE0200-T/QTAHRMGR QTARDCAP FAILS

The [U] Tapeutil option is not available for i5/OS with this release as all the underlying operations require the IBM Tape Device Driver to be installed.

FC 5912 SAS HBA support is only for POWER6 and V6R1 configurations that are attached to LTO Gen 4 HH tape drives (No support for LTO 3 HH SAS).

All supported operating systems

This section describes the known issues and limitations of the ITDT-SE program on all other supported operating systems.

Prevent/Allow Medium Removal is missing as a Tape Drive option. But, it can still be completed by using the [56] Prevent/Allow Medium Removal option for tape libraries while the tape device is opened.

User Interface issues

If you press the arrow keys on most UNIX operating system consoles, the input is ignored after **Enter** is pressed.

When the **Tab** key is pressed as an input string for field data, the user interface is corrupted.

Make sure that field input does not start with a number followed by space and extra text. This input is interpreted as an entry to a specific row in the field. To avoid this issue, use an underscore character (_) instead of the space character.

Command timeout

There is no instant operation termination upon SCSI command timeout; for example, when the SCSI cable is unplugged after POST A is started.

When a command timeout condition occurs, ITDT might still continue to complete more operations (like unmounting the cartridge) instead of instantly terminating with a timeout condition.

TS3310 and TS4500 tape libraries

Library Firmware Update with ITDT-SE and ITDT-GE is not supported by the TS3310 and TS4500 libraries. Update the firmware by using the Web User Interface for those libraries.

3494 tape library

Drives in a 3494 tape library or an STK silo library are supported, only the [T] Test option does not work because of device-specific restrictions for handling cartridges.

Standard Edition - Start menu commands

After program startup, ITDT-SE displays the start screen menu.

```
IBM Tape Diagnostic Tool Standard Edition - Version:9.3.0.20181029


Diagnostic and Maintenance Functions:
[S] Scan for tape drives and enter Diagnostic/Maintenance Mode
[H] Help
[Q] Quit program

Notes:
- During a test, user data on the cartridge will be erased!
- Make sure no other program is accessing the devices used by ITDT!
- A device scan may take several minutes in some cases!


Expert Functions for known devices:
[U] Tapeutil
[A] Add Device Manually
[P] Preferences




:[H] Help | [Q] Quit | Command > []
```

Figure 20. Start screen menu

The following commands are available on the start screen menu:

- [S] Scan for tape drives and enter Diagnostic/Maintenance Mode

  Opens the screen for the Scan function (refer to "Standard Edition - Scan menu commands" on page 135).
- [H] Help

Help starts and displays the available online help.

- [Q] Quit program

  Quits the program.

- [U] Tapeutil

  Opens the screen for the *Tapeutil* operation commands. These commands are the standardized *tapeutil* functions with most of the options available that were available with the previous tapeutil functions (refer to "Standard Edition - Tapeutil menu commands" on page 152).

- [A] Add Device Manually

  Opens the screen for specifying a device manually instead of using the Scan function.

- [P] Preferences

  Opens the dialog where default program settings can be defined and altered.

Standard Edition - Scan menu commands

When ITDT-SE is used after **S** is entered on the start screen, the Scan function starts and displays the first device list screen.


```
IBM Tape Diagnostic Tool Standard Edition  - Device List

        Host Bus  ID   LUN  Model          Serial        Fware  Changer      [#]
      +----+----+----+----+----+-------------+------------+------+-----------+-+
      | 0  | 2  | 0  | 8  | 0  | ULT3580-HH6 | 1013000112 | E4J1 |           | |
      | 1  | 3  | 0  | 0  | 0  | 03592E05    | 00001365271| 1F05 |           | |
      | 2  | 3  | 0  | 1  | 0  | ULT3580-HH5 | 9068030258 | D8D5 | 78G8705_LL0| |
      | 3  | 3  | 0  | 2  | 0  | ULT3580-HH6 | 10WT023884 | E6R3 | 78G8705_LL0| |
      | 4  | 3  | 0  | 2  | 1  | 3573-TL     | 78G8705_LL0| A.60 |           | |
      | 5  | 5  | 0  | 0  | 0  | ULTRIUM-HH5 | 1068048260 | D8D5 |           | |
      | 6  |    |    |    |    |             |            |      |           | |
      | 7  |    |    |    |    |             |            |      |           | |
      | 8  |    |    |    |    |             |            |      |           | |
      | 9  |    |    |    |    |             |            |      |           | |
      +----+----+----+----+----+-------------+------------+------+-----------+-+

       Please select a device by entering the number in the leftmost column
       of the list followed by enter.
    [S] Scan


    [H] Help    [M] Main Menu  [V] Toggle View
    <[Q] Quit | [P] Previous | [N] Next | Line # | Command >
```

Figure 21. Scan screen menu

To select a device, enter a number from the leftmost column, then click **Enter**.

Entering the **M** command returns to the **Start Screen** menu. Entering the **V** command toggles between displaying the physical device address and the driver name.

```
        IBM Tape Diagnostic Tool Standard Edition  - Device List

          Host Bus  ID   LUN  Model           Serial        Fware  Changer       [#]
       +----+----+----+----+----+--------------+------------+------+-----------+-+
       | 0  | 2  | 0  | 8  | 0  | ULT3580-HH6  | 1013000112 | E4J1 |           |X|
       | 1  | 3  | 0  | 0  | 0  | 03592E05     | 00001365271| 1F05 |           | |
       | 2  | 3  | 0  | 1  | 0  | ULT3580-HH5  | 9068030258 | D8D5 | 78G8705_LL0| |
       | 3  | 3  | 0  | 2  | 0  | ULT3580-HH6  | 10WT023884 | E6R3 | 78G8705_LL0| |
       | 4  | 3  | 0  | 2  | 1  | 3573-TL      | 78G8705_LL0| A.60 |           | |
       | 5  | 5  | 0  | 0  | 0  | ULTRIUM-HH5  | 1068048260 | D8D5 |           | |
       | 6  |    |    |    |    |              |            |      |           | |
       | 7  |    |    |    |    |              |            |      |           | |
       | 8  |    |    |    |    |              |            |      |           | |
       | 9  |    |    |    |    |              |            |      |           | |

       +----+----+----+----+----+--------------+------------+------+-----------+-+


       [S] Scan          [T] Health Test   [D] Dump          [F] Firmware Update
       [Y] sYstem Test   [J] eJect Cartrid.[A] CleAning Stat.


       [H] Help   [M] Main Menu   [V] Toggle View   [O] Other Functions...
       <[Q] Quit | [P] Previous | [N] Next | Line # | Command >
```

Figure 22. Scan screen second menu

This screen contains the **S, T, D, F, Y, J,** and **A** commands. Entering the 0 command displays the second device list screen. The second screen contains the **W, U, K, L, I, E, C,** and **R** commands.

The following commands are described:

- S - "Scan" on page 137
- T - "Health Test" on page 139
- D - "Dump" on page 141
- F - "Firmware Update" on page 142
- Y - "System Test" on page 144
- J - "Eject Cartridge" on page 145
- A - "Cleaning Statistics" on page 145
- O - "Other Functions" on page 145

```
        IBM Tape Diagnostic Tool Standard Edition  - Device List

        Host Bus  ID   LUN  Model          Serial       Fware  Changer       [#]
      +----+----+----+----+----+--------------+------------+------+------------+-+
      | 0  | 2  | 0  | 8  | 0  | ULT3580-HH6  | 1013000112 | E4J1 |            |X|
      | 1  | 3  | 0  | 0  | 0  | 03592E05     | 00001365271| 1F05 |            | |
      | 2  | 3  | 0  | 1  | 0  | ULT3580-HH5  | 9068030258 | D8D5 | 78G8705_LL0| |
      | 3  | 3  | 0  | 2  | 0  | ULT3580-HH6  | 10WT023884 | E6R3 | 78G8705_LL0| |
      | 4  | 3  | 0  | 2  | 1  | 3573-TL      | 78G8705_LL0| A.60 |            | |
      | 5  | 5  | 0  | 0  | 0  | ULTRIUM-HH5  | 1068048260 | D8D5 |            | |
      | 6  |    |    |    |    |              |            |      |            | |
      | 7  |    |    |    |    |              |            |      |            | |
      | 8  |    |    |    |    |              |            |      |            | |
      | 9  |    |    |    |    |              |            |      |            | |
      +----+----+----+----+----+--------------+------------+------+------------+-+


      [W] Full Write      [U] Tape Usage      [K] Check LTFS Readiness
      [L] Library Test    [I] lIb. Media Screening
      [E] Encryption      [C] Config.TCP/IP

      [H] Help    [M] Main Menu   [V] Toggle View   [R] Return
     <[Q] Quit | [P] Previous | [N] Next | Line # | Command >
```

Figure 23. More scan options

- W - "Full Write" on page 146
- U - "Tape Usage" on page 147
- K - "Check LTFS Readiness" on page 148
- L - "Library Test" on page 148
- I - "Library Media Screening" on page 148
- E - "Encryption" on page 149
- C - "Configure TCP/IP" on page 151
- R - "Return" on page 152

Scan

The Scan function [S] is used to discover all supported tape and library devices that are attached to the computer system so that they can be selected for the subsequent ITDT-SE operations. The scan function also serves as a connection test that can be used to verify correct attachment of the devices.

Make sure that no other program is accessing the devices that are used by ITDT-SE. For example, stop the backup jobs that are accessing the devices when ITDT-SE is used, or if not sure, stop the entire backup application.

After ITDT-SE is started, type S followed by **Enter** to activate the scan function.

Depending on the operating system and the number of attached drives, the scan can take several minutes. See "Standard Edition - known issues and limitations" on page 131 for details.

During the scan operation, a bar in the lower left edge of the screen shows that the scan operation is still in progress.

When the scan is finished, the first device list screen is displayed.

Labels around the figure:
- Name of current screen
- Device number
- If marked with an X, the device is selected
- Commands
- Command prompt

Screen content:

```
        IBM Tape Diagnostic Tool Standard Edition  - Device List

       Host Bus  ID  LUN  Model        Serial       Fware  Changer      [#]
     +----+----+----+----+------------+------------+------+------------+-+-+
     | 0 | 2 | 0 | 8 | 0 | ULT3580-HH6 | 1013000112 | E4J1 |            |X| |
     | 1 | 3 | 0 | 0 | 0 | 03592E05    | 00001365271 | 1F05 |            | | |
     | 2 | 3 | 0 | 1 | 0 | ULT3580-HH5 | 9068030258 | D8D5 | 78G8705_LL0| | |
     | 3 | 3 | 0 | 2 | 0 | ULT3580-HH6 | 10WT023884 | E6R3 | 78G8705_LL0| | |
     | 4 | 3 | 0 | 2 | 1 | 3573-TL     | 78G8705_LL0| A.60 |            | | |
     | 5 | 5 | 0 | 0 | 0 | ULTRIUM-HH5 | 1068048260 | D8D5 |            | | |
     | 6 |   |   |   |   |             |            |      |            | | |
     | 7 |   |   |   |   |             |            |      |            | | |
     | 8 |   |   |   |   |             |            |      |            | | |
     | 9 |   |   |   |   |             |            |      |            | | |
     +----+----+----+----+------------+------------+------+------------+-+-+

     [S] Scan         [T] Health Test   [D] Dump        [F] Firmware Update
     [Y] sYstem Test  [J] eJect Cartrid.[A] CleAning Stat.

     [H] Help   [M] Main Menu  [V] Toggle View   [O] Other Functions...
     <[Q] Quit | [P] Previous | [N] Next | Line # | Command >
```

Figure 24. Device List screen

The first device list screen shows all detected devices and the connection information (host adapter number, bus number, SCSI/FCP ID, and LUN or driver name) along with product data (Model name, Unit Serial number, Microcode revision). For drives that are attached to a library, the Changer column shows the serial number of the changer the drive is attached to.

Scrollable data is indicated by "VVVVVVVVV" in the bottom border of the table. To view the non-displayed entries, type + and press **Enter**.

Note: For fast down scrolling, type + followed by a space and the number of lines to scroll down, then press **Enter**. Alternately, type N and press **Enter** to scroll down one page.

To scroll back, use **-** instead of **+**.

Note: For fast up (backward) scrolling, type - followed by a space and the number of lines to scroll up. Press **Enter**, or type P and press **Enter** to scroll up one page.

If no devices appear or if devices are missing in the list, make sure that

- ITDT-SE is running with administrator/root rights.
- The devices are properly attached and powered on.
- Linux: The devices must be attached at boot time.
- i5/OS: Only tape drives are detected.
- Solaris, when no IBM tape device driver is in use:
  - Ensure that sgen is correctly configured.

    ```
    file /kernel/drv/sgen.conf
    ```

    is correctly configured (see "Starting ITDT-SE on Solaris operating systems" on page 128).
  - Solaris 10, see (see "Standard Edition - known issues and limitations" on page 131)
- More than 10 devices displayed - scroll down the Device List.

ITDT-SE uses the IBM Tape Device Driver for its operations. If no IBM Tape Device Driver is installed, the generic device driver for the operating system is used instead. On Microsoft Windows, any Tape Device Driver that is installed is used.

If you must bypass the IBM Tape Device Driver for diagnostic purposes, start ITDT-SE with the following command.

```
itdt -force-generic-dd
```

Note: For operating system-specific information on how to use this command, see the corresponding Initial Startup sections.

When the wanted device is displayed, select the device for test. Only one device can be selected at a time.

Health Test

The Health Test function [T] checks if the tape device is defective and outputs a pass/fail result.

⚠️ **Attention:** The health test function erases user data on the cartridge that is used for the test.

For the library or autoloader test, the Library Test [L] must be selected.

Note:

1. The test can take from 15 minutes up to 2 hours.

2. The test runs only on tape drives, not on autoloaders or libraries.

To complete the test function, it is recommended that a new or rarely used cartridge is used. Scaled (capacity-reduced) cartridges must not be used to test the device.

To test tape drives within a library, the library must be in online mode.

1. Start ITDT-SE, then type S and press **Enter** to scan for the devices.

2. Select the device that you want to test by entering its number and press **Enter**.

3. Type T followed by **Enter** to activate the test.

If no cartridge is inserted, ITDT-SE prompts to insert a cartridge. Either insert a cartridge and press **Enter** or stop the test by entering C followed by **Enter**.

Note: If ITDT-SE detects data on the cartridge, the Device Test screen displays a message (as shown in Figure 25 on page 139.

Figure 25. Data Delete question

Type Y followed by **Enter** to continue the test if you are sure that data on the cartridge can be overwritten. If you are unsure, type N followed by **Enter** to stop the test.

During the test, the program shows a progress indicator in the form of a bar of number signs (#) (**1**) that shows the progress of a single subtest and also a description of that subtest. The user might stop the test by selecting the [A]Abort option (exception: POST A).

During the test, a progress indicator (**1**) is shown on the test screen. Messages from the test steps are shown in the **Status** field (**2**).

Figure 26. Test running

The test sequence contains the following steps.

1. Initialize Device
2. Read Thermal Sensor (might get skipped)
3. Mount Medium
4. [Medium Qualification] - only if the previous step indicated this requirement
5. Load/Write/Unload/Read/Verify
6. POST A
7. Performance Test (run 2 times if first run failed with performance failure)
8. Unmount Medium
9. Read Thermal Sensor (might get skipped)
10. Get FSC
11. Get Logs

The test can be stopped by typing A followed by **Enter** at any time except during the POST test, which is not interruptible.

Note: It might take some time until the test stops.

Figure 27. Test results

When all subtests are finished, ITDT-SE shows a screen that displays the attachment and device information as in the first device list screen. It also shows the test result and failure information in the code field. The screen also shows the output files that were generated during the test run. The files might be requested by the IBM Support Center.

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to the first device list screen. Otherwise, type Q followed by **Enter** to exit the program.

Dump

Complete the following steps to start the Dump [D] process.

1. Start ITDT-SE, then type S and press **Enter** to scan for the devices.

2. Select the device that you want to retrieve a dump from by entering its number and pressing **Enter**.

3. Type D and press **Enter** to start the dump retrieval for the selected device. The ongoing dump process is completed (it takes less than 1 minute).

Figure 28. Dump

When the dump process is completed on a tape library or autoloader other than the 3584/TS3500/TS4500, the Dump function stores 1 log file in the output folder of the program (*.blz). For the 3584/TS3500/TS4500, a dump file (*.a) is stored in the output folder.

Note: When the Dump function is completed for tape libraries or autoloaders other than the 3584/TS3500/TS4500, the log file contains only Log Sense and Mode Sense pages, while a Drive or 3584/TS3500/TS4500 dump contains much more diagnostic information.

Retrieve the files from the ITDT-SE output subdirectory that was created during the installation. The following are examples of the directory:

- Example output directory (Windows): `c:\ITDT\output`
- Example output directory (UNIX): `/home/user/ITDT/output`
- Example output directory (i5/OS): `/home/ITDT/output`

  (On the IFS) use FTP or the System i Navigator to transfer the file

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to the device list; otherwise, type Q followed by **Enter** to exit the program.

Firmware Update

The Firmware Update [F] upgrades the firmware of tape drives and tape libraries.

Note: See "TS3310 and TS4500 tape libraries" on page 134 for information on how to update the firmware on TS3310 or TS4500 tape libraries.

```
IBM Tape Diagnostic Tool Standard Edition  - Firmware Update

  Host Bus  ID   LUN  Model          Serial       Fware  Changer
  +----+----+----+----+--------------+-----------+------+-----------+
  | 0  | 0  | 0  | 0  | ULT3580-TD4  | 1300001016 | 8197 | IBM0600_LL0|
  +----+----+----+----+--------------+-----------+------+-----------+
       +---------------------------------------------------------+
FW Dir:  | /tmp/itdt/ITDT/input/                                  |
       +---------------------------------------------------------+
                                                      [#]
       +---+-----------------------------------+-+       +------+
Content: | 0 |   IBM_3573_6_90.fbi             | |  Dir OK: | true |
         | 1 |   df080109b_8192.FC.ro          | |       +------+
         | 2 |   df080109g_8197.FC.ro          | |
         | 3 |   IBM_3573_6_70.fbi             | |   [F] FW Directory
         | 4 |                                 | |   [D] Dir Refresh
         | 5 |                                 | |   [H] Help
         | 6 |                                 | |   [R] Return
         | 7 |                                 | |
         | 8 |                                 | |   [C] Continue
         | 9 |                                 | |
       +---+-----------------------------------+-+
[Q] Quit | + | - | [N] Next | [P] Previous | Command >
```

Figure 29. Firmware Update screen

The following site is available for the latest firmware files: http://www.ibm.com/systems/support/storage/tape

Download the files to the ITDT-SE input subdirectory that was created during the installation. The following are examples of the directory:

```
        Example input directory (Windows): c:\ITDT\input

        Example input directory (Unix): /home/user/ITDT/input

        Example input directory (i5/OS): /home/ITDT/input
            (on the IFS) use FTP or the i-Series Navigator to transfer the file
```

To do a Firmware Update, complete the following steps:

1. Start ITDT-SE, then type S and press **Enter** to scan for the devices.
2. Select the device that you want to update by typing the number of the device and pressing **Enter**.
3. Type F and press **Enter** to display the **Firmware Update** screen.
4. To select the needed firmware update, complete one of the following steps:
   - If the downloaded firmware file is listed in the **Content** field of the **Firmware Update** screen, type the corresponding line number and press **Enter**.
   - If the firmware file is stored in a directory other than **FW Dir**, type F followed by a space and the fully qualified path to the directory that contains the firmware file, then press **Enter**.

     For example, enter the following to change the firmware directory (UNIX):

     ```
     f /home/user/firmware
     ```

   - If no files are displayed in the **Content** field, check the **Dir OK** field on the right side of the screen. It indicates true if the directory exists, false otherwise.
   - If the content of the displayed **FW Dir** changed, type D and press **Enter** to refresh the directory content.

     Note: The selected file name is reset to the first item (#0) after the Refresh function is used.

   - If the displayed directory contains more files than the files shown, type + and press **Enter** to scroll down the list. For fast down scrolling type + followed by a space and the number of lines to scroll down then press **Enter**. To scroll back, use – instead of +.

     Scrollable data is indicated by "VVVVVVVVVVVVVVVVV".

```
IBM Tape Diagnostic Tool Standard Edition  - Firmware Update

 Host Bus  ID   LUN  Model          Serial       Fware  Changer
+----+----+----+----+--------------+-----------+------+-----------+
| 0  | 0  | 0  | 0  | ULT3580-TD4  | 1300001016 | 8197 | IBM0600_LL0|
+----+----+----+----+--------------+-----------+------+-----------+
        +----------------------------------------------------------+
FW Dir: | /tmp/Firmware/                                           |
        +----------------------------------------------------------+
                                                      [#]
        +---+-----------------------------------------+-+    +-----+
Content:| 0 | df070308a_7381.SAS.ro                   | |    Dir OK: | true |
        | 1 | df070417d_74H4.FC.ro                    | |           +-----+
        | 2 | df080319o_83KF.FC.ro                    | |
        | 3 | df070308a_7381.FC.ro                    | |    [F] FW Directory
        | 4 | df070417d_74H4.ro                       | |    [D] Dir Refresh
        | 5 | df070308a_7381.ro                       | |    [H] Help
        | 6 | df070308d_7384.FC.ro                    | |    [R] Return
        | 7 | df070308d_7384.ro                       | |
        | 8 | df070417d_74H4.SAS.ro                   | |    [C] Continue
        | 9 | df0080402p_842G.FC.ro                   | |
        +VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV+-+
[Q] Quit | + | - | [N] Next | [P] Previous | Command >
```

VVVVV
=
more data

Figure 30. Scrollable Data screen

5. After the firmware file is selected, type C and press **Enter** to continue.
6. Before the firmware update is started, make sure the file that is displayed in the **FW File** field is the correct file.
   - If the correct file is displayed, proceed to the next step.
   - If the correct file is not displayed, type C and press **Enter** to change the selected firmware file. Go to Step 4.

     Note: The selected file name is reset to the first item in the list when you return to that dialog from the Start Update dialog.

7. If you decide to run the firmware update, type S and press **Enter** to start the firmware update.

During the firmware update, a firmware update progress screen is displayed.

⚠️ **Attention:** Once started, do not interrupt the firmware update.

The firmware update usually takes 3-5 minutes, but it can take up to 45 minutes for libraries. If you decide not to run the firmware update, type R and press **Enter** to return to the Device List.

Note: If ITDT-SE detects FIPS-certified drive firmware, it displays a warning dialog. Before you continue, ensure that you use FIPS-certified firmware to update the drive.

8. After completion, the **Status** field on the lower right side indicates PASSED if the firmware was updated successfully and FAILED otherwise.

   Type R and press **Enter** to return to the Device List.

System Test

The System Test [Y] is a short test that completes the following steps:

- Reveals system performance bottlenecks. Compressible data throughput values can reveal bandwidth limitations that are caused by the system, cabling, or HBA.
- Measures performance variations across the different block sizes to find the ideal block size for the system configuration.

The System Test runs only on tape drives, not on autoloaders or libraries. To complete a System Test on tape drives within a library, the library must be in online mode.

1. Start ITDT-SE, type S, and press **Enter** to scan for the devices.
2. Type Y and press **Enter** to start the System Test.

   ITDT-SE then switches to the System Test screen. If no cartridge is inserted, ITDT-SE prompts to insert a cartridge. Either insert a cartridge and press **Enter** or stop the test by typing C followed by **Enter**.

   Note: If ITDT-SE detects data on the cartridge, it shows the System Test screen, and displays the following message.

   ```
   Cartridge not empty!
     Overwrite data?
   ```

   Type Y followed by **Enter** to continue the test if you are sure that data on the cartridge can be overwritten. If you are unsure, type N followed by **Enter** to stop the test.

   The System Test is completed as follows:

   a. System Test determines the amount of data to write for each supported blocksize (a percentage of the cartridge is written for each blocksize).
   b. The test determines the maximum supported blocksize of the system.
   c. Next, the System Test writes the calculated size with all supported block sizes in powers of two down to 64kB (at maximum 1024, 512, 256, 128, 64), first with incompressible data, then with compressible data.
   d. At the end of the test, a summary screen is displayed.

```
    IBM Tape Diagnostic Tool Standard Edition  - System Test

    Model          Serial      Fware          Result:
    +--------------+-----------+------+        +--------------------+
    | ULT3580-TD4  | F09789A000| 89B2 |        | PASSED             |
    +--------------+-----------+------+        +--------------------+
                                               Code:
    Compres- Transfer  Data Size Elapsed Data Rate  +--------------------+
     sible   Size (KB)   (MB)    Time (s)  (MB/s)   | OK                 |
    +------+---------+---------+-------+----------+  +--------------------+
    | No   | 512     | 953     | 12.684| 75.1734  |
    | No   | 256     | 953     | 13.245| 71.9894  |
    | No   | 128     | 953     | 13.26 | 71.9174  |  Text Log:
    | No   | 64      | 953     | 13.256| 71.9391  |  +--------------------+
    | Yes  | 512     | 953     | 4.501 | 211.842  |  | 1013000112.004.txt |
    | Yes  | 256     | 953     | 4.922 | 193.722  |  +--------------------+
    | Yes  | 128     | 953     | 6.279 | 151.875  |
    | Yes  | 64      | 953     | 9.002 | 105.935  |  Bin Log:
    |      |         |         |       |          |  +--------------------+
    |      |         |         |       |          |  | 1013000112.004.blz |
    +------+---------+---------+-------+----------+  +--------------------+

    <[Q] Quit | + | - | [R] Return>
```

Figure 31. System Test results

"Compressible = Yes" means that the data written was just zeros so that the data is compressed by the drive with a maximum compression ratio. "Compressible = No" means that a data pattern was written that the drive almost cannot compress at all. If the compression ratio is 1, the drive was not able to compress the data (equivalent to 1:1 compression ratio). If the compression ratio is 94.0, the drive was able to do 94:1 compression, meaning that 94 bytes in the original data is compressed to 1 byte on the medium. 100.0 means 100 bytes is compressed down to 1 byte on the medium.

The System Test can be stopped by typing A followed by **Enter** at any time.

Note: It can take some time until the System Test stops.

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to the device list. Otherwise, press Q followed by **Enter** to exit the program.

Eject Cartridge

The Eject Cartridge [J] function unloads a cartridge from a tape drive.

1. Start ITDT-SE, then type S and press **Enter** to scan for the devices.

2. Select the device that you want to unload a cartridge from by entering its number and pressing **Enter**.

3. Type J and press **Enter** to unload a cartridge.

Cleaning Statistics

Cleaning Statistics [A] retrieves statistical data about cleaning actions. Some devices do not support this function.

1. Start ITDT-SE, type S, and press **Enter** to scan for the devices.

2. Select the device that you want to retrieve cleaning statistics from by entering its number and pressing **Enter**.

3. Type A and press **Enter** to start the cleaning statistics retrieval for the selected device.

Other Functions

Other Functions [O] - type 0 followed by **Enter** to display a screen with the following commands:

- W - "Full Write" on page 146
- U - "Tape Usage" on page 147
- K - "Check LTFS Readiness" on page 148

- L - "Library Test" on page 148
- I - "Library Media Screening" on page 148
- E - "Encryption" on page 149
- C - "Configure TCP/IP" on page 151
- R - "Return" on page 152

Full Write

The Full Write [F] function writes the entire cartridge with a specified block size either with compressible or incompressible data and output performance data.

⚠️ **Attention:** The Full Write function erases data on the cartridge that is used for the test.

Note:

1. The Full Write function takes approximately 2 hours when incompressible data is written, less time for compressible data.
2. The Full Write function runs only on tape drives, not on autoloaders or libraries.

The Full Write test can be used to

- Demonstrate that the drive can write the full amount of data on a cartridge.
- Identify system issues with compression.

  Drive data compression is always turned on during the full write. When run with compressible data, the output shows the compression rate. If the compression rate is higher than 1.0 but the system does not appear to be able to compress data on the cartridge, check the device driver and software settings to see whether they disable compression.

1. After ITDT-SE is started, type S followed by **Enter** to activate the device scan.
2. Select the device that you want to write to by entering its number and press **Enter**.
3. Type W and press **Enter** to start the full write.

   ITDT-SE then switches to the Full Write screen. If no cartridge is inserted, ITDT-SE prompts to insert a cartridge. Either insert a cartridge and press **Enter** or stop the test by typing C followed by **Enter**.

   Note: If ITDT-SE detects data on the cartridge, it shows the Full Write screen, and displays the following message:

   ```
   Cartridge not empty!
     Overwrite data?
   ```

   Type Y followed by **Enter** to continue the test if you are sure that data on the cartridge can be overwritten. If you are unsure, type N followed by **Enter** to stop the test.
4. The system prompts for entry of a transfer size between 16 KB and the maximum block size that is supported by the system (maximum value is 1024 KB). This action is a check for the type of supported block size that is completed. Enter the appropriate values for your system.

   Note: Values of 16 KB and 32 KB are not tested in cases where the capability of a system supports higher block sizes.
5. Select the type of data to write, either **[C] Compressible** or **[I] Incompressible**.

   During the full write, the program shows a progress indicator in form of a bar of number signs (#) that shows the progress of the full write.

   The full write can be stopped by typing A followed by **Enter** at any time.

   Note: It can take some time until the full write stops.

   If all write operations are finished, ITDT-SE shows a screen that displays the compression ratio (**1**) and the write performance (shown in **2** as the Data Rate) for the selected block size. If an error occurred during the full write, data is only written partially.

"Compressible = Yes" means that the data written was just zeros so that the data is compressed by the drive with a maximum compression ratio. "Compressible = No" means that a data pattern was written that the drive almost cannot compress at all. If the compression ratio is 1, the drive was not able to compress the data (equivalent to 1:1 compression ratio). If the compression ratio is 94.0, the drive was able to do 94:1 compression, meaning that 94 bytes in the original data is compressed to 1 byte on the medium. 100.0 means 100 bytes is compressed down to 1 byte on the medium.

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to option 4 the device list. Otherwise, type Q followed by **Enter** to exit the program.

Figure 32. Full Write results

Tape Usage

The Tape Usage [U] function retrieves statistical data and error counters from a cartridge.

Figure 33. Tape Usage screen

1. After ITDT-SE is started, type S followed by **Enter** to activate the device scan.
2. Select the device that you want to test by entering its number and press **Enter**.

3. Type U followed by **Enter** to start the tape usage log retrieval. ITDT-SE then switches to the tape usage screen. If no cartridge is inserted, ITDT-SE prompts to insert a cartridge. Either insert a cartridge and press **Enter** or stop the test by entering C followed by **Enter**.

During the get logs operation, the program shows a progress indicator in form of a bar of number signs (#) that shows the progress of a single suboperation and a description of that operation.

When all suboperations are finished, ITDT-SE shows a **Tape Usage** completion screen. The **Status** field on the lower right side indicates PASSED if the log retrieval completed successfully and ABORTED otherwise.

Check LTFS Readiness

The Check LTFS Readiness test analyzes the operating system and tape drive environment to ensure that the IBM linear tape file system can be installed. This test checks the operating system version, the tape device driver version, the tape drive firmware, and the LTFS HBA requirements.

Note: The tape drive firmware must be at least version: C7RC (for LTO 5), C974 (for LTO 6), and 36A5 (for TS1140 and TS1150). The LTFS Readiness Check requires an empty data cartridge. The maximum transfer size is detected at the beginning of the test. If it is under 512kB, a warning is displayed. If it is under 256kB, the test fails.

The LTFS Readiness Check can return with result FAILED and one of the following error codes.

Table 22. Codes and root causes.

Code	Root causes
LTFS CDB LENGTH	Unsupported SCSI 16 Byte command.
LTFS CARTRIDGE TYPE	Cartridge Density Code is not supported.
LFTS XFER SIZE	Supported block size is too less.
LTFS PARTITION SUPPORT	Partitioning commands are not supported.
LTFS FW LEVEL	Unsupported Tape Device firmware level.
LTFS DATA TRANSFER SIZE	Data Integrity Test failed.
LTFS DD VERSION	IBM Tape Device Driver version is not supported.
LTFS OPERATING SYSTEM	Operating system is not supported.

Library Test

The Library Test [L] starts and monitors the library-internal self-test. This test runs only on libraries and autoloaders, not on tape drives.

1. Start ITDT-SE, type S, and press **Enter** to scan for the devices.
2. Type 0 and press **Enter** to display the second device list screen.
3. On the second device list screen, type L and press **Enter** to start the Library Test.

   A Device Test screen is displayed and a functionality test on the tape library is completed.

   At the end of the test, a results screen is displayed.

   The Library Test can be stopped by typing A followed by **Enter** at any time.

   Note: It can take some time until the Library Test stops.

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to the device list; otherwise press Q followed by **Enter** to exit the program.

Library Media Screening

Library Media Screening [L] generates dumps for each drive and cartridge within a library. It runs only on libraries (except TS3500/TS4500) and auto-loaders, not on tape drives.

First, the test tries to read dump files from each drive that is installed from the library. After that, the customer must select one drive for loading the cartridges.

All cartridges of the I/O and storage slots are moved - one after the other - from their source to the selected drive. A dump is taken and moved back to the source address.

In the result screen, the dumps taken and the count of dumps are displayed.

Encryption

The Encryption [E] function is used to verify whether data on the cartridge was written encrypted. It reads both decrypted and raw data from the cartridge into two separate files on disk. The user can then verify that the data differs to ensure that encryption worked.

The Encryption function does not provide a Write - Read test.

The Encryption function is supported only on encryption enabled drives. It requires that an encryption infrastructure, including the Encryption Key Manager (EKM), is properly set up. An encrypted data cartridge must be used.

The Encryption function is supported for the following encryption environments:

- System Managed: IBM tape device driver must be installed and in use by ITDT to read decrypted data
- Library Managed
- Application Managed: Only raw encrypted data is read (result file *.ENC)

Note: On i5/OS, media changers and media changer operations are not supported by this release of ITDT-SE. To test a tape drive inside a library, the tape drive must be varied online and the tape library must be varied offline (see "Starting ITDT-SE on i5/OS operating systems" on page 130 for details). As the library is varied offline, the Encryption function does not deliver decrypted data in a Library Managed Encryption environment.

1. After ITDT-SE is started, type S followed by **Enter** to activate the device scan.
2. Select the device that you want to test by entering its number and press **Enter**.
3. Type E and press **Enter** to start the encryption test. ITDT-SE then switches to the **Encryption Verification** screen. On this screen, the system requires the entry of the number of the start record and the amount of data (in KB) to be read.
4. Type S followed by a space and the start record number, then press **Enter** to enter the start record number. Type L followed by a blank and the data length, then press **Enter** to enter the data length, maximum 100000 KB.

```
IBM Tape Diagnostic Tool Standard Edition  - Device Test

              +-------------------+                +---------------+
Model:        |+-----------------------------------------+365056  |
              +|                                          |--------+
               |   ITDT - Encryption Verification         |
              +|                                          |--------+
Host:         ||                         +-----------+    |        |
              +|    [S] Start Record:    | 0         |    |--------+
Bus:          ||                         +-----------+    |        |
              +|                                          |--------+
               |                         +-----------+    |
              +|    [L] Data Length(kB)  | 10000     |    |------------+
Progress:     ||                         +-----------+    |            |
              +|                                          |------------+
               |                                          |
               +------------------------------------------+

       [A] Abort



  < [Enter] OK  |[S] Start Record |[L] Length |[C] Cancel >
```
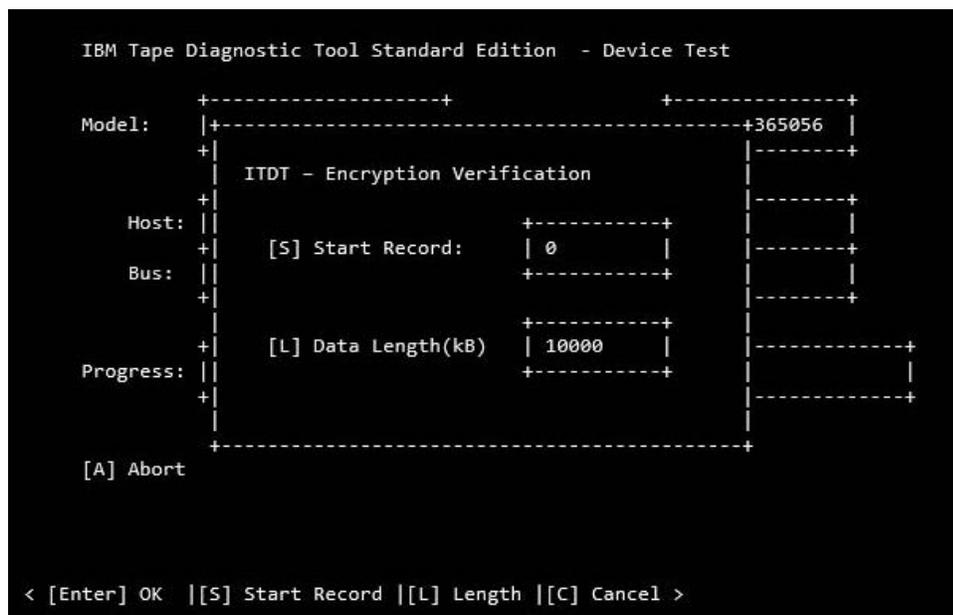
Figure 34. Encryption Start screen

5. If you entered the values correctly, press **Enter** to start the encryption.

   During the encryption, the program shows a progress indicator in form of a bar of number signs (#) that shows the progress of a single subtest and information about that subtest.

   The Encryption function can be stopped by typing A followed by **Enter** at any time.

   Note: It can take some time before the Encryption function stops.

If all encryption operations are finished, ITDT-SE shows a screen that displays the **Status** field on the lower left side that indicates PASSED if the encrypted test completed successfully and ABORTED otherwise.

The screen also shows the output files that were generated during the Encryption function:

• file *serial#* .n.**ENC** contains the raw encrypted data

• file *serial#* .n.**DEC** contains the decrypted data

Table 23 on page 150 defines the abort codes.

Table 23. Abort code definitions	
ABORT CODE	**ROOT CAUSE**
LOCATE FAILED	Start position as requested by the user was not reached
MEDIUM NOT ENCRYPTED	ITDT detected medium as non-encrypted
NO DRIVER SPECIAL FILE	System-Managed environment, but generic device file is used instead of IBM device driver special file
DRIVE ENCRYPTION DISABLED	Mode Sense detected disabled drive encryption
UNEXPECTED DATA	• Set Raw read mode failed • One of the commands failed
END OF MEDIUM	End of medium that is encountered before the specified amount of data was read
END OF DATA	End of data that is encountered before the specified amount of data was read

Table 23. Abort code definitions (continued)	
ABORT CODE	**ROOT CAUSE**
READ FAILED	
ENCRYPTION ERROR	
INVALID PARAMETER	User entered data length of 0 kB
FILE IO ERROR	The hard drive that ITDT is installed on might have run out of space.

If you want to use other ITDT-SE functions, type R followed by **Enter** to return to the device list. Otherwise, type Q followed by **Enter** to exit the program.

Configure TCP/IP

Configure TCP/IP [C] configures the ethernet port settings of LTO 5, TS1140, and later drives. For those drives, the current settings are read and displayed and can be changed.

Note: LTO drives have one port and TS1140 and later drives have two ports that can be configured. Configuring the ethernet ports must not be done in a TS3500/TS4500. Although the ports can be configured, it is ineffective.

1. Start ITDT-SE, type S, and press **Enter** to scan for the devices.
2. Select a device from the list (just the ones that are listed are supported) by entering the number, then press **Enter**.
3. Type 0 and press **Enter** to display the second device list screen.
4. On the second device list screen, type C and press **Enter** to open the **Configure TCP/IP** screen.

ITDT-SE switches to the **Configure TCP/IP** screen and reads the data configuration of port 1. To toggle between port 1 and 2, type P and press **Enter**.


```
    ITDT- Configure TCP/IP Port 1

  Host Bus  ID   LUN  Model          Serial       Fware  Device
  +----+----+----+----+-------------+-----------+------+--------------------+
  | 3  | 0  | 0  | 0  | ULT3580-HH5 | 1068000051| B17A |                    |
  +----+----+----+----+-------------+-----------+------+--------------------+


                         +-+            Active IP Addresses
  [1] DHCP enabled       |0|       +---+-------------------------+
                    +-----------------+ | v4| 10.100.10.17        |
  [2] Address IPV4  | 10.100.10.17    | |   | 1111:2222:3333:4444:5555:6|
                    +----+----+------+ |   | 169.254.0.3         |
  [3] Subnet Mask Length V4 | 23 |      |   | FE80:0000:0000:0000:0221:5|
                    +---------------------+---+-------------------------+
  [4] Address IPV6     | 1111:2222:3333:4444:5555:6666:7777:8888 |
                    +----+----+----------------------------+
  [5] Subnet Mask Length V6 | 112|
                         +----+


  [P] Port 2 Settings

  [A] Apply
  <[R] Return | [Q] Quit | Command >
```

Figure 35. TCP/IP screen: Read data

Each parameter can be set by entering the number (1 - 5) and a following value. If you want to enable DHCP, enter '1 1' and press **Enter**. The value of the **DHCP** field is refreshed with the value entered.

The values for both ports are applied to the drive by entering A and pressing **Enter**. ITDT-SE configures the drive and the current active addresses are shown in the field: **Active IP Addresses**. Regular field values:

```
[1] DHCP enabled:              0/1 (false/true)
[2] Address IPV4               Regular IPv4 address
[3] Subnet Mask Length V4:     0...23
[4] Address IPV6:              Regular IPv6 address
[5] Subnet Mask Length V4:     0...127
```

If you want to use other ITDT-SE functions, type R, then press **Enter** to return to the device list. Or, press Q and **Enter** to exit the program.

Return

Return [R] - type R followed by **Enter** to go back to the first device list screen.

Standard Edition - Tapeutil menu commands

When the user runs the **U** command on the ITDT-SE start screen, the Tapeutil operation screen is displayed.

Note: On any screen, to start a command, press the shortkey displayed in brackets [ ], followed by **Enter**.

The following commands are described in this section:

[1] Open a Device

When you select the **Open a Device** command [1]:

1. ITDT checks if a device is already opened.
2. You are prompted for a device special file name.
3. You are prompted for an open mode (rw, ro, wo, append).
4. ITDT opens the device that you selected.

Note: Always use the Read Only mode when you are working with write-protected media.

The combination of open cmd with parameter **-force-generic-dd** is not supported.

Device file names - device addressing

ITDT supports generic and Device Driver claimed devices. This section shows examples for device names (addressing) of all supported platforms. The used abbreviations stand for:

host	Number of the host adapter (SCSI, FC, SAS)
bus	Number of the bus from the host adapter
target	Target Number of the device
lun	Logical Unit Number of the device that is separated with blanks.

Note: The correct IDs are reported in the ITDT Control Center after a scan or with the scripting function "scan".

Table 24. Device addressing			
	IBM Tape Device Driver	**Generic IDs separated with blanks**	**Generic (alternative, as a result from ".itdt scan")**
IBM AIX	/dev/rmtX.Y /dev/smcX	<host><bus><target><lun>	H<host>-B<bus>-T<target>-L<lun>
Linux	/dev/IBMtapeX /dev/IBMchangerX		
Microsoft Windows	\\.\tape0 \\.\changer0		
Oracle Solaris	/dev/rmtXsmc /dev/smc/Xchng		
HP-UX	/dev/rmt/Xmnb /dev/rmt/Xchng		
Apple Mac	-	<host><bus><target><lun>	H<host>-B<bus>-T<target>-L<lun> tapeX changerX
IBM 'i'	-	-	Device Name; for example, TAP01

Example for Linux (IBM Tape Driver devices):

```
./itdt scan
Scanning SCSI Bus ...
#0 /dev/IBMchanger2 - [3573-TL]-[C.50] S/N:00L4U78D6118_LL0 H3-B0-T5-L1  (IBM-Device)
#1 /dev/IBMtape3 - [ULT3580-TD5]-[BBNE] S/N:1168001104 H3-B0-T5-L0
Changer: 00L4U78D6118_LL0 (IBM-Device)
Exit with code: 0
```

Example for Linux (generic Operating System devices):

```
./itdt -force-generic-dd scan
Scanning SCSI Bus ...
#0 /dev/sg7 - [3573-TL]-[C.50] S/N:00L4U78D6118_LL0 H3-B0-T2-L1  (Generic-Device)
#1 /dev/sg8 - [ULT3580-TD5]-[BBNE] S/N:1168001104 H3-B0-T5-L0
Changer: 00L4U78D6118_LL0 (Generic-Device)
Exit with code: 0
```

To open the tape device by using the IBM Tape Device Driver, use the **/dev/IBMtape3** as device file name. By using **H3-B0-T5-L0** or **3 0 5 0** as the device name, it is opened with the generic Operating System device driver.

[2] Close a Device

When you select the **Close a Device** command [2]:

1. ITDT checks if the device is already closed.
2. ITDT closes the device.

[3] Inquiry

When you select the **Inquiry** command [3]:

1. You are prompted for page code.
2. ITDT then displays a decoded format of a hexadecimal dump and prints a hexadecimal dump of the inquiry data.

[4] Test Unit Ready

When you select the **Test Unit Ready** (TUR) command [4], ITDT issues the Test Unit Ready *ioctl* command.

[5] Reserve Device

When you select the **Reserve Device** command [5], ITDT issues a reserve command for the device.

[6] Release Device

When you select the **Release Device** command [6], ITDT issues a release command for the device.

[7] Request Sense

When you select the **Request Sense** command [7]:

1. ITDT issues a **Request Sense** command.
2. ITDT then displays a decoded format of hexadecimal dump sense data and prints hexadecimal dump sense data.

[8] Log Sense

When you select the **Log Sense** command [8]:

1. You are prompted for Log Sense Page.
2. ITDT issues a mode sense command.
3. ITDT completes a hexadecimal dump page.

[9] Mode Sense

When you select the **Mode Sense** command [9]:

1. You are prompted for Mode Sense Page.
2. ITDT issues mode sense command.
3. ITDT completes a hexadecimal dump page.

[10] Query Driver Ver. (Version)

When you select the **Query Driver Version** command [10]:

1. ITDT issues the required command to get the driver version.
2. ITDT prints the driver version.

[11] Display All Paths

When you select the **Display All Paths** command [11]:

1. ITDT issues an *ioctl* command.
2. ITDT outputs decoded path information for all paths.

[12] Query Runtime Info

When you select the **Query Runtime Info** command [12]:

1. ITDT issues the required command to get the runtime info.
2. ITDT prints out the Dynamic Runtime Attribute Values.

[20] Rewind

When you select the **Rewind** command [20], ITDT issues the *ioctl* rewind command for the device.

[21] Forward Space File Marks

When you select the **Forward Space File Marks** command [21]:

1. You are prompted for the number of file marks to space forward.
2. ITDT issues (extrinsic) *ioctl* command.

[22] Backward Space File Marks

When you select the **Backward Space File Marks** command [22]:

1. You are prompted for the number of file marks.
2. ITDT issues (extrinsic) *ioctl* command.

[23] Forward Space Records

When you select the **Forward Space Records** command [23]:

1. You are prompted for the number of records to space forward.
2. ITDT issues (extrinsic) *ioctl* command.

[24] Backward Space Records

When you select the **Backward Space Records** command [24]:

1. You are prompted for the number of records to space backward.
2. ITDT issues (extrinsic) *ioctl* command.

[25] Space to End of Data

When you select the **Space to End of Data** (EOD) command [25], ITDT issues the (extrinsic) *ioctl* command.

[26] Read and Write Tests

When you select the **Read and Write Tests** command [26]:

- You are prompted for block size (If you press **Enter,** the default block size is 10240 bytes).

  Note: If the block size is zero, variable mode is used. With a fixed block size, a data amount of (block size * blocks) is transferred with a single operation. This process can get rejected if the total amount exceeds the transfer size the system can handle.
- You are prompted for the number of blocks per read/write (If you press **Enter**, the default number of blocks is 20).
- You are prompted for the number of repetitions (If you press **Enter**, the default number of repetitions is 1).

You can then select one of the following options:

- Read data from tape (to run Read only test)
- Write data to tape (to run Write-only test)
- Write/Read/Verify (to run Read and Write test)

ITDT runs the selected test. Then, it displays the transfer size and block size that is used for this test, the number of records read/written, and the total bytes transferred.

[27] Read or Write Files

When you select the **Read or Write Files** command [27]:

- You are prompted to specify the file name of the source file (for Write test) or the destination file (for Read test).
- You are prompted for the number of records to be read.

You can then select one of the following options:

- Read File from Tape: ITDT reads a file from tape and stores data into a file with the specified file name.
- Write File to Tape: ITDT reads data from file with the specified file name and writes data to tape.

ITDT displays the number of records read/written, the transfer size, and the total bytes transferred.

[28] Erase

When you select the **Erase** command [28], ITDT issues the (extrinsic) *ioctl* command to erase the cartridge.

For more information, refer to the Tapeutil Scripting Command at "erase" on page 170.

[29] Load Tape

When you select the **Load Tape** command [29], ITDT issues the load tape command.

[30] Unload Tape

When you select the **Unload Tape** command [30], ITDT issues the unload tape command.

[31] Write File Marks

When you select the **Write File Marks** command [31]:

1. You are prompted for the number of file marks to write.
2. ITDT issues the (extrinsic) *ioctl* command.

[32] Synchronize Buffers

When you select the **Synchronize Buffers** command [32], ITDT issues the *ioctl* command.

[33] Query/Set Parameter

When you select the **Query/Set Parameter** command [33]:

1. ITDT displays non-changeable parameters.

   Note: The list of non-changeable parameters is operating system specific.
2. ITDT displays changeable parameters.

   Note: The list of changeable parameters is operating system specific. For a list of changeable parameters, refer to Table 25 on page 177.
3. You are prompted for parameter to change.
4. ITDT requests prompt for parameter value (if required).
5. ITDT requests safety prompt (if required).
6. ITDT issues the *ioctl* command.

[34] Query/Set Tape Position

When you select the **Query/Set Tape Position** command [34]:

1. ITDT displays the current position
2. You are prompted for a new position to set.
3. ITDT issues the **Set Position** *ioctl* command.

[35] Query Encryption Status

When you select the **Query Encryption Status** command [35]:

1. ITDT issues **Get Encryption State** *ioctl* command.
2. ITDT displays encryption settings (Encryption capability, Encryption method, Encryption state).

[36] Display Message

When you select the **Display Message** command [36]:

1. You are prompted for the text of message 0 (8 characters or less).
2. You are prompted for the text of message 1 (8 characters or less).
3. You are prompted for message type (msg0, msg1, flash0, flash1, alt).
4. ITDT issues the **Display Message** *ioctl* command.

Not all drives have a display. The 3592 drive is the only one that has display message capability. It is the only one with a display that is more than one character long. Eight is the limit of the characters on a display screen.

[37] Report Density Supp (Support)

When you select the **Report Density Support** command [37]:

1. ITDT prints report status text for all supported media.
2. ITDT issues **Report Density Support** *ioctl* command to retrieve all supported media.
3. ITDT prints all requested reports. Data is printed in a decoded way. Scroll the screen to print each one of the following information:
   - Density name
   - Assigning organization
   - Description
   - Primary density code
   - Secondary density code
   - Write OK
   - Duplicate
   - Default
   - Bits per MM
   - Media Width
   - Tracks
   - Capacity (megabytes).
4. ITDT prints report status text for current media
5. ITDT issues **Report Density Support** *ioctl* command to retrieve current media
6. ITDT prints report data in a decoded way.

[38] Test Encryp. Path (Test Encryption Key Path/Setup)

When you select the **Test Encryption Key Path/Setup** command [38]:

Note: Not supported for the HP-UX operating system.

1. ITDT prints status message that server configuration and connections are tested
2. ITDT issues the **Encryption Diagnostics** *ioctl* command, **Ping Diag**
3. ITDT prints number of servers available or error message
4. ITDT issues the **Encryption Diagnostics** *ioctl* command, **Basic Encryption Diag**
5. ITDT prints completion code or error message
6. ITDT issues the **Encryption Diagnostics** *ioctl* command, **Full Encryption Diag**
7. ITDT prints completion code or error message.

[39] Configure TCP/IP Port

For LTO 5, TS1140, and later drives, the ethernet port settings can be configured with the **Configure TCP/IP Port** command. The **Configure TCP/IP Port** command displays the current settings:

```
    ITDT- Set TCP/IP Port
                                  +-+
 Port 1: DHCP enabled             |0|
                                  +----------------+
 Port 1: Address IPV4             | 10.100.10.17   |
                                  +----+-----------+
 Port 1: Subnet Mask Length V4    | 24 |
                                  +----------------------------------------+
 Port 1: Address IPV6             | 1111:2222:3333:4444:5555:6666:7777:8888 |
                                  +----+-----------------------------------+
 Port 1: Subnet Mask Length V6    | 112|
                                  +-+--+
 Port 2: DHCP enabled             | |
                                  +----------------+
 Port 2: Address IPV4             |                |
                                  +----+-----------+
 Port 2: Subnet Mask Length V4    |    |
                                  +----------------------------------------+
 Port 2: Address IPV6             |                                        |
                                  +----+-----------------------------------+
 Port 2: Subnet Mask Length V6    |    |
                                  +----+

<Specify Port 1: DHCP enabled | [enter] for 0>
```

Figure 36. TCP/IP Port command

You can change any of the settings by stepping through each parameter - press **Enter**. To change a parameter, enter the new value, then press **Enter**. All data is sent to the drive and the following screen display is shown:

```
    IBM Tape Diagnostic Tool Standard Edition   - Device Test

 Host Bus  ID   LUN  Model           Serial       Fware  Device
 +----+----+----+----+--------------+-----------+------+-------------------+
 | 3  | 0  | 0  | 0  | ULT3580-HH5  | 1068000051 | B17A |                   |
 +----+----+----+----+--------------+-----------+------+-------------------+
 V-----------------------------------------------------------------------V
 | Setting TCP/TP Configuration...                                       |
 | Reading current TCP/TP Configuration...                               |
 | Number of Port Descriptors 1                                          |
 | Port Descriptor for Port 1                                            |
 | Number of Socket Descriptors 2                                        |
 | Adapter:1 IPV4 10.100.10.17/23 DHCP:1                                 |
 | Adapter:2 IPV6 [1111:2222:3333:4444:5555:6666:7777:8888]/112          |
 | Active IP Addresses:                                                  |
 | IPv4: 10.100.10.17                                                    |
 | Ipv6: 1111:2222:3333:4444:5555:6666:7777:8888                         |
 V-----------------------------------------------------------------------V
           +--------------------+           +----------------------------+
 Result:   | PASSED             |  Code:    | OK                         |
           +--------------------+           +----------------------------+

<[Q] Quit | [N] Next | [P] Previous | + | - | [Enter] Return>
```

Figure 37. TCP/IP Port command results

Note: Because earlier drive generations do not have an ethernet port, the **Configure TCP/IP Port** command is rejected for these devices with the following message:

TCP/IP configuration is not supported on this product.

[50] Element Information

When you select the **Element Information** command [50]:

1. ITDT issues the *ioctl* command
2. ITDT displays the
   - Number of robots
   - First robot address
   - Number of slots
   - First slot address
   - Number of I/E elements
   - First element address
   - Number of drives
   - First drive address

[51] Position to Element

When you select the **Position to Element** command [51]:

1. You are prompted for destination address
2. ITDT issues the *ioctl* command.

[52] Element Inventory

When you select the **Element Inventory** command [52]:

1. ITDT issues the **Element Info** *ioctl* command.
2. ITDT issues the **Element Inventory** *ioctl* command.
3. ITDT displays decoded element inventory information. Type n followed by **Return** to show the next page of information.

[53] Exchange Medium

When you select the **Exchange Medium** command [53]:

1. You are prompted for source address.
2. You are prompted for first destination address.
3. You are prompted for second destination address.
4. ITDT issues the *ioctl* command.

[54] Move Medium

When you select the **Move Medium** command [54]:

1. You are prompted for source address.
2. You are prompted for destination address.
3. ITDT issues the *ioctl* command.

[55] Initialize Element Status

When you select the **Initialize Element Status** command [55]:

1. ITDT prints the command summary.
2. ITDT issues the *ioctl* command.

[56] Prevent/Allow Medium Removal

When you select the **Prevent/Allow Medium Removal** command [56]:

1. You are prompted to select (**1**) for Prevent Removal, or (**0**) for Allow Removal.

[57] Initialize Element Status Range

When you select the **Initialize Element Status Range** command [57]:

  1. You are prompted for the first slot address.
  2. You are prompted for the number of slots.
  3. ITDT issues the *ioctl* command.

[58] Read Device IDs

When you select the **Read Device IDs** command [58], ITDT retrieves the device ID information for all available drives and displays the information. Type n followed by **Enter** to show the next page.

[59] Read Cartridge Location

When you select the **Read Cartridge Location** command [59]:

  1. You are prompted for the address of the first slot.
  2. You are prompted for number of elements.
  3. ITDT verifies that the specified address range is valid, otherwise prints error message and exit.
  4. ITDT issues the **Read Cartridge Location** *ioctl* command.
  5. ITDT issues the **Element Info** *ioctl* command.
  6. ITDT verifies that the address range is valid; otherwise, print the error message and exit.
  7. If no slots are found in Element Info data, print the error message and exit.
  8. ITDT issues the **Read Cartridge Location** *ioctl* command.
  9. ITDT prints decoded storage element information, Type n followed by **Enter** to show next page.

[70] Dump/Force Dump/Dump

When you select the **Dump/Force Dump/Dump** command [70]:

- ITDT retrieves the dump.
- ITDT issues the **Force Dump** command.
- ITDT retrieves second dump.
- ITDT displays the name of stored dump files and the output directory where they are stored. The dump file names start with the serial number of the device.

[71] Firmware Update

When you select the **Firmware Update** command [71]:

  1. ITDT displays the default input directory where the firmware files must be stored. The following are examples of the directory:
     - Example input directory (Windows): `c:\itdt\input`
     - Example input directory (UNIX): `/home/user/itdt/input`
  2. You are prompted to specify a different input directory if required, or to press **Enter** to keep the standard ITDT directory.
  3. You are prompted to specify the firmware file name and press **Enter** to start.
  4. ITDT runs firmware update and displays progress status and result.

     Note: See "TS3310 and TS4500 tape libraries" on page 134 for information on how to update the firmware on a 3576/TS3310 tape library.

     The following site is available for the latest firmware files: http://www.ibm.com/storage/lto.

[101] HDP Discover

Discover the configuration of the HD-P system of all attached libraries - just TS3500/TS4500. The function scans the host for attached TS3500/TS4500 devices and uses their data to discover the HD-P system.

If it is successful, it delivers two maps that represents the logical and physical HD-P environment.

The logical map is a representation of the libraries, where a "1" is the indicator for a connection and a "-1" of no connection.

```
 Command Result
+-------------------------------------------------------------------------------+
| Shuttle Call System discover.....                                             |
| Scanning devices.....                                                         |
|   .....DeviceFileName:/dev/smc1   SN:0000013AAA160404                         |
|                                                                               |
| Discovering Libraries......                                                   |
|   .....Passed                                                                 |
|                                                                               |
| Connection Map:                                                               |
| LL01: /dev/smc1                                                               |
|                                                                               |
|      LL01                                                                     |
| LL01   -1                                                                     |
|                                                                               |
| Physical Map:                                                                 |
|                                                                               |
|                                                                               |
| SCS Discover passed                                                           |
|                                                                               |
|                                                                               |
|                                                                               |
+-------------------------------------------------------------------------------+
< [Q] Quit | [N] Next| [P] Previous | + | - | [Enter] Return >
```

Supported platforms: AIX, Linux on P, and X64

Note: Mixed Media environments (3592 and LTO) are not supported.

[102] HDP Initiate Call Home

Issuing a Test Call Home function.

Supported platforms: AIX, Linux on P, and X64

[103] HDP Show Import Export Elements

Shows the extended HD-P Import Export Elements.

Supported platforms: AIX, Linux on P, and X64

Add device manually

On the **Start** screen, press the [**A**] key followed by **Enter** to add a drive and a changer manually. In a dialog box, the tape device and the associated changer device can be defined. Supported formats are: **devicename** and **H B T L**. For a standalone tape drive the changer device is not required.

A default tape device is set and stepping through the device names the values can be altered.

When **Enter** is pressed, those drives which are accessible are opened. The manually added devices are shown in the same way as they are shown after an ITDT **Scan** command.

Standard Edition - Program options

For problem determination and customization, ITDT is providing the following command line options.

```
-h —help
                      Prints help information
-version
                      Displays the version of ITDT,
                      used configuration files and creation dates.
```

```
 -force-generic-dd
                        the usage of the generic Operating System driver
                          (not using the IBM Tape Device driver)will be forced.
 -LP logpath
                        Use 'logpath' as logging path (default: output)
 -L logfile
                        Use 'logfile' for log messages (default: metro.log)

-LL Errors|Warnings|Information|Debug
                               Set log level (default: Error)
 -R resultdir
                        Use 'resultdir' as result file path (default: output)
 -settings              Change default values of ITDT configuration parameters.
```

Standard Edition - Tapeutil scripting commands

Scripting is enabled with the 4.0 release of ITDT SE. ITDT-SE provides compatibility with earlier versions for existing tapeutil scripts. While some legacy commands exist, they are not documented in their entirety as they are phased out over time. New scripts must always use the scripts that are listed in this guide, the Common Command set (CS). Also, existing scripts must be modified for forward compatibility with ITDT.

You can find a list of commands, on each command you find the command, a description, parameter list, and which platforms are supported. Some commands have numbers after them. The numbers mean that a corresponding menu command is in "Standard Edition - Tapeutil menu commands" on page 152.

The calling convention for the Common Command set is

```
itdt -f filename [Open Mode] Subcommand [Subcommand ...]
```

Note: "filename" is a device special file for the drive/changer or the device address (host bus target lun). For a complete list of the file name or address syntax, refer the section "Special Files" on each platform or go to "Device file names - device addressing" on page 153.

The Open Mode flag is supported on all platforms. If the flag is not set, the device is opened in read/write mode. More parameters that might be required for opening the device are automatically detected and set.

```
 -w mode
Open mode, by default Read/Write.
Valid modes are:
1 = Read/Write
2 = Read Only
3 = Write Only
4 = Append
```

Note: Always use the Read Only mode when you are working with write-protected media.

The new command set enables legacy commands on every platform, even if that is not previously supported by Tapeutil. The output follows current Tapeutil conventions. But, if different output displays for a single command on various platforms, the output is implemented according to the AIX output as the primary scripting platform.

Tapeutil allows undocumented abbreviations for some of the commands. For example, it was possible to shorten "inquiry" to "inq" or "inqu" or "inqui". The following command abbreviations are supported by ITDT-SE too: inq(uiry), req(sense), pos(ition), ele(mentinfo), inv(entory), devid(s), cartridge(location). Deprecated commands are listed at "Deprecated commands" on page 185. Also, there is a list of unsupported commands and known exceptions at "Standard Edition scripting commands: known limitations and deviations" on page 187.

The following commands are described.

General commands

- "allow" on page 165
- "devinfo" on page 166
- "inquiry" on page 166
- "logpage" on page 166

Tape commands

Medium Changer Subcommands

Service Aid commands

HD-P commands

allow

(Deprecated: **unlock, -o rem**) Allow medium removal for tape or changer devices (unlock door). The counter command for this is prevent.

Parameters:

```
None
```

Supported platforms: All

devinfo

(Deprecated: **-o gdi**) Show device information (device type, sub type and block size)

Parameters:

```
None
```

Supported platforms: AIX, Solaris, HP-UX

inquiry

(Deprecated: **-o inq**) Issue an **Inquiry** command and dump the bytes in Hex.

Parameters:

```
inquiry [pagecode]

pagecode (page in Hex without the leading x, 00-FF)
```

Note: ITDT prints a hex dump of the inquiry data on all platforms.

Supported platforms: All

logpage

(Deprecated: **-o log**) This subcommand issues the **SCSI Log Sense** command to the device for the specified page and displays the log sense data.

Parameters:

```
logpage pagecode [subpagecode]

pagecode (page in hex without the leading x, 00-FF)
subpagecode (in hex without leading x, 00-FF)
```

Supported platforms: All

loop

This subcommand loops all subsequent subcommands continuously or a number of times if the **Count** parameter is specified. Also refer to the sleep subcommand.

Parameters:

```
loop [Count]
```

Supported platforms: All

modepage

(Deprecated: **-o mod**) This subcommand issues the SCSI Mode Sense command to the device for the specified page and displays the mode sense data.

Parameters:

```
modepage Page (page in hex without leading x)
```

Supported platforms: All

prevent

(Deprecated: **-o lck, lock**) Prevent medium removal for tape or changer devices (lock door). The counter command for this command is **allow**.

Parameters:

```
None
```

Supported platforms: All

print

This subcommand prints the associated text to standard output. It can be used at any time to display the progress of the subcommands.

Parameters:

```
print Text
```

Supported platforms: All

qrypath

(Deprecated: **-o phs, path, checkpath**) This subcommand displays information about the device and SCSI paths, such as logical parent, SCSI IDs, and the status of the SCSI paths for the primary path and all alternate paths that are configured.

Parameters:

```
None
```

Note: ITDT shows the entire path information for all the commands.

Supported platforms: All

qryversion

(Deprecated: **-o drv**) This subcommand prints out the current version of the IBM device driver.

Parameters:

```
None
```

Supported platforms: All

release

(Deprecated: **-o rel**) This subcommand explicitly releases a device and makes it available for other hosts by issuing the SCSI Release command.

Parameters:

```
None
```

Supported platforms: All

reqsense

(Deprecated: **-o req**) This subcommand issues the SCSI Request Sense command to the device and displays the sense data in hex format.

Parameters:

```
None
```

Supported platforms: All

reserve

(Deprecated: **-o res**) This subcommand explicitly reserves a device by issuing the SCSI Reserve command.

Parameters:

```
None
```

Supported platforms: All

scan

Displays the list of connected devices. For each detected device special file name, vendor id, firmware version, serial-number, SCSI bus address, associated changer, and device driver name is shown.

Parameters:

```
scan [-force-generic-dd] [-o formatstring] [-start=device] [-end=device] [-exclude=device]
```

Supported platforms: All

Example scan:

```
./itdt scan
Scanning SCSI Bus ...
#0 /dev/IBMtape3 - [ULT3580-TD5]-[ACDF] S/N:1168001104 H3-B0-T3-L0
#1 /dev/IBMchanger1 - [3573-TL]-[9.20] S/N:00L4U78D6118_LL0 H3-B0-T5-L1
#2 /dev/IBMtape7 - [ULTRIUM-TD4]-[A232] S/N:1310000593 H1-B0-T0-L0
```

By using the optional parameter **-force-generic-dd**, the usage of the generic Operating System driver (not with the IBM Tape Device Driver) is forced.

The formatstring controls the output and specifies how the connected devices must be reported. It can include any alphanumeric character. The default formatstring is "`"#%# %D - [%P]-[%F] S/N:%S H %H-B%B-T%T-L%L"`".

Interpreted identifiers are

```
%D device name
%V vendor name
%P product name
%F firmware version
%S serial number
%H host adapter
%B bus number
%T target id
%L logical unit
%h host adapter as hexadecimal value
%b bus number as hexadecimal value
%t target id as hexadecimal value
%l logical unit as hexadecimal value
%I interface type
%# enumeration number
%C serial number of associated changer device
```

Minimum field width.

An integer that is placed between a % sign and the format command acts as a minimum field width specifier, a negative value uses right text alignment.

Example scan with format string:

```
./itdt scan -o "%-2#. %-18S %-12P %F %I"
Scanning SCSI Bus ...
 0.        1310115166  ULT3580-TD4 97F2 Fibre
 1.        1310034311  ULT3580-TD4 A232 Fibre
 2.        1168001104  ULT3580-TD5 B170 Fibre
 3.   00L4U78D6118_LL0      3573-TL 9.20 N/A
 4.   00L2U78G8705_LL0      3573-TL 9.20 N/A
 5.       000001327208     03592E06 26CA Fibre
 6.        cigen22164  ULT3580-TD2 73V1 Fibre
```

```
   7.       000001365271      03592E05 1DD1 Fibre

Exit with code: 0
```

Any combination of the identifiers that are listed here are supported.

Known problem: On Solaris for IBM device driver-managed device, the information about the host, bus, target, and lun for generic devices is incorrect.

With the parameters **-start**, **-end**, and **-exclude**, the scan can be limited to only a particular HBA or target ID range (partial scan). It starts at `-start=device` to search for supported devices until `-end=device` is reached. Devices that are specified with **-exclude** are skipped during the scan. Multiple excluded devices must be separated by colons. Supported formats are **devicename** and **H B T L**.

sleep

Sleep for the specified number of seconds before running the next subcommand.

Parameters:

```
sleep [Seconds]
```

Supported platforms: All

tur

(Deprecated: **-o tur**) This subcommand issues the SCSI Test Unit Ready command to the device.

Parameters:

```
None
```

Supported platforms: All

vpd

This subcommand displays Vital Product Data (VPD) that are part of the Inquiry command data and outputs Manufacturer, Product Identification and Revision Level.

Parameters:

```
None
```

Supported platforms: All

append

Opens the device in append mode. The file access permission is Write Only.

Parameters:

```
None
```

Supported platforms: All, but on Windows this open mode is not supported by the IBM Tape Device Driver. On HP-UX this open mode is remapped to `r/w` by the IBM Tape Device Driver.

bsf

(Deprecated: **-o bsf**) This subcommand backward spaces Count filemarks. The tape is positioned on the beginning of the last block of the previous file. An optional Count can be specified. The default is 1.

Parameters:

```
bsf [Count]
```

Supported platforms: All

bsr

(Deprecated: **-o bsr**) This subcommand backward spaces Count records. An optional count can be specified. The default is 1.

Parameters:

```
bsr [Count]
```

Supported platforms: All

channelcalibration

This subcommand issues a self diagnostic command for drive servo channel calibration. The channel calibration returns PASSED or FAILED regarding the result of the command.

Parameters:

```
None
```

Supported platforms: All

chgpart

This subcommand changes the current active tape partition to a new partition specified by Number. Optionally, a Blockid can also be specified. If Blockid is omitted, the tape is positioned at the start of the new partition. Otherwise, the tape is positioned at the Blockid specified.

Parameters:

```
chgpart Number [Blockid]
```

Supported platforms: All

density

(Deprecated: **-o gdn / -o rds**) This subcommand issues the SCSI Report Density Support command for all supported media and for the current media loaded in the drive, and displays the results. If the drive is not loaded, the current media density is not reported.

Parameters:

```
None
```

Note: ITDT-SE outputs detailed information on all platforms.

Supported platforms: All

display

(Deprecated: **-o msg**) This subcommand displays a message on the display panel of the tape device. Up to 16 characters can be used for the message. If the message is longer than eight characters, the display alternates between the first eight characters and the remainder of the message.

Parameters:

```
display "message1" "message2"
```

Supported platforms: All

erase

(Deprecated: **-o era**) This subcommand writes EOD at the current position and erases the tape from EOD to the end of current partition.

Parameters:

```
None
```

Supported platforms: All except i5/OS operating system

Note: The **erase** command triggers a long erase of the cartridge that sets EOD to the current position. Then, it writes the Data Set Separator (DSS) pattern from the new EOD to the end of the current partition. This process overwrites any data that is on the cartridge after the current logical position. To remove the entire cartridge, the user must remove all partitions (use the **rmp** command for LTO 5, TS1140, and newer drives). Then, issue the **rewind** command before the **erase** command.

Examples:

For LTO 5 / TS1140 and later

```
itdt -f <device name> load rmp rewind erase
```

For all earlier LTO and Enterprise drive generations

```
itdt -f <device name> load rewind erase
```

fdp

This subcommand creates fdp (fixed data partitions) wrap wise. The default size for LTO 5 of partition 0 in this case is 1425 GB and the size of partition 1 is 37.5 GB. It also works for TS1140 but the size depends on the used cartridge. Supported by LTO 5, TS1140, and later.

Parameters:

```
None
```

Supported platforms: All

fdpl

This subcommand creates fdp (fixed data partitions) longitudinal. The command is valid only for TS1140 and later drives and creates partitions 0 and 1 on the cartridge. The size depends on the used cartridge.

Parameters:

```
None
```

Supported platforms: All

fsf

(Deprecated: **-o fsf**) This subcommand forward spaces count filemarks. The tape is positioned on the first block of the next file. An optional count can be specified. The default is 1.

Parameters:

```
fsf [Count]
```

Supported platforms: All

fsr

(Deprecated: **-o fsr**) This subcommand forward spaces count records. An optional count can be specified. The default is 1.

Parameters:

```
fsr [Count]
```

Supported platforms: All

getparms

(Deprecated: **-o parms / status / -o gpa**) Get and show drive, media and driver parameters.

Parameters:

```
None
```

Supported platforms: All

idp

This subcommand creates initiator defined partitions (IDP) wrap wise on tape. The parameter pSize0 is used to specify the size of partition 0 and the parameter pSize1 is used to specify the size of partition 1. One of pSize0 or pSize1 must have a value that is entered in hex matching 37.5 * n with (1 <= n <= 38) to specify the wanted size of that partition. The other parameter of pSize0 or pSize1 must have the value 0xFFFF to specify that the remaining capacity is used for that partition. If 0xFFFF is not used for one of the parameters, pSize0 or pSize1, the drive might reject the command | unless pSize0 and pSize1 exactly match predefined allowable values.

For TS1140 and later drives (not LTO), the parameters pSize2 and pSize3 are valid and they follow the same rules as described earlier.

For example: If you want a 37.5 GB partition (the minimum size partition) in partition 0 and the remainder in partition 1, then set pSize 0 to 0x26 and pSize1 to 0xFFFF. This action results in a volume with a 37.5 GB sized partition 0 and a 1425 GB sized partition 1.

Parameters:

```
idp pSize0 pSize1
pSize0: size of partition 0
pSize1: size of partition 1
```

Example Call:

```
idp 0x26 0xffff
```

Supported platforms: All

idpl

This subcommand creates initiator defined partitions (IDP) longitudinal wise on tape. The parameter pSize0 is used to specify the size of partition 0 and the parameter pSize1 is used to specify the size of partition 1. One of pSize0 or pSize1 must have a value that is entered in hex matching 37.5 * n with (1 <= n <= 38) to specify the wanted size of that partition. The other parameter of pSize0 or pSize1 must have the value 0xFFFF to specify that the remaining capacity is used for that partition. If 0xFFFF is not used for one of the parameters, pSize0 or pSize1, the drive might reject the command | unless pSize0 and pSize1 exactly match predefined allowable values.

For TS1140 and later drives (not LTO), the parameters pSize2 and pSize3 are valid and they follow the same rules as described earlier.

For example: If you want a 37.5 GB partition (the minimum size partition) in partition 0 and the remainder in partition 1, then set pSize 0 to 0x26 and pSize1 to 0xFFFF. This action results in a volume with a 37.5 GB sized partition 0 and a 1425 GB sized partition 1.

Parameters:

```
idp pSize0 pSize1
pSize0: size of partition 0
pSize1: size of partition 1
```

Example Call:

```
idp 0x26 0xffff
```

Supported platforms: All

list

This subcommand displays the content of a tape. The output lists filemarks and the size of each record found on the tape until the end of data is reached. The output that is generated from this subcommand can be large depending on the amount of data on the tape and must usually be redirected to a file.

Parameters:

```
list [-start blockid] [-count recordcount]
```

Supported platforms: All

load

(Deprecated: **-o lod**) This subcommand issues a **SCSI Load** command to load a tape. The subcommand loops all subsequent subcommands continuously or a number of times if the **Count** parameter is specified. Also refer to the sleep subcommand.

Parameters:

```
load [-amu 0|1]
```

amu enables or disables archive mode unthread during **Load** command.

Supported platforms: All

logsense

Retrieves all Log Sense pages and outputs them as hex.

Parameters:

```
None
```

Supported platforms: All

qrypar/qrypart

Queries and displays tape partitioning information.

Parameters:

```
None
```

Supported platforms: All

qrylbp

Queries and displays logical block protection information.

Parameters:

```
None
```

Supported platforms: All

qrypos

(Deprecated: **-o gpo**) This subcommand displays the current tape position.

Parameters:

```
None
```

Supported platforms: All

qrytcpip

This subcommand outputs the current drive TCP/IP configuration. Only supported with LTO 5, TS1140, and later drives. Outputs adapter and TCP/IP address information for IPv4 and IPv6 with address, port and subnet mask. For example:

```
./itdt -f /dev/IBMtape3 qrytcpip
Reading current TCP/TP Configuration...
Number of Port Descriptors 1
Port Descriptor for Port 1
Number of Socket Descriptors 2
Adapter:1 IPV4 9.11.22.111/23 DHCP:0
Adapter:2 IPV6[0002:0000:0000:0000:0007:0008:0000:0000]/24
Active IP Addresses:
IPv4: 169.254.0.3
Exit with code: 0
```

Parameters:

```
None
```

Supported platforms: All

qrytemp

Reads the thermal sensor values of a tape drive and writes the following output:

```
Thermal Value, Max Thermal Value,
Fencing Threshold and Fencing Removal Threshold.
All values are units of °C.
```

Parameters:

```
None
```

read

This subcommand reads a file, or a specified number of records, from the tape to the destination file name specified with the **-d** flag. If the optional count parameter is used, only the number of records that are specified with the **-c** flag are read unless a filemark is encountered before the number of specified records. If the count parameter is not used, all records up to the next filemark on tape are read.

Parameters:

```
read -d Dest [-c Count]
```

Supported platforms: All

readattr

This subcommand reads a Medium Auxiliary Memory (MAM) attribute from a cartridge to the destination file name that is specified with the **-d** flag. The partition parameter **-p** is a number in the range 0 - 3. The attribute parameter **-a** is the hexadecimal value of the identifier. All three parameters are required.

Parameters:

```
readattr -p[0|1|2|3] -a Identifier -d DestinationPathFile
```

Supported platforms: All

resetdrive

This subcommand issues a Send Diagnostic command (Reset Drive subcommand) to reset the device.

Parameters:

```
None
```

Supported platforms: All

rmp

Remove partitioning.

Parameters:

```
None
```

Supported platforms: All

runtimeinfo/qryruntimeinfo

This subcommand is used to query the dynamic runtime information. Dynamic runtime information allows an initiator to set dynamic runtime attributes (DRA) about itself into a device server. The device server then associates those attributes to the I_T_L nexus and uses the information and associations for enhanced data collection and debugging.

Parameters:

```
None
```

Supported platforms: All (supported since LTO 5 and 3592 E07)

rewind

(Deprecated: **-o rew**) Rewinds the tape.

Parameters:

```
None
```

Supported platforms: All

rtest

(Deprecated: **-o rea**) This subcommand runs a read test by reading a random data pattern from the tape and verifying that it matches the written data. The **rtest** subcommand can be used after the **wtest** subcommand to verify the data. An optional block size, count, and repetition can be specified with the **-b**, **-c**, and **-r** flags, respectively. If the block size is fixed, then the count specifies the number of blocks to read on each repetition. If the block size is zero (variable), then the count specifies the number of bytes to read on each repetition. The default is a block size of 10240, a count of 20 blocks, and a repetition of 1.

Parameters:

```
read [-b Blocksize] [-c Count] [-r Repetition]
```

Supported platforms: All

rwtest

This subcommand runs a read and write test by writing a random data pattern on the tape, reading it, and verifying that it matches the written data. An optional block size, count, and repetition can be specified with the **-b**, **-c**, and **-r** flags, respectively. If the block size is fixed, then the count specifies the number of blocks to write on each repetition. A single transfer transmits (block size * count) bytes. The operation is rejected if the total amount exceeds the transfer size the system is capable of. If the block size is zero (variable), then the count specifies the number of bytes to write on each repetition. The default is a block size of 10240 bytes, a count of 20 blocks, and a repetition of 1.

In **SCSI Generic mode**, the actual transfer size equals to *blocksize*. In **IBM Device Driver mode**, the transfer size is *blocksize * blocks per read/write*. In either case, the blocksize must be equal to or less than the maximum Host Bus Adapter supported transfer size. The maximum supported transfer size for **SCSI Generic** is 1048576 Bytes and for **IBM Device Driver** is 500 MB.

Parameters:

```
rwtest [-b Blocksize] [-c Count] [-r Repetition]
```

Supported platforms: All

sdp

Creates SDP (Select Data Partitions) wrap wise on tape.

Parameters:

```
sdp count
For LTO (5 and higher) only the values 0 and 1 are valid.
Using value 0 as parameter leads to partition 0 with 1.5TB
and partition 1 does not exist.
Using value 1 as parameter leads to partition 0 with 750 GB
and partition 1 with 712.5 GB.
For TS1140 and later drives values 0, 1, 2 and 3 are valid.
Using value 0 as parameter will create only one partition,
value 1 creates two and so on.
The sizes of the partitions are depending on the cartridge used in drive.
```

Supported platforms: All

sdpl

Creates SDP (Select Data Partitions) longitudinal on tape.

Parameters:

```
sdpl count
For TS1140 and later drives values 0 and 1 are valid.
Using the value 0 as the parameter creates partition 0 only
and the value 1 as the parameter creates partitions 0 and 1.
The sizes of the partitions depends on the cartridge
used in drive.
```

Supported platforms: All

seod

(Deprecated: **-o eod**) Spaces to end of data on the tape.

Parameters:

```
None
```

Supported platforms: All

setparm

(Deprecated: **-o spa / volid / compress / nocompress / sili / nosili / autoload / noautoload / retain / noretain**)

ITDT-SE uses the new setparm option that corresponds to the current interactive mode options.

Parameters: The Value is

- 0-65535 for the blocksize parameter
- 0-100 for the capacity parameter (=percentage)
- 1 (SCSI) and 2 (AIX) for recordspacemode
- The Volume Id string for the volid parameter
- NONE|ASSO|PERS|WORM for the **writeprotect** parameter
- 0 for off/no and 1 for on/yes for setparm autoload, autodump, buffering, compression, immediate, readpastfilemark, sili, simmim, trace, trailer, volumelogging

Supported platforms: All, but only a subset of the parameters is supported by the platform's device drivers.

Table 25. Supported platforms	Linux	Windows	AIX	Solaris	HP-UX
setparm autoload			X		
setparm autodump	X				
setparm blocksize	X	X	X	X	X
setparm buffering	X		X	X	X
setparm capacity	X	X^3	X	X	X
setparm compression	X	X	X	X	X
setparm datasafemode[1]	X	X	X	X	X
setparm immediate	X		X	X	X
setparm readpastfilemark	X				
setparm recordspacemode			X		
setparm sili			X	X	X
setparm simmim	X				
setparm skipsync[2]	X	X	X	X	X
setparm sleepmode	X	X	X	X	X
setparm trace	X				
setparm trailer	X		X	X	X
setparm volid			X		
setparm volumelogging	X		X		
setparm writeprotect[2]	X	X^3	X	X	X
setparm archivemodeunthread	X	X	X	X	X

Note:

1. The datasafemode can be set to YES or NO when no cartridge is loaded. When a cartridge is loaded, the datasafemode can be set only to YES.
2. Depending on the support of the device.
3. Only supported by 3592.

setpos

(Deprecated: **-o spo / asf**) This subcommand issues the SCSI Locate command to the device to set the tape position. If the optional Blockid parameter is specified, the tape position is set to the Blockid. Otherwise, if the **Blockid** parameter is omitted, the tape position is set to the last position saved by using the **qrypos** subcommand.

Parameters:

```
setpos [Blockid]
```

Supported platforms: All

settcpip

This subcommand sets the drive ethernet port TCP/IP settings for LTO 5, TS1140, and later drives. Either a static IPv4 or IPv6 address can be set or DHCP enabled.

Example DHCP:

```
./itdt -f /dev/IBMtape3 settcpip DHCP
Initializing device...
Setting TCP/TP Configuration...
Reading current TCP/TP Configuration...
Number of Port Descriptors 1
Port Descriptor for Port 1
Number of Socket Descriptors 2
Adapter:1 IPV4 9.11.22.111/23 DHCP:1
Adapter:2 IPV6 [0002:0000:0000:0000:0007:0008:0000:0000]/24
Active IP Addresses:
Exit with code: 0
```

IPv4 or IPv6 addresses are entered in the syntax a.b.c.d:/subnet_mask_length where a, b, c, and d are values with 1 to 3 digits. If the optional parameter subnet_mask_length is not specified, the current setting is kept.

Example static IPv4:

```
./itdt -f /dev/IBMtape3 settcpip 9.155.27.14/23
Initializing device...
Setting TCP/TP Configuration...
Reading current TCP/TP Configuration...
Number of Port Descriptors 1
Port Descriptor for Port 1
Number of Socket Descriptors 2
Adapter:1 IPV4 9.155.27.14/23 DHCP:0
Adapter:2 IPV6 [0002:0000:0000:0000:0007:0008:0000:0000]/24

Active IP Addresses: IPv4:

169.254.0.3 IPv4:

9.155.27.46 IPv4:

9.155.27.14


Exit with code: 0
```

Parameters:

```
dhcp, address[/subnet_mask_length]
```

Supported platforms: All

Note: With the current firmware level, the device can be reached (ping, FTP) only within the same subnet. For example, the sample is configured with a static IP address (9.155.27.14) and DHCP enabled. The drive can be pinged only within the same subnet (9.155.27.xxx). Both IP addresses (9.155.27.14 and the DCP address 9.155.27.46) are active and can be used.

sync

(Deprecated: **-o syn**) This subcommand synchronizes buffers/flushes the tape buffers to tape.

Parameters:

```
None
```

Supported platforms: All

unload

(Deprecated: **-o off / offline / rewoffl**) This subcommand rewinds and unloads the tape.

Parameters:

```
unload [-amu 0|1]
```

amu enables or disables archive mode unthread during **Load** command.

Supported platforms: All

verlbp

This subcommand verifies logical block protection written blocks. The verification length can be set with parameter value filemarks count or with EOD.

Parameters:

```
filemarks (numeric value) | eod
```

Supported platforms: All

weof

(Deprecated: **-o eof / eof**) These subcommands write count filemarks. An optional count can be specified. The default is 1.

Parameters:

```
weof [Count]
```

Note: The weof parameter [count] is optional, if it is not supplied, one filemark is written.

Supported platforms: All

write

This subcommand writes the source file specified with the **-s** flag on the tape. In case the parameter '**raw**' is specified, the blocksize specified in setparm (setparm blocksize) is used instead of the default blocksize of 64 kB. The parameter count specifies the amount of blocks which should be written.

Parameters:

```
write [-raw] [-count] -s Source
```

Supported platforms: All

writeattr

This subcommand writes a Medium Auxiliary Memory (MAM) attribute from a cartridge from the source file name that is specified with the **-s** flag. The partition parameter **-p** is a number in the range 0 - 3. The attribute parameter **-a** is the hexadecimal value of the identifier. All three parameters are required.

Parameters:

```
writeattr -p[0|1|2|3] -aIdentifier -sSourcePathFile
```

Supported platforms: All

wtest

(Deprecated: **-o wri**) This subcommand runs a write test by writing a random data pattern on the tape. The **rtest** subcommand can be used after the **wtest** subcommand to verify the data that was written. An optional block size, count, and repetition can be specified with the **-b**, **-c**, and **-r** flags, respectively. If the block size is fixed, the count specifies the number of blocks to write on each repetition. If the block size is zero (variable), the count specifies the number of bytes to write on each repetition. The default is a block size of 10240, a count of 20 blocks, and a repetition of 1.

Parameters:

```
wtest [-b Blocksize] [-c Count] [-r Repetition]
```

Supported platforms: All

audit

(Deprecated: **-o aud / -o ier**) This subcommand with no parameters issues the SCSI Initialize Element Status command to the device. Using the optional parameters Address and Count issues the SCSI Initialize Element Status With Range command to the device. The Address parameter specifies the starting element address and the Count parameter, if used, specifies the number of elements to initialize. If Count is omitted, it defaults to 1.

Parameters:

```
audit [[Address] [Count]]
```

Supported platforms: All

cartridgelocation

This subcommand with no parameters issues the SCSI Read Element Status command to the device to report all slots with the cartridge location information. Using the optional parameters Slot and Count issues the SCSI Read Element Status to the device for a specific starting Slot address and optionally the Count specifies the number of slots to return. If Count is omitted, it defaults to 1.

Parameters:

```
cartridgelocation [Slot [Count]]
```

Supported platforms: All

elementinfo

(Deprecated: **-o ele**) This subcommand displays element information (number and address) of each element type.

Parameters:

```
None
```

Supported platforms: All

exchange

(Deprecated: **-o exh**) This subcommand issues the SCSI Exchange Medium command to the device by using the **Source**, **Dest1**, and **Dest2** addresses specified. This command runs the equivalent function of two **Move Medium** commands. The first moves the cartridge from the element address that is specified by the **Dest1** parameter to the element address specified by the **Dest2** parameter. The second moves the cartridge from the element address that is specified by the **Source** parameter to the element address specified by the **Dest1** parameter.

Parameters:

```
exchange Source Dest1 Dest2
```

Supported platforms: All

inventory

(Deprecated: **-o inv**) This subcommand with no parameters issues the SCSI Read Element Status command for each element type and displays the element status information. If the optional **-i** parameter is used, then only the import/export element status information is returned. If the optional **-v** parameter is used, then only the element status information for the specified Volid if found is returned.

Parameters:

```
inventory [-i | -v Volid]
```

Note: ITDT supports the optional parameters on all platforms.

Supported platforms: All

move

(Deprecated: **-o mov**) This subcommand issues the SCSI Move Medium command by using the source and destination addresses specified. The element addresses can be obtained with the **elementinfo** subcommand.

Parameters:

```
move Source Dest
```

Supported platforms: All

position

(Deprecated: **-o pos**) This subcommand issues the SCSI Position to Element command by using the destination specified.

Parameters:

```
position Dest
```

Supported platforms: All

dump

(Deprecated: **-o sdp**) This subcommand forces a dump of the tape drive and stores the dumps before and after the force dump in the ITDT-SE output folder with the ITDT-SE naming convention (serialnumber.a.gz and serialnumber.b.gz).

Parameters:

```
None
```

Supported platforms: All

ekmtest

Test encryption key path/setup.

Parameters:

```
None
```

Supported platforms: AIX, Linux, Solaris, Windows

encryption

Query tape drive encryption settings and display the encryption state.

Parameters:

```
None
```

Supported platforms: All

ucode

(Deprecated: **-o dmc**) This subcommand downloads microcode to the device. The Filename is a file that contains the ucode.

The TS4300 (3555) tape library does not support code update with SCSI commands. ITDT integrated RESTFul API functions to support code update by using the HTTPS connection of the library. The process is similar to the regular code update sequence, but in addition the user must enter credentials during the code update sequence.

Parameters:

```
ucode [-password loginpassword -user username -ipaddress library Address] Filename
```

Supported platforms: All

tapephcp

Creates a physical copy of a tape cartridge. The created cartridge has the same physical layout and contents as the origin cartridge. The amount of transferred data and the current data transfer rate is displayed every 3-5 minutes. Tapephcp is supported for LTO and 3592 tape drives and can therefore be used for data migration. A **tapephcp** command that is issued to copy data from a 3592 drive to an LTO drive or from an LTO Gen 4 to an LTO Gen 3 works, if the amount of used data from the source device is equal or less than the capacity of the destination device.

Parameters:

```
tapephcp [-cqs Memorysize] source destination
```

Source and destination can either a special device file name, or a tape image file name. The special device file format is identical to the format specified in chapter 3.19 parameter **"-f device"**.

Examples: Tape to Tape copy with the IBM tape driver

```
./itdt tapephcp /dev/IBMtape0 /dev/IBMtape1
Tape to Image File using generic interface
    ./itdt tapephcp 3 2 1 0 /tmp/MyTapeImage.img
Image File to Tape using IBM Tape driver
    ./itdt tapephcp /tmp/MyTapeImage.img /dev/IBMtape1
Tape to Tape copy with adjusted memory allocation
 ./itdt tapephcp -cqs 1000 /dev/IBMtape0 /dev/IBMtape1
```

To ensure maximum performance for tape to tape copy actions, tapephcp allocates a read buffer of 2500 MB (assuming the maximum system block size is 1 MB). If the system does not provide this buffer, the operation is aborted with MEMORY ALLOCATION FAILED. The value for memory allocation can be changed with an integer value for the parameter **cqs** (Command Queue Size). The **cqs** value must be multiplied with the maximum supported system blocksize to determine the size of memory that is allocated by ITDT. Supported copy operations are from tape to tape, from image file to tape, and from tape to image file. On UNIX operating systems, a warning to check the file size limit is shown before an image file is created, if the maximum file size is below 2 GB.

ltfsphcp

Creates a physical copy of an LTFS formatted cartridge. Ltfsphcp is based on tapephcp. The LTFS specified parameters **volumeuuid** and **VCI** are adjusted during this copy operation. The created cartridge has the same physical layout as the origin cartridge. Expect the **volumeuuid** to be identical to the contents of the two cartridges. The amount of transferred data and the current data transfer rate is displayed every 3-5 minutes. When ltfsphcp is used with a non-LTFS formatted cartridge, the behavior of ltfsphcp is identical to tapephcp.

Parameters:

```
ltfsphcp [-cqs Memorysize] [-VOL1 volume id] source destination
```

Source and destination can either a special device file name, or a tape image file name. The special device file format is identical to the format specified in chapter 3.19 parameter **"-f device"**.

Examples:

```
Tape to Tape copy using IBM tape driver
    ./itdt ltfsphcp /dev/IBMtape0 /dev/IBMtape1
```

```
Tape to Image File using generic interface
    ./itdt ltfsphcp 3 2 1 0 /tmp/MyTapeImage.img
Image File to Tape using IBM Tape driver
    ./itdt ltfsphcp /tmp/MyTapeImage.img /dev/IBMtape1
Tape to Tape copy with adjusted memory allocation
 ./itdt ltfsphcp -cqs 1000 /dev/IBMtape0 /dev/IBMtape1
```

To ensure maximum performance for tape to tape copy actions, ltfsphcp allocates a read buffer of 2500 MB (assuming the maximum system block size is 1 MB). If the system does not provide this buffer, the operation is aborted with `MEMORY ALLOCATION FAILED`. The value for memory allocation can be changed with an integer value for the parameter **cqs** (Command Queue Size). The **cqs** value must be multiplied with the maximum supported system blocksize to determine the size of memory that is allocated by ITDT. Supported copy operations are from tape to tape, from image file to tape, and from tape to image file. On UNIX operating systems, a warning to check the file size limit is shown before an image file is created, if the maximum file size is below 2 GB.

For LTFS formatted cartridges, the volume identifier can be changed for a physical target with the parameter **VOL1**. The value must be alphanumeric with a minimum of 1 and a maximum of 6 characters.

verify

Verifies the physical contents of two cartridges. The physical data layout and the binary data are compared.

Parameters:

```
verify source destination
```

Source and destination can either a special device file name, or a tape image file name. The special device file format is identical to the format specified in chapter 3.19 parameter **-f**.

Examples:

```
./itdt verify /dev/IBMtape0 /dev/IBMtape1
```

checkltfsreadiness

This subcommand issues the LTFS Readiness Check test.

The LTFS Readiness Check analyzes the Operating System and tape drive environment to ensure that the IBM Linear Tape file system can be installed. This test checks the Operating System version, the tape device driver version, the tape drive firmware, and the LTFS HBA requirements. LTFS Readiness Check requires an empty data cartridge.

Parameters:

```
None
```

ltfsdefragmentation

On an LTFS formatted cartridge, the physical data records for a single file can be fragmented across the entire media. When such a file is accessed, a long response time might result. The tape drive must locate to different cartridge positions to retrieve the entire contents the file. If the first data records of a file are stored at the end of the tape and the other records are stored at the beginning of the media, the tape drive must run several times intensive seek operations to fulfill the complete file retrieval. This subcommand creates a copy of the cartridge with unfragmented content.

As an initial step, ITDT stores the complete content of the source tape media in a Tape Image file that is on an HDD. Using this Tape Image file and the ITDT image file backend driver for LTFS, LTFS is able to mount the previously created Tape Image file as a read-only volume. As the final step, the data is defragmented by copying the files from the mounted Tape Image file to the mounted destination cartridge. This algorithm avoids any seek operations on the physical tape device. The seek operations are completed on the temporary ITDT image file that is on a hard disk. The source and destination tape device are accessed at maximum media speed. The defragmentation of a cartridge can take up to 6 hours.

Parameters:

```
ltfsdefragmentation source tempdirectory destination [options]
```

Supported platforms: Linux x86_64 only

Prerequirements: IBM LTFS SDE Version 2.2 (Build 4700 or later) and sufficient free hard disk space for temporary Tape Image file

Example:

```
./itdt ltfsdegragmentation /dev/IBMtape0 /tmp/tapeimages
/dev/IBMtape1 -verbose -mkltfsoption=--force
```

standardtest

The Test function (Scan Menu Command [T]) checks if the tape device is defective and outputs a pass/fail result. This test requires a loaded cartridge.

Parameters:

```
standardtest [-forcedataoverwrite]
```

Supported platforms: All

fullwrite

Runs the ITDT Full Write Test (Scan Menu Command [F]).

The Full Write function writes the entire cartridge with a given block size either with compressible or incompressible data and output performance data. This test requires a loaded cartridge.

Parameters:

```
fullwrite [-b Blocksize] [-compressible|-incompressible] [-forcedataoverwrite]
```

Supported platforms: All

systemtest

Runs the ITDT Systemtest (Scan Menu Command [Y]).

The System Test is a short test that runs the following actions.

- Reveals system performance bottlenecks. Compressible data throughput values can reveal bandwidth limitations that are caused by the system or cabling or HBA.
- Measures performance variations across the different block sizes to find the ideal block size for the system configuration.

This test requires a loaded cartridge.

Parameters:

```
systemtest [-forcedataoverwrite]
```

Supported platforms: All

tapeusage

Displays the tapeusage information (Scan Menu Command [U]).

This test requires a loaded cartridge.

Parameters:

```
None
```

Supported platforms: All

hdp discover

Discovers the HD-P system and presents the logical and physical HD-P environment. The logical map is an n x n representation of the libraries, where a "1" is the indicator for a connection and a "-1" of no connection. In case the command is called without any device files, all attached TS3500/TS4500 are used.

Parameters:

```
hdp discover [-d device-file]
```

Supported platforms: AIX, Linux on P, and X64

A mixed environment (LTO and 3592 devices) is not supported.

hdp senderror

Issues a Test Call Home function. In case the command is called without any device file, all attached TS3500/TS4500 are used.

Parameters:

```
hdp senderror [-d device-file]
```

Supported platforms: AIX, Linux on P, and X64

hdp show

Shows the extended HD-P Import Export Elements. In case the command is called without any device file, all attached TS3500/TS4500 are used.

Parameters:

```
hdp show [-d device-file]
```

Supported platforms: AIX, Linux on P, and X64

Deprecated commands

The following is a list of commands that are currently available in this version of ITDT. However, in a future release the following commands and some alternate calls of the Common Command Scripting set are no longer available and the scripts that contain these commands must be changed. The scripts that use the deprecated commands must be changed for future editions.

General commands

- -o dis / disablepath
- -o ena / enablepath
- fuser
- kill
- passthru
- resetpath

Tape commands

- bsfm
- -o chk
- fsfm
- -o grs
- -o gmi

- qryinquiry
- qrysense
- -o ret
- setblk
- -o gds
- getrecsize
- setrecsize

Medium Changer subcommands

- -o dvc
- mount
- demount

Service Aid commands

- fmrtape
- -o fdp
- reset
- -o qmc

Alternative mount/demount script - sample for Windows

The script (`load.drive.cmd`) issues a **mount/umount** command to the specified library. If the drive is empty, a cartridge is moved from the first available storage slot to the drive. If the drive contains a cartridge, the cartridge is moved to the previous storage location.

Requirements:

- Windows operating system
- IBM tape library with one or more tape drives
- IBM tape device driver or Generic SCSI driver
- Path variable must include ITDT executable

```
Usage: load-drive.cmd drivername|hbtl [drivenumber]
          drivername is the device driver name assigned by the IBM device driver
          hbtl is the associated SCSI address h=host, b=bus, T=target id and l=lun
          drivenumber, logical drive number, default is 1
```

Example for using the IBM device driver: `load-drive.cmd \\.\Changer0`

Example for using the SCSI Generic driver: `load-drive.cmd "2 0 3 1"`

```
load-drive.cmd:
@ECHO OFF
IF [%1]==[] (
    echo.
    echo Usage load-drive.cmd drivername^|hbtl [drivenumber]
    echo.
    echo drivername is the drivername assigned by the IBM device driver
    echo example:load-drive.cmd \\.\Changer0
    echo.
    echo hbtl is the associated SCSI address h=host, b=bus, T=target id and l=lun
    echo example: load-drive.cmd "3 0 2 1"
    echo.
    goto :EOF
)

set driveNumber=1
IF not [%2]==[] set driveNumber=%2
echo Loading/Unload Cartridge Drive:%driveNumber%

itdt -f %~1 inventory >inventory.txt
set /a count=0
set action=load
```

```
set sourceAddress=
set destination=
set driveAddress=
set slotAddress=
FOR /F "tokens=1,2,3,4,5" %%G IN (inventory.txt) DO (
    call :checkline %%G %%H %%I %%J %%K
)
GOTO :moveMedium

:checkline
set name=%1 %2
if "%name%"=="Drive Address" (
    set /a count+=1
    set currentTag=%name%
    set driveAddress=%3
)
if "%name%"=="Media Present" (
rem echo full drive addr:%driveAddress% slot addr:%slotAddress%
action:%action% source:%sourceAddress% Tag:%currentTag%

  if "%count%"=="%driveNumber%" if "%currentTag%"=="Drive Address" if "%4"=="Yes" (
      set action=unload
      set sourceAddress=%driveAddress%
   )

  if "%count%"=="%driveNumber%" if "%currentTag%"=="Drive Address"
  if not "%4"=="Yes" (
      set action=load
      set destination=%driveAddress%
   )

  if "%sourceAddress%"=="" if "%currentTag%"=="Slot Address"
  if "%action%"=="load" if "%4"=="Yes" (
      set sourceAddress=%slotAddress%
   )
)

if "%name%"=="Source Element" (
  if "%count%"=="%driveNumber%" if "%currentTag%"=="Drive Address"
  if "%action%"=="unload" (
      set destination=%5
   )
)

if "%name%"=="Slot Address" (
    set currentTag=%name%
    set slotAddress=%4
)

GOTO:EOF
:moveMedium
echo %action% move media from %sourceAddress% to destination %destination%
itdt -f %~1 move %sourceAddress% %destination%
del inventory.txt
GOTO:EOF
```

Standard Edition scripting commands: known limitations and deviations

The scripting commands **idp**, **sdp**, **fdp**, and **qrypart** are currently only supported by LTO 5, TS1140, and later drives.

When scripting, one must be aware of the following general deviations to the legacy tapeutil scripting command set.

The **Verbose Mode** parameter is ignored for the ITDT-SE implementation; instead always the full information is printed.

For some operations, the sense data length is limited to 32 bytes - this length is required by the ITDT test sequences.

The list command does not work on Linux variants where the reported maximum SCSI transfer size is larger than the size the system can actually transfer.

Because ITDT-SE opens the device read/write by default in scripting mode, the WORM mode cannot be deactivated in scripting mode. Use the Tapeutil interactive mode instead to deactivate the WORM mode.

Scripting mode command deviations to legacy tapeutil (tapeutil is not changed):

1. The **erg** (Erase Gap) command is not supported.
2. The **mtdevice** command is not supported.
3. The **tell** command is not supported.
4. The **seek** command is not supported.
5. The **format** command is not supported.
6. The **-o qsn** command is not supported.
7. path/querypath/path / qrypath / checkpath / - o phs - output: always show all paths.

   The command is valid only in combination with an IBM device driver.
8. devinfo - different output (decoded on all platforms)
9. inquiry - different output on Linux (like AIX in hex)
10. vpd - different behavior on Solaris (like AIX)
11. modepage - HP-UX and Solaris output deviations (like AIX)
12. inventory - additional parameters on AIX available on all platforms
13. cartridgelocation - AIX parameter deviation available on all platforms
14. mediainfo - different output --> decode on all platforms

    The command is valid only in combination with an IBM device driver.
15. setpos - logical versus physical position, only set logical position as on AIX
16. HPUX: **-o gpo -t 1|2 --> parameter -t1|2** (logical, physical) is not supported.
17. density - output all information on all platforms
18. setparm (new) - work around the inability to set all parameters on all platforms except the undocumented HP-UX release
19. getparms (new) - retrieve all parameters on all platforms, independent of flag set
20. qryinquiry - output the same as on AIX
21. logsense - does not output header with device/serial/volid, example:

    ```
    05/12/09 15:10:44 Device: ULT3580- S/N: 1300000206 Volid: UNKNOWN
    ```
22. erase - does not work on i5/OS because of operating system limitation.
23. Using **-w x** parameter without the necessary open leads to a core at least on Solaris.

IBM Tape Diagnostic Tool - Graphical Edition

Installing ITDT - Graphical Edition

Installing ITDT-GE on Windows operating systems

To install ITDT-GE on Windows, download the executable file **install_ITDT_GE_*<version>*.exe** on a directory of your choice.

Double-click the downloaded file to start the installer application.

ITDT-GE installer automatically uninstalls any previous version before the current one is installed.

For the graphical user interface (GUI), a minimum screen resolution of 1024*768 pixels is required.

The supported Microsoft Windows operating systems for ITDT-GE are:

- Microsoft Windows Server 2016 / 2012R2 (64-bit x64)

Installing ITDT-GE on Linux operating systems

To install ITDT-GE on Linux, download the executable file **install_ITDT_GE_<*version*>.bin** to a directory of your choice.

install_ITDT_GE_<*version*>.bin must be run by a user with root access rights.

The ITDT-GE installer automatically uninstalls any previous version before the current one is installed.

For the graphical user interface (GUI) a minimum screen resolution of 1024*768 pixels is required. The supported Linux operating systems for ITDT-GE are

• Linux Distributions with Kernel 2.6, glibc 2.2.5 and later (64-bit x64).

Graphical Edition - known issues and limitations

This section describes the known issues and limitations of ITDT-GE.

Linux operating systems

It is recommended to not operate Security Enhanced Linux (SELinux) in enforcing mode while ITDT-GE is running.

On RedHat Enterprise Linux 4 and 5 and SuSE Enterprise Linux 10, starting the online help might cause an error message `Problems opening link / Unable to open web browser on {0}`. Workarounds are to issue the commands

```
a) ln -s /usr/bin/firefox /usr/local/bin/mozilla
or
b) export MOZILLA_FIVE_HOME=/usr/lib/firefox<version>
```

Replace with the appropriate path to your installed Firefox version before ITDT-GE is started.

Gnome desktop

If you are using the Gnome desktop, be sure to log in to the desktop session as root to use ITDT-GE to prevent device access issues.

Windows operating systems

On Microsoft Windows systems where the maximum transfer size is limited to less than 64 kB, the Dump and Firmware update operations do not work.

Performance issues

If you are using Adaptec SCSI Host Bus Adapters, ensure that you are using the latest Adaptec Host Bus Adapter Drivers instead of the drivers that are shipped with the Windows operating system.

Devices disappear after firmware update

After a firmware update, devices might disappear.

Repeated **Scan** operations might help to rediscover the device.

All supported operating systems

Command timeout

There is no instant operation termination upon SCSI command timeout. For example, when the SCSI cable is unplugged after POST A is started.

When a command timeout condition occurs, ITDT might still continue to run more operations (like unmounting the cartridge) instead of instantly terminating with a timeout condition.

3576/TS3310 tape library

Library Firmware Update with ITDT-GE is not supported by the 3576/TS3310 tape library. Update the firmware by using the 3576/TS3310 Web User Interface.

3494 tape library

Drives in a 3494 tape library or an STK silo library are supported. Only the Test option does not work because of device-specific restrictions for handling cartridges.

ITDT-GE user interface description
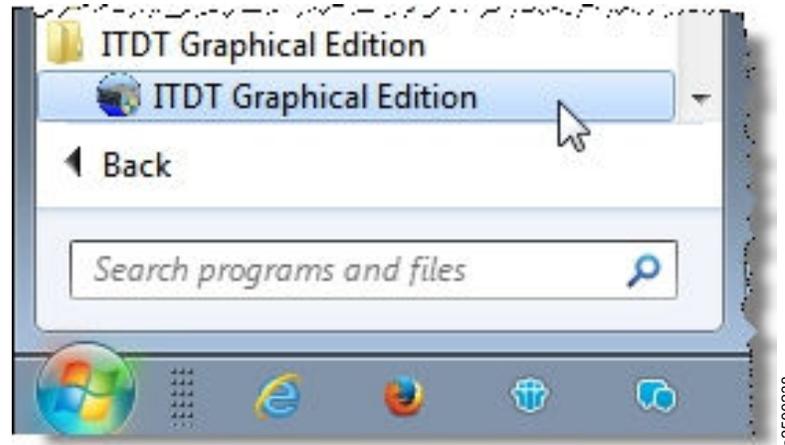
Figure 38. Graphical Edition user interface

To start ITDT-GE on Windows, click the shortcut that is created by the installation process. On Linux, no start menu entry is generated. Start ITDT-GE by opening a Terminal window, then switch to root user.

```
$ su -
```

Finally, start ITDT-GE with

```
$ /opt/ibm/itdt-ge/itdt-ge
```

The **User Settings** dialog box displays the first time that the program is run, allowing the entry of user specifications: User name, company name, output path, and log level.

The Output Path defines the location where the test reports and dumps are saved. The Windows default output path is

```
C:\Documents and Settings\<username>\.itdt-ge\output
```

or

```
C:\Users\<username>\.itdt-ge\output
```

where <username> is the Windows user login name. The Linux default output path is

```
/root/.itdt-ge/output
```

The Log Level must not be changed unless requested to do so by the IBM Support Center. It is recommended that this information be provided to allow for further analysis of test results.
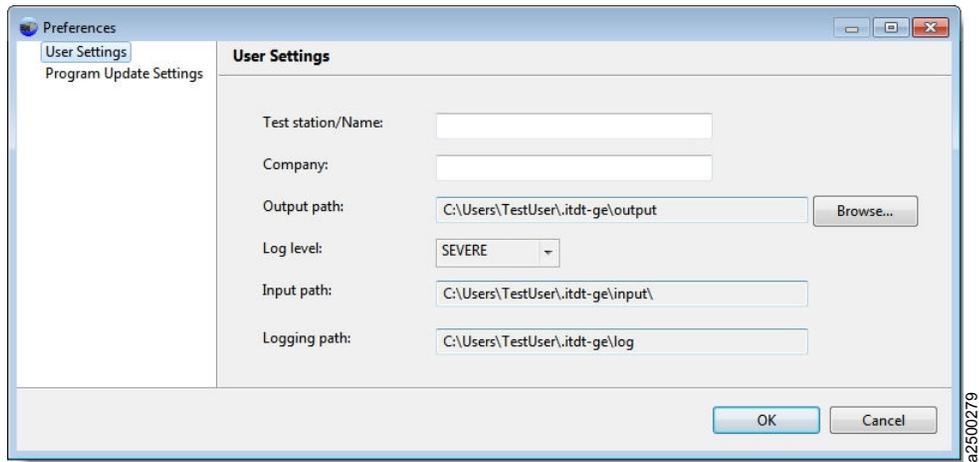
Figure 39. Graphical Edition preferences

The ITDT-GE interface contains the following sections:
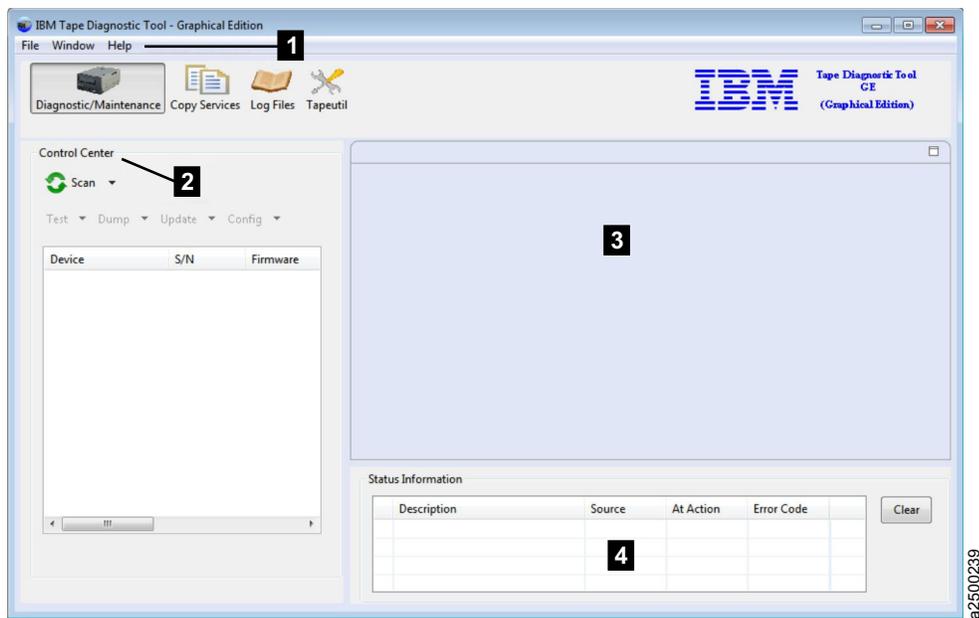
Figure 40. Graphical Edition interface

- Main menu (**1** on Figure 40 on page 191)- in upper left (File, Window, Help) The following main program menu items are available:
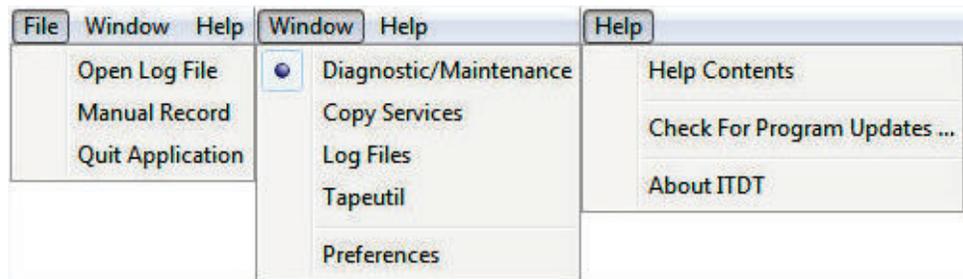

Figure 41. Main program menu items

- Control Center (**2** on Figure 40 on page 191) - On left side (Device operations - Scan, Test, Dump, and Update)

Extra device operations are available by using drop-down arrows.

- Test Lab (**3** on Figure 40 on page 191) - Located from center to right side (Contains running and previously run tests)
- Status Information (**4** on Figure 40 on page 191) - Located below the Test Lab (Contains summary results of tests)

The Control Center is the primary section the ITDT-GE operations.

The following toolbar buttons for the device operations are available.
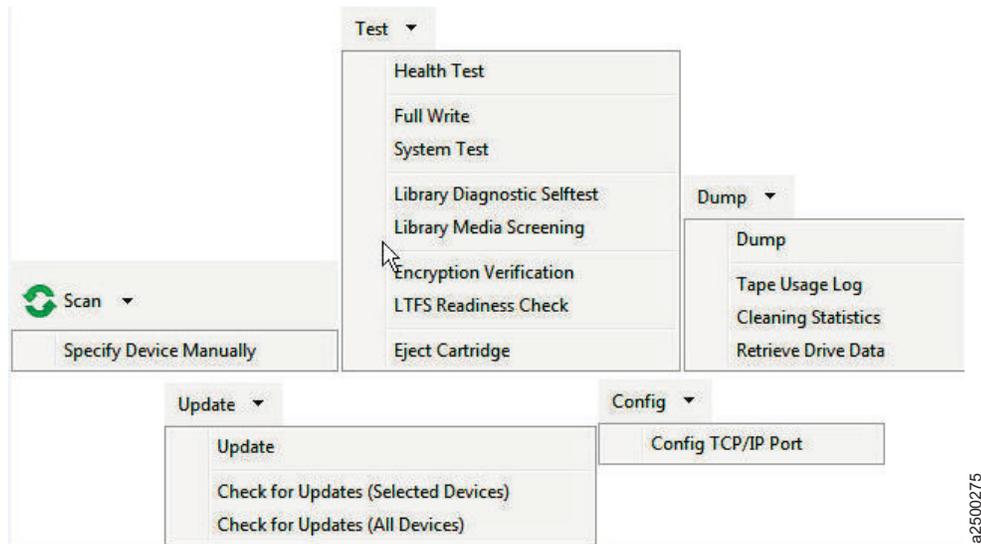
Figure 42. Toolbar buttons

- Click the **Scan** menu item in the Control Center to display the list of tape devices found. When the scan is complete, select one device in the Test Lab by clicking the corresponding check box. Click the arrow next to the **Scan** menu item to add a device manually.
- **Test**

  Click the arrow next to the **Test** menu item to select an extended test.
- **Dump**

  Click the arrow next to the **Dump** menu item to select more log options.
- **Update**

  Click the **Update** menu item to start the firmware update. Click the arrow next to the **Update** menu item to select Online update options.
- **Config**

  Click the **TCP/IP Port** menu item to configure the TCP/IP port.

For each device on which the operation is started, a tab displays on the right panel (Test Lab area). The tab contains the operation information and status. Only one operation can be run at a time with ITDT-GE. The benefit in using tabs even for the single operation mode is that you get a history of operations as for each consecutive operation, a separate tab is opened.

Graphical Edition - Scan menu commands

The following commands are described in this section:

- "Dump" on page 196
- "Firmware Update" on page 197
- "Firmware Update - check for updates" on page 197
- "Encryption" on page 199
- "Full Write" on page 199
- "Tape Usage" on page 201
- "System Test" on page 202
- "Library Diagnostic Self-Test" on page 203
- "Library Media Screening" on page 203
- "LTFS Readiness Check" on page 204
- "Manual Inspection Record Entry" on page 204

Scan
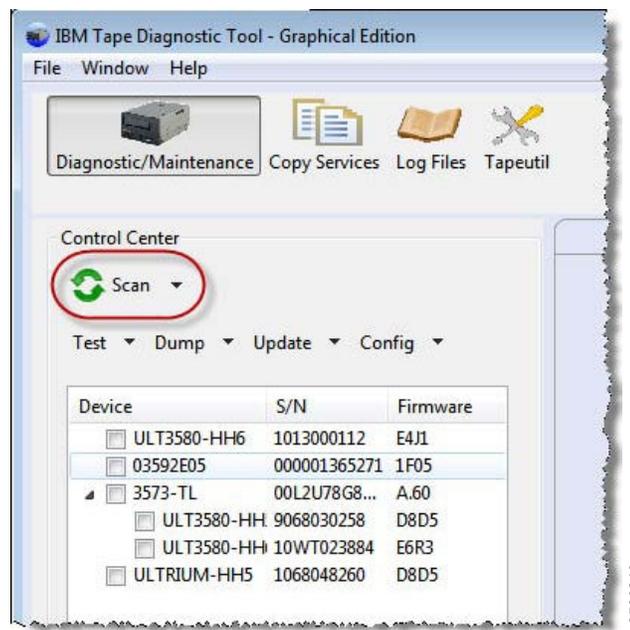
Figure 43. Scan

The scan function is used to discover all supported tape and library devices that are attached to the computer system. Then, they can be selected for the subsequent ITDT-GE operations. The scan function also serves as a connection test that can be used to verify correct attachment of the devices.

Note: When **Scan** is pressed for the first time, a dialog box is displayed that warns the user to stop all backup jobs.

When the scan is finished, the device list is displayed in the Control Center area.

A scroll bar is available to show all the devices. When the device you want is displayed, select the device for test. Only one device can be selected.

Specify Device Manually

The drop-down list next to **Scan** allows you to define a tape device and an associated changer device that must be used for testing. This function is a fast alternative to the **Scan** function where all Host Bus Adapters are discovered for supported tape and changer devices. The function supports the device name and HBTL addressing schema. For stand-alone tape devices the parameter **Changer Device** is not required.

Example device names:

```
Windows: \\.\tape0
Linux: /dev/IBMtape0
```

Example HBTL (all platforms):

```
H1-B0-T3-L0 or 1 0 3 0
```

Partial Scan

Partial Scan is used instead of **Scan** in cases when only a particular HBA or target ID range is used for device-discovering. The scan starts at "First device to scan" and checks for supported devices until "Last device to scan" is reached. Devices that are specified within "Exclude from scan" are skipped during the scan. If "First device to scan", "Last device to scan", or "Exclude from Scan" is not specified, ITDT performs a regular scan.

Partial Scan supports the device name and HBTL addressing schema.

Example device names:

```
Windows: \\.\tape0
Linux: /dev/IBMtape0
```

Example HBTL (all platforms):

```
H1-B0-T3-L0 or 1 0 3 0
```

Health Test
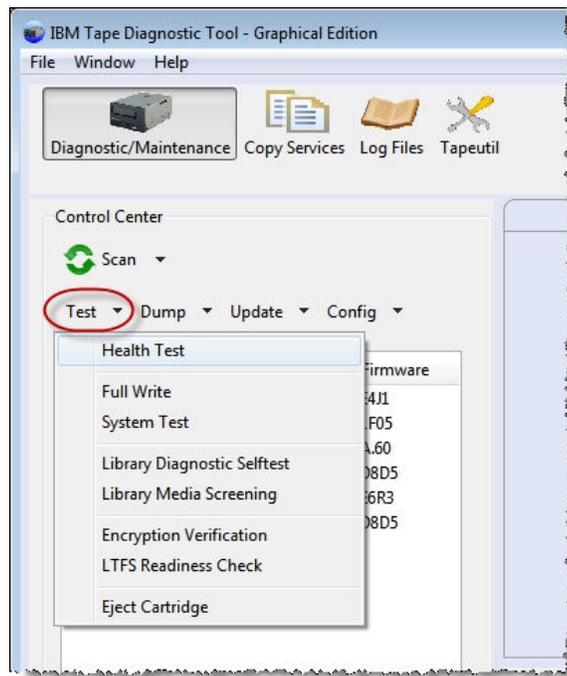
Figure 44. Test

The Health Test function checks if the tape device is defective and outputs a pass/fail result.

⚠️ **Attention:**

1. The test functionality erases user data on the cartridge that is used for the test.
2. The test can take from 15 minutes up to 2 hours.

3. The test runs only on tape drives, not on autoloaders or libraries.

To start the Health Test function, it is recommended that a new or rarely used cartridge is used. Scaled (capacity-reduced) cartridges must not be used to test the device.

To test tape drives within a library, the library must be in online mode.

After the device is selected, start the Health Test function by selecting the **Health Test** menu item.

The Health Test function can be stopped by clicking **Abort**.

Note: It can take some time until the Health Test function stops.
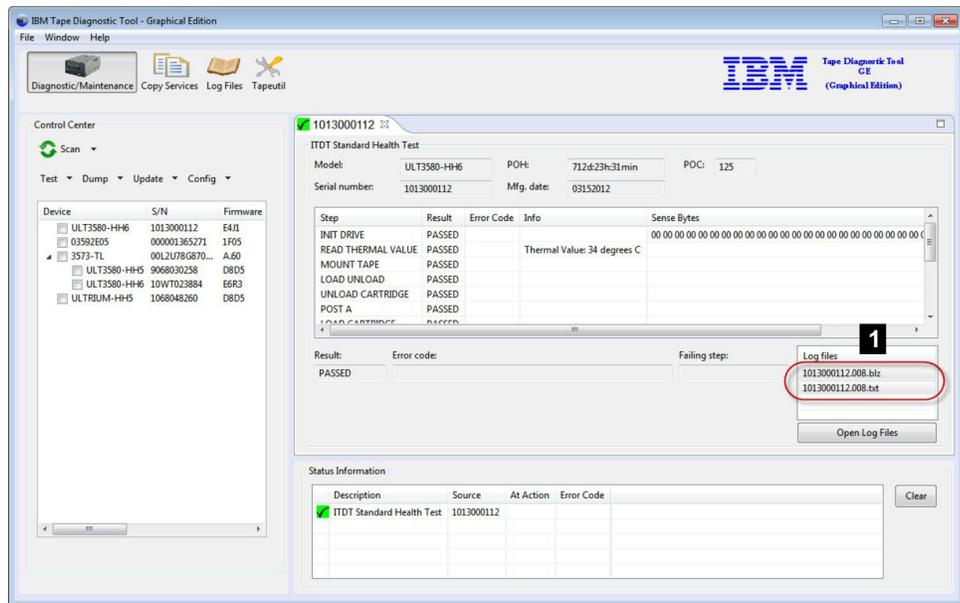
Figure 45. Test results

Note: Information can be found in the .txt/.blz files. See the log file section (**1**).

The test sequence contains the following steps:

1. Initialize Drive
2. Read Thermal Sensor
3. Mount Medium
4. [Medium Qualification] – only if previous step indicated requirement
5. Load/Write/Unload/Read/Verify
6. POST A
7. Performance Test (run 2 times if first run failed with performance failure)
8. Unmount Medium
9. Read Thermal Sensor
10. Get FSC
11. Get Logs

Configure TCP/IP Ports

For LTO 5, TS1140, and later drives, the ethernet port settings can be configured with the **Configure TCP/IP Port** command. The **Configure TCP/IP Port** command displays the current settings:
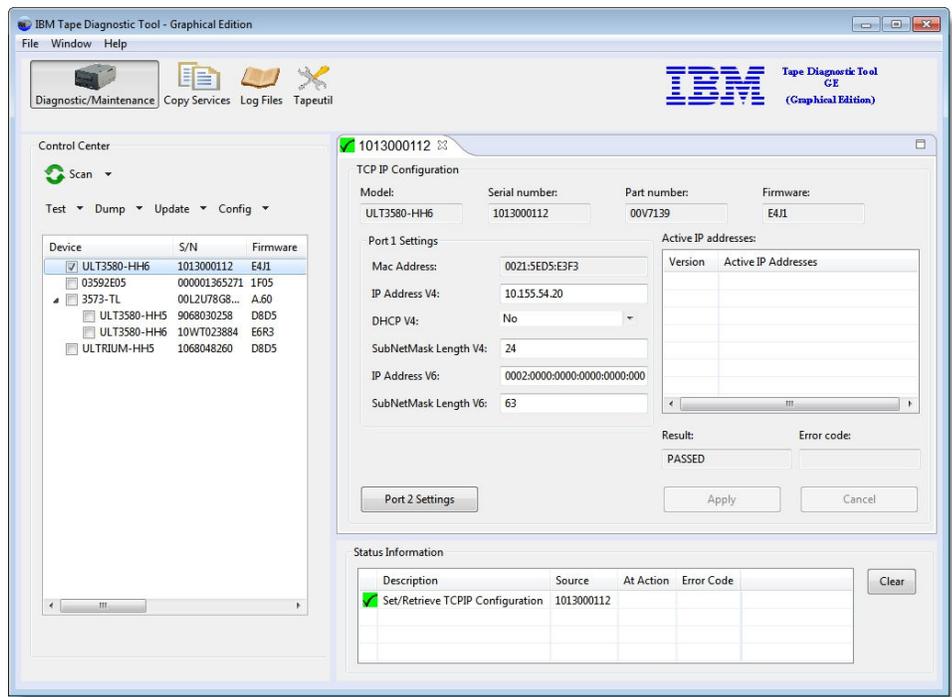
Figure 46. Configure TCP/IP Ports

After you click **Apply**, the new values are set and the updated values display.

Note: Because earlier drive generations do not have an ethernet port, the **Configure TCP/IP Ports** command is rejected for these devices with the following message:

```
TCP/IP configuration is not supported on this product.
```

Dump

After the device you want to dump is selected, start the Dump function by selecting **Dump** > **Dump** from the actions toolbar.

When the dump process is run on a tape library or autoloader other than the 3584/TS3500/TS4500, the Dump function stores 1 log file in the output folder of the program (*.blz). For the 3584/TS3500/TS4500, a dump file (*.a) is stored in the output folder. Both files start with the serial number of the device (**1**).
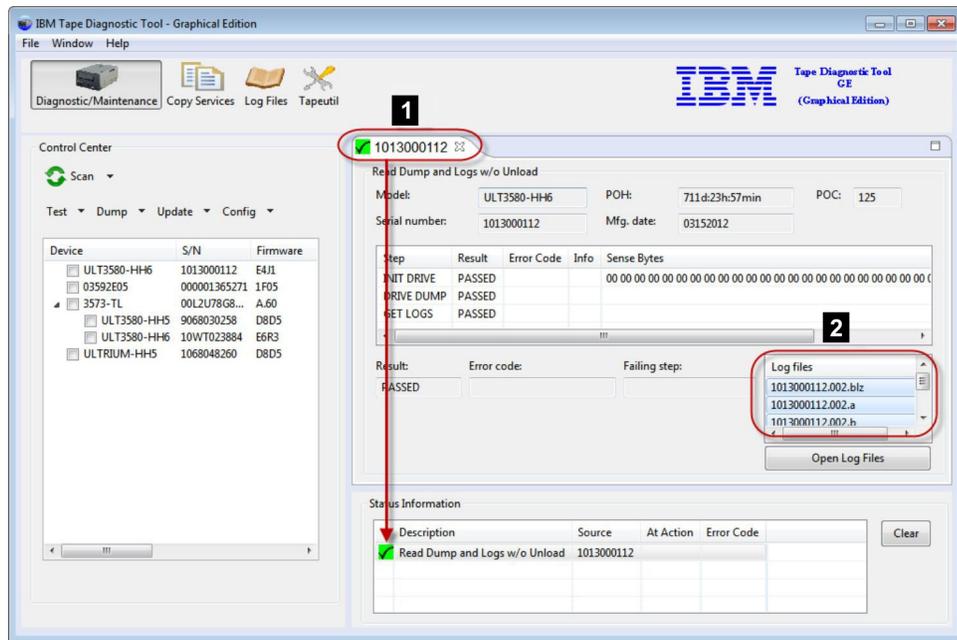
Figure 47. Dump results

Note: When the Dump function is run for tape libraries or autoloaders other than the 3584/TS3500/TS4500, the log file contains Log Sense and Mode Sense pages only. A Drive or 3584/TS3500/TS4500 dump contains more diagnostic information. (**2**)

Firmware Update

The Firmware Update upgrades the firmware of tape drives and tape libraries.

Note: See "TS3310 and TS4500 tape libraries" on page 134 for information on how to update the firmware on a 3576/TS3310 tape library.

The following site is available for the latest firmware files: http://www.ibm.com/storage/lto

To do a Firmware Update, run the following steps:

1. Select the device that you want to update.
2. Select the **Update** menu item.
3. A standard file dialog opens to select the path of where the firmware update is located. The path is either the default input path or the location of the last successfully opened firmware file.
4. Press **OK** on this file dialog to start the update on the selected device.
5. During the firmware update, a firmware update progress screen is displayed, indicating the progress of the update.

⚠️ **Attention:** Once started, do not interrupt the firmware update.

The firmware update usually takes 3-5 minutes, but it can take up to 45 minutes for libraries.

Note: If ITDT-GE detects a FIPS-certified drive firmware, it shows a warning dialog message. Before you continue, ensure that you use a FIPS-certified firmware to update the drive.

Firmware Update - check for updates

ITDT-GE can **Check for Device Updates** for IBM tape drives and IBM tape libraries. You can choose to select either one device or all devices by selecting the corresponding option from the drop down menu under **Update** in the ITDT Control Center.

The program connects to IBM FixCentral and identify updates for the devices. If the connection cannot be established or another problem occurred, the problem description is shown at the bottom of "FixCentral" Test Tab.
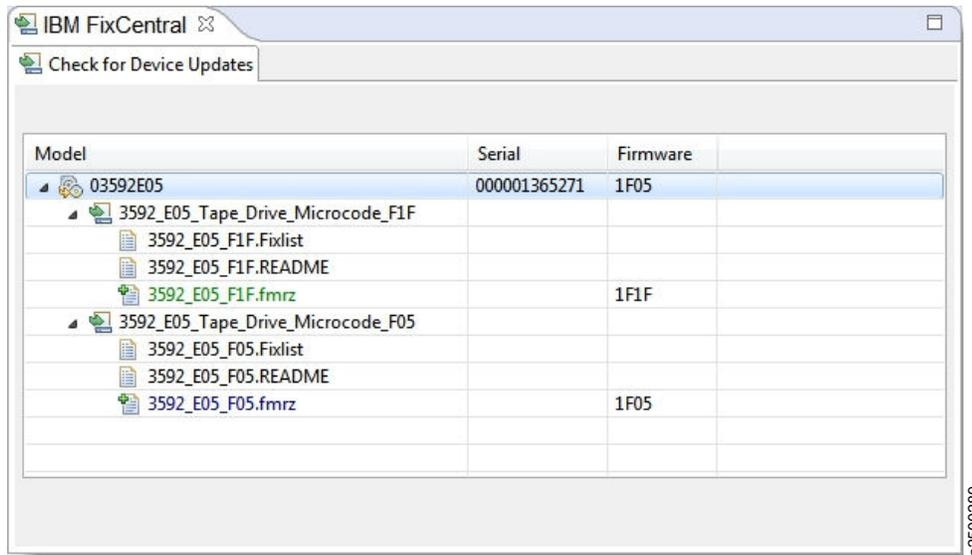

Figure 48. Check for Device Updates - FixCentral components

In the sample above, the drive has two FixCentral components. Each component has several items; such as code files and textual meta information.

The code files (binary files) have a "+" in the icon to distinguish and can be downloaded either by double-clicking or by using the right mouse button. The text files (for example, readme files) can be viewed in the same way. A separate Test Tab is opened and the information shown.

For tape drives an available code is colored:

- GREEN: the code level is newer than the one of the drive.
- RED: the code level is older than the one of the drive.
- BLUE: the code level is the same as the one of the drive.

For automation drives (drives in a library), both devices are used. A code level for an automation drive is directly linked to a code level of a library.
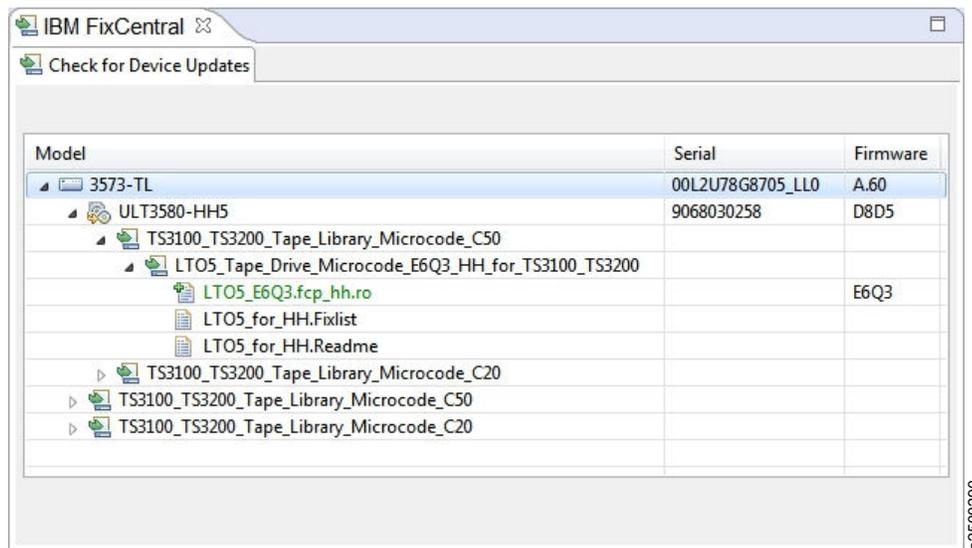

Figure 49. Check for Device Updates - code level

Encryption
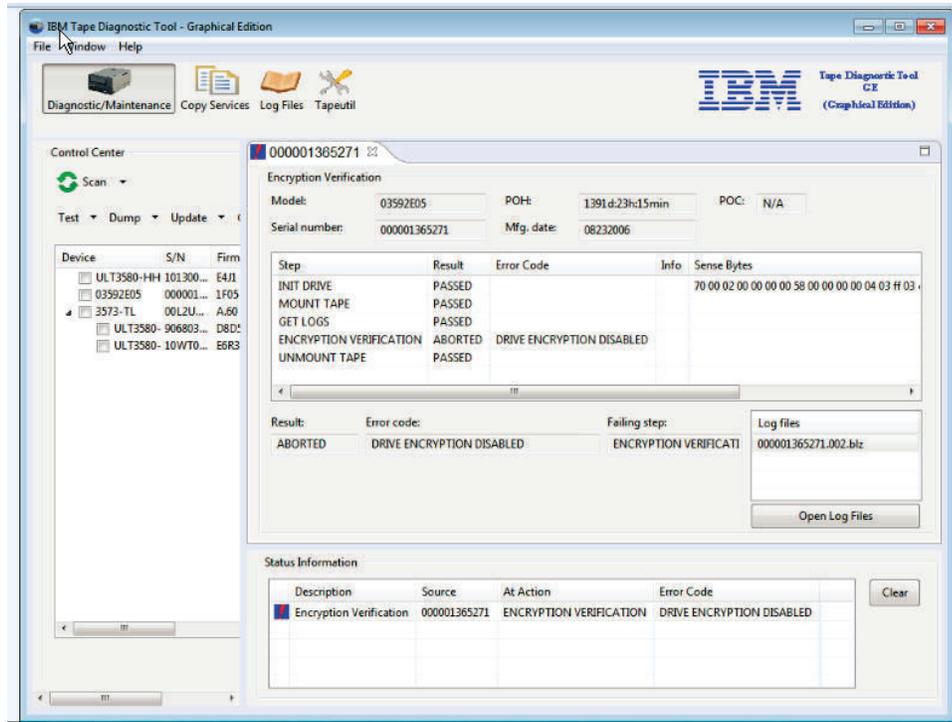
Figure 50. Encryption

Note: The test that is shown on the graphic was run on a non-encrypted device and is showing a failure.

The Encryption function is used to verify whether data on the cartridge is written encrypted. It reads both decrypted and raw data from the cartridge into two separate files on disk. The user can then verify that the data differs to ensure that encryption worked.

The Encryption function is only supported on encryption enabled drives and requires an encryption infrastructure, including the Encryption Key Manager (EKM) to be properly set up.

1. After the device you want to test is selected, start the encryption function by selecting **Test** > **Encryption Verification** from the actions toolbar.
2. ITDT-GE then shows the **Encryption Verification** screen. On this screen, the system requires the entry of the number of the start record and the amount of data (in KB) to be read.
3. Enter the required values and click **OK** to start the encryption.

   The Encryption function can be stopped by clicking **Abort**.

   Note: It can take some time until the Encryption function stops.

Table 23 on page 150 defines the abort codes.

Full Write

The Full Write function writes the entire cartridge with a specified block size either with compressible or incompressible data and output performance data.

⚠️ **Attention:**

1. The Full Write function erases data on the cartridge that is used for the test.
2. The Full Write function takes approximately 2 hours when incompressible data is written, less time for compressible data.
3. The Full Write function runs only on tape drives, not on autoloaders or libraries.

The Full Write test can be used to

- Demonstrate that the drive can write the full amount of data on a cartridge.
- Reveal system performance bottlenecks.

  Full Write runs the test with incompressible data first, then runs the test with compressible data. If no difference in overall performance is observed, a bandwidth limitation might be caused by the system or cabling or HBA.
- Identify system issues with compression.

  Compression is always turned on during the full write. When run with compressible data, the output shows the compression rate. If it is higher than 1.0 but your system is not able to compress data on the cartridge, check your device driver and software settings to see whether they disable compression.

To run a full write on tape drives within a library, the library must be in online mode.

1. After the device you want to write to is selected, start the Full Write function by selecting **Test** > **Full Write** from the actions toolbar.
2. Click **OK** to start the full write.
3. ITDT-GE then shows the **Full Write** screen. If no cartridge is inserted, ITDT-GE prompts you to insert a cartridge. Either insert a cartridge and click **OK** or stop by clicking **Abort**.

   **Note:** If ITDT-GE detects data on the cartridge, it shows the following message.
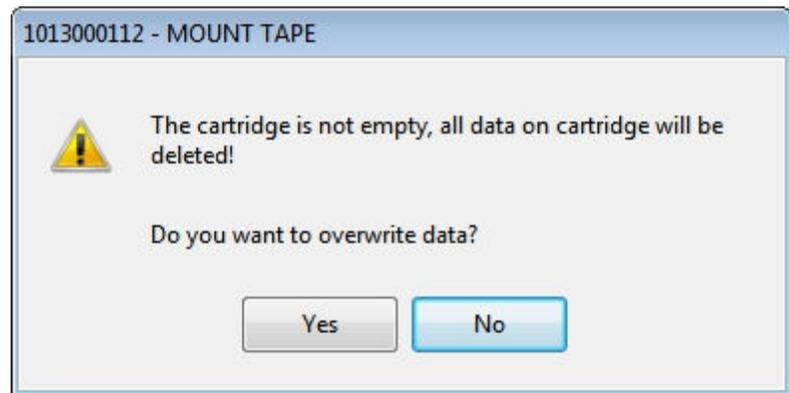
Figure 51. Overwrite data?

   Click **Yes** to continue the test if you are sure that data on the cartridge can be overwritten. If you are unsure, click **No** to stop the test.
4. The system prompts for entry of a transfer size between 16 KB and the maximum block size that is supported by the system. Maximum value is 512 KB. Select the appropriate value for your system.
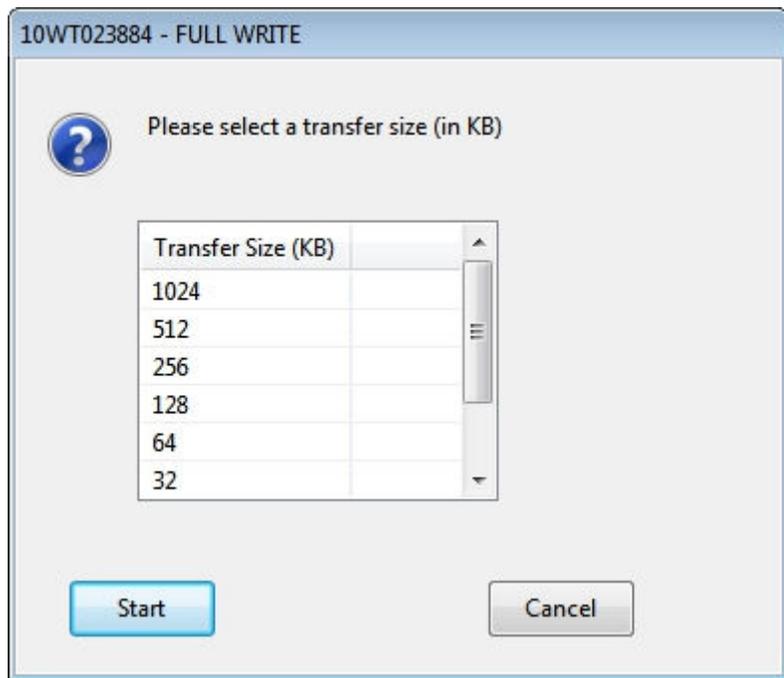
Figure 52. Transfer size

5. Select the type of data to write, either **[C] Compressible** or **[I] Incompressible**.

   The full write can be stopped by clicking **Abort**.

   Note: It can take some time until the full write actually stops.

   "Compressible = Yes" means that the data written was just zeros so that the data can be compressed by the drive with a maximum compression ratio. "Compressible = No" means that a data pattern was written that the drive almost cannot compress at all. If the compression ratio is 1, the drive was not able to compress the data (equivalent to 1:1 compression ratio). If the compression ratio is 94.0, the drive was able to do 94:1 compression. It means that 94 bytes in the original data was compressed to 1 byte on the medium. 100.0 means 100 bytes is compressed down to 1 byte on the medium.

   If all write operations are finished, ITDT-GE shows the performance statistics for the selected block size that is written on the cartridge, in the **Status Information** area. If an error occurred during the full write, data is only partially written.

Tape Usage
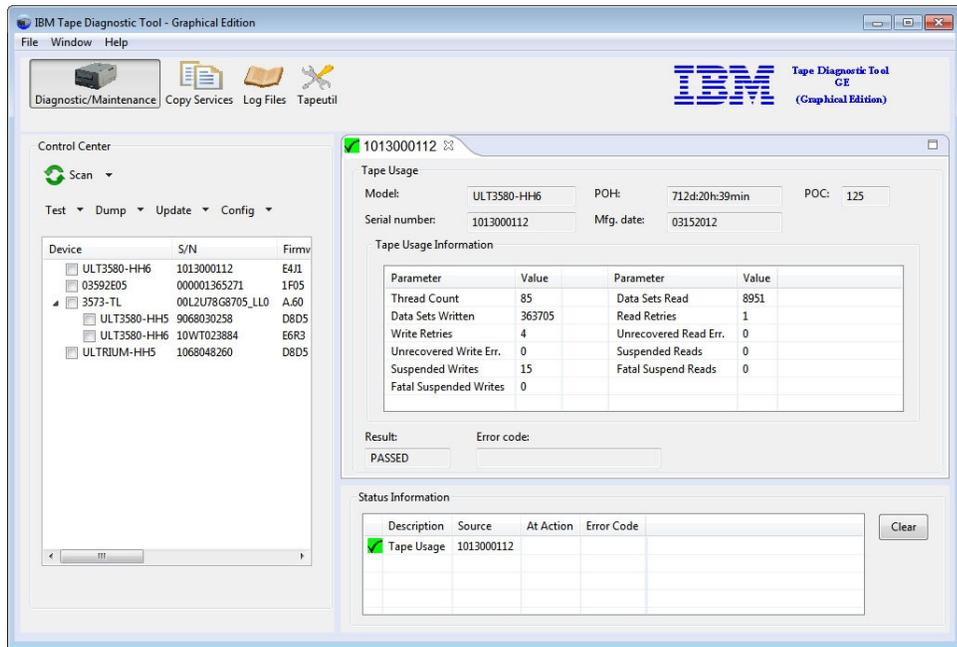
Figure 53. Tape Usage

The Tape Usage function retrieves statistical data and error counters from a cartridge.

1. After the device you want to test is selected, start the Tape Usage function by selecting **Dump** > **Tape Usage Log** from the actions toolbar.

2. ITDT-GE then shows the tape usage screen. If no cartridge is inserted, ITDT-GE prompts you to insert a cartridge. Either insert a cartridge and click **OK** or stop by clicking **Abort**.

System Test

The System Test is a short test that runs the following tests:

- Reveals system performance bottlenecks. Compressible data throughput values can reveal bandwidth limitations that are caused by the system or cabling or HBA.

- Measures performance variations across the different block sizes to find the ideal block size for the system configuration.

The System Test runs only on tape drives, not on autoloaders or libraries. To run a System Test on tape drives within a library, the library must be in online mode.

After the device you want to test is selected, start the System Test function by selecting **Test** > **System Test** from the actions toolbar.

ITDT-GE then shows the **System Test** screen. If no cartridge is inserted, ITDT-GE prompts you to insert a cartridge. Either insert a cartridge and click **OK** or stop by clicking **Abort**.

Note: If ITDT-GE detects data on the cartridge, it shows the following message -

```
Cartridge not empty!
  Overwrite data?
```

Click **Yes** to continue the test if you are sure that data on the cartridge can be overwritten. If you are unsure, click **No** to stop the test.
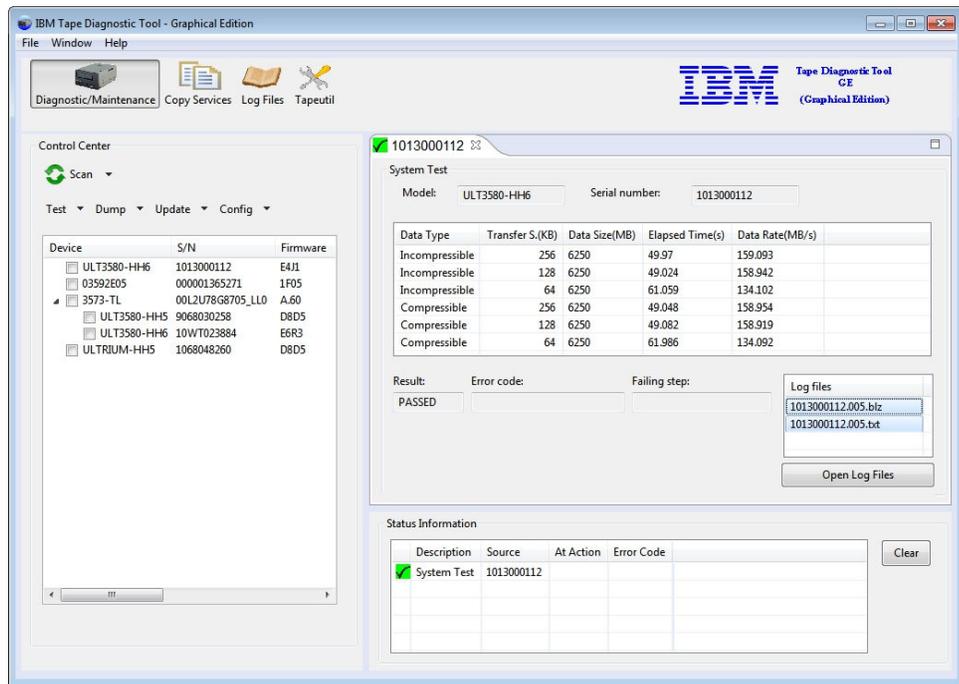
Figure 54. System Test

The System Test is run as follows:

1. System Test determines the amount of data to write for each supported blocksize (a percentage of the cartridge is written for each blocksize).
2. The test determines the maximum supported blocksize of the system.
3. System Test writes the amount of data with all supported block sizes in powers of two down to 64 KB (values of 16 KB and 32 KB are not tested in cases where the capability of a system supports higher block sizes). It begins with the maximum supported blocksize that is detected before, first with incompressible, next with compressible data. Then, it shows performance data and a progress screen.
4. At the end of the test, a summary information is shown.

Library Diagnostic Self-Test

The Library Self-Test starts and monitors the library-internal self-test. This test runs only on libraries and autoloaders, not on tape drives.

After the device you want to test is selected, start the Library Self-Test function by selecting **Test** > **Library Diagnostic Self-Test** from the actions toolbar.

At the end of the test, the results are shown in the Status Information area.

Library Media Screening

The Automated Library Media Screening test generates dumps for each drive and cartridge within a library. It runs only on libraries (except TS3500/TS4500) and auto-loaders, not on tape drives.

First, the test tries to read dump files from each drive that is installed from the library. Then, you can select one drive for loading the cartridges.

All cartridges of the I/O and storage slots are moved - one after the other from their source to the selected drive. A dump is taken and moved back to the source address. In the result screen, the dumps taken and the count of dumps are shown.

LTFS Readiness Check

The LTFS Readiness Check analyzes the Operating System and tape drive environment to ensure that the IBM Linear Tape File system can be installed. For extended information, refer to "Check LTFS Readiness" on page 148.

Manual Inspection Record Entry

A manual inspection record can be generated if the device does not show in the device list. This test is intended for devices that are not recognized or have a technical problem that cannot be determined by ITDT-GE.

If a tape drive cannot be identified by using a device scan, the user can manually create a test record for the drive. The system prompts the user to run the SCSI/FC Wrap test for the drive (see the service manual for the drive). The results of the wrap test can be entered along with extra inspection information. The results are saved into binary and text output files that have the same format as the output files generated by the test.

1. From the **Main Program** menu, select **File** > **Manual Record**.
2. Enter the required information to complete the items in the screen.

    a. Enter the device serial number.

    b. Enter the content of the Message Display.

    c. Optionally, enter any information text.

3. After all information is entered, click **OK**.

    The information is stored in a binary file (which can be used for further analysis), and in a human-readable text file. Both files are stored in the ITDT-GE output folder.

Copy Services

With **Copy and Migration Services**, tape content can either be copied or moved

- From a cartridge to another cartridge
- From a cartridge to an image file, or
- From an image file to a cartridge.

On UNIX operating systems, a warning to check the file size limit is shown before an image file is created, if the maximum file size is below 2 GB.

The tool offers different use cases like copying data or migrating data from one generation to another. That is, data can be copied from a Gen4 cartridge to a Gen5 cartridge. Even migration from an LTO to IBM Enterprise Tape Systems is supported. For an LTFS environment, the data can be copied or moved with the LTFS Physical copy that adjusts the LTFS parameter on the target to be unique. Such a copy can be used in the same LTFS environment as the source. To ensure maximum performance for tape to tape copy actions, ITDT allocates a read buffer that calculates to 2500 multiplied by the maximum supported system blocksize. If the system does not provide this buffer, the operation is aborted with MEMORY ALLOCATION FAILED. An infinite progress bar indicates the ongoing copy procedure. A dialog box confirms the completion.

Tape Physical Copy

Creates a physical copy of a tape cartridge either to another cartridge or to an image file. The created cartridge has the same physical layout and contents as the source cartridge. **Tape Physical Copy** supports LTO and 3592 tape drives and can therefore be used for data migration. A copy from a previous generation to a newer generation cartridge and from an LTO to a 3592 works. However, the amount of used data from the source device must be equal or less than the capacity of the destination device. If the source cartridge is partitioned, the target must support the same partitioning sizes and amount. The amount of transferred data and the current data transfer rate is displayed every 3 - 5 minutes.

LTFS Physical Copy

Creates a physical copy of an LTFS formatted cartridge. The LTFS specified parameters **volumeuuid** and **VCI** are adjusted during this copy operation. The created cartridge has the same physical layout as the origin cartridge. Expect the **volumeuuid** to be identical to the contents of the two cartridges. The amount of transferred data and the current data transfer rate is displayed every 3 - 5 minutes. When 'LTFS Physical Copy' is used with a non-LTFS formatted cartridge, the behavior is identical to **Tape Physical Copy**. For LTFS formatted cartridges, the volume identifier can be changed for a physical target by specifying **New LTFS Volume Label**.

Verify

Verifies the physical contents of two cartridges. The physical data layout and the binary data are compared.

Usage

By opening the "Copy Services" perspective, the user can run a 'Scan...' to discover attached devices.
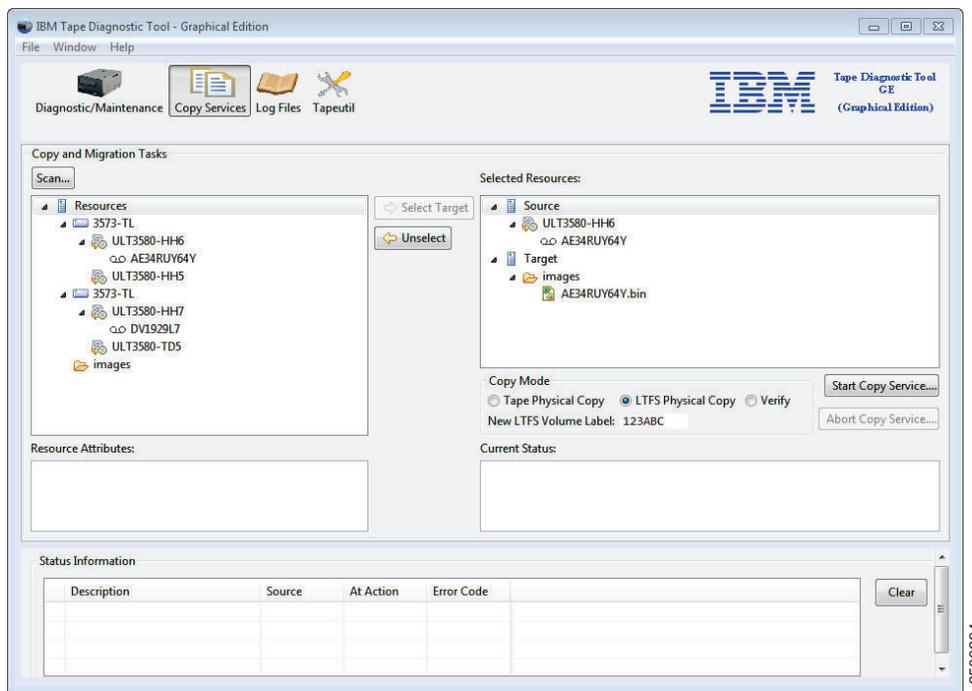

Figure 55. Copy Services

A cartridge can be loaded or unloaded by double-clicking or pressing the right mouse button on the drive that is used for the copy tasks. When a cartridge is loaded, the cartridge Serial Number or the VOLSER in a library environment is shown. If a cartridge or an image file is selected on the left, it can be used as "Source" by pushing **Select Source**. After the 'Source' is selected, the target can be chosen. To select the target, either a different cartridge in a different drive or the image file folder can be selected. By pressing **Select Target**, the target is set on the right.

If the source and the target are selected, the Copy Services or a verification can be started regarding the used Mode: "Tape Physical Copy" on page 204, "LTFS Physical Copy" on page 205, or "Verify" on page 205.

Graphical Edition - visualizing log files

ITDT-GE offers the opportunity to visualize the content of DUMP and ITDT log files (BLOB files).

- Dump files can be retrieved with ITDT or any other tool that supports this function.
- Dump files that are generated by ITDT have the suffix ".a" or ".b".
- BLOB files are generated during the run of an ITDT test sequence, such as "Standard Test".
- BLOB files have the suffix ".blz".
- Both file types can be opened and visualized with ITDT-GE.
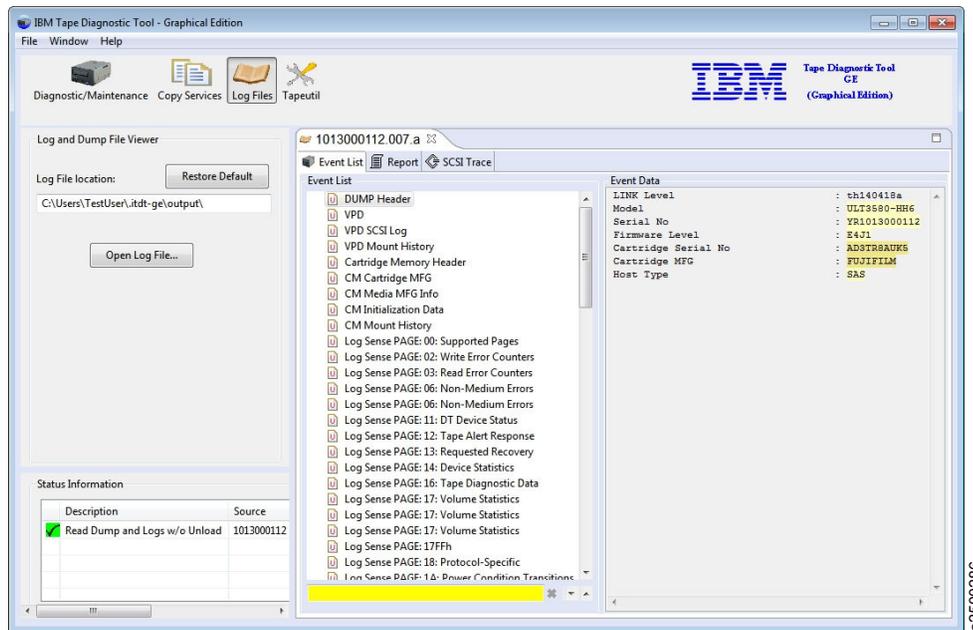
Figure 56. Graphic Edition: log view

Opening a Dump or BLOB file

A Dump or a BLOB file can be opened either with the menu command **File/Open Log File** or by switching to the **Log Files** perspective and pressing **Open Log File ...**. In both cases, a **File Selection** dialog opens where files can be selected for display. After the successful opening of a file, the data is shown.

Two views are available for presenting the data - each at a separate panel.

- The **Event List** shows the events of this file on the left side. An event is a group of information and consists of 1 to n Elements shown on the right. By selecting one event list entry on the left, the corresponding data (event elements) is shown on the right.
- The **Report** panel offers the opportunity to generate a sublist of the available 'Event List' entries.

Graphical Edition - Tapeutil menu commands

After the initial startup, ITDT-GE shows three figures under the top menu. After the Tapeutil option is selected, the following page opens.
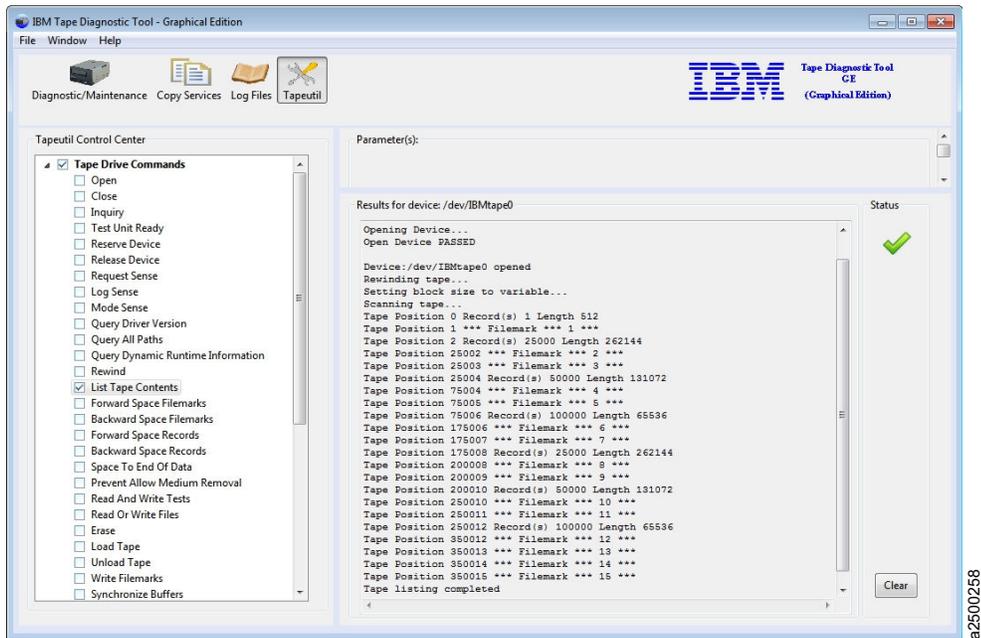
Figure 57. Tapeutil Control Center

On the left, the **Tapeutil Control Center** tree contains all Tapeutil commands for tape drives and tape libraries.

The commands from the **General Commands** and **Service Aid Commands** categories are duplicated into the two sections (to make the GUI navigation easier). After one category is expanded, the related commands open that allows users to select the command.
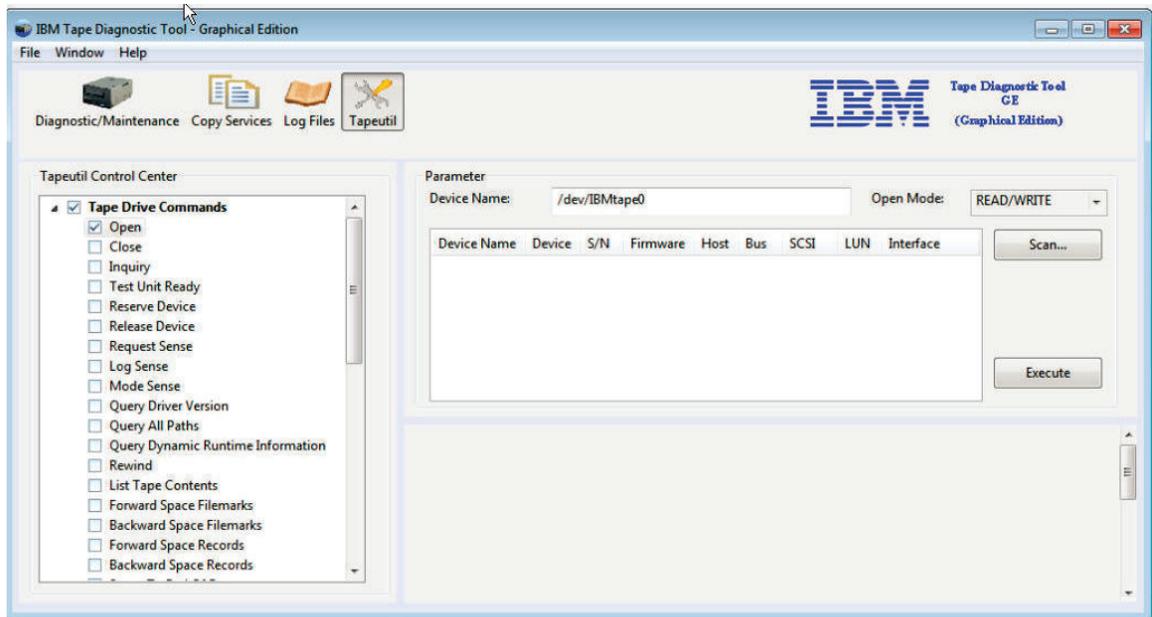

Figure 58. Command parameters

When the user presses **Execute**, the **Results** output is placed below the **Parameter** section:
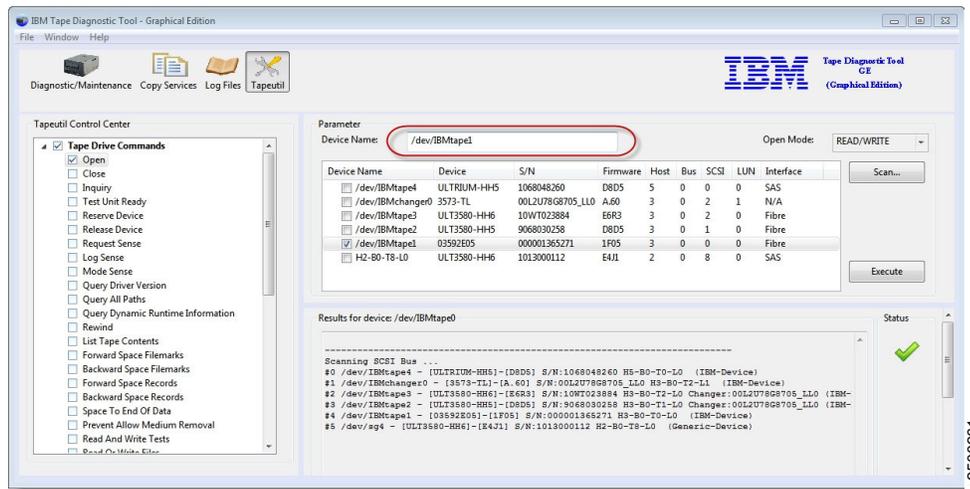
Figure 59. Command parameter results

The **Open** command has a **Scan ...** button in the **Parameter** view. Pressing **Scan...** runs a scan on the host and shows the attached devices in the **Result View** at the bottom. This information is helpful to identify the right Device Name for the open function field **Device Name**.
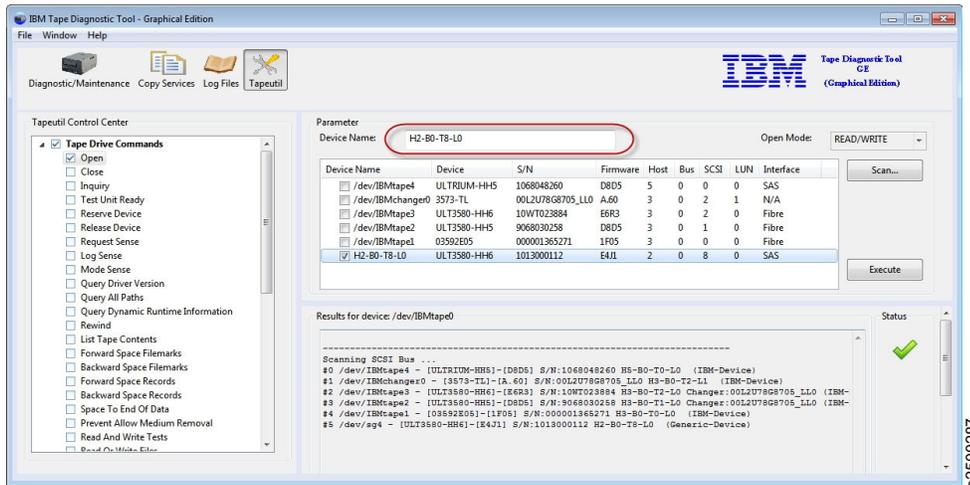

Figure 60. Generic tapeutil scan
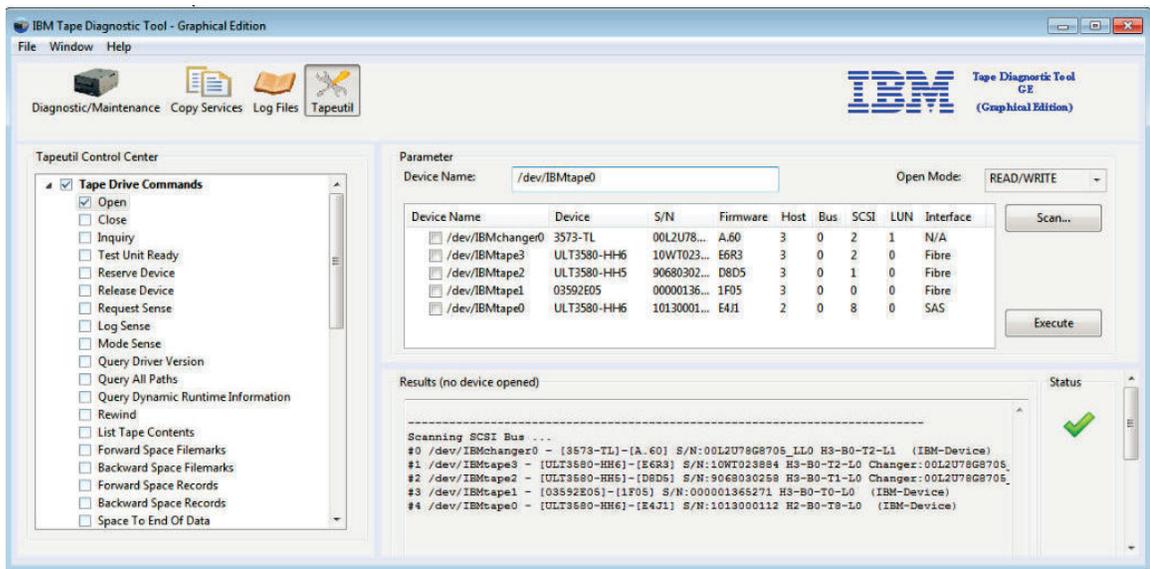
Figure 61. DD tapeutil scan

This screen layout stays within the **Tapeutil** perspective until the program is closed. Outputs of subsequent operations are added to the **Results** field. Commands that fail are indicated with a red cross in the **Status** area. Commands that succeed are indicated with a green check mark. The status area can be cleared by pressing **Clear**.

General commands

- "Open" on page 210
- "Close" on page 210
- "Inquiry" on page 210
- "Test Unit Ready" on page 211
- "Reserve Device" on page 211
- "Release Device" on page 211
- "Request Sense" on page 211
- "Log Sense" on page 211
- "Mode Sense" on page 211
- "Query Driver Version" on page 211
- "Display All Paths" on page 211

Tape drive specific commands

- "Rewind" on page 211
- "Forward Space Filemarks" on page 211
- "Backward Space Filemarks" on page 212
- "Servo Channel Calibration" on page 212
- "Forward Space Records" on page 212
- "Backward Space Records" on page 212
- "Space to End of Data" on page 212
- "Read and Write Tests" on page 212
- "Read or Write Files" on page 214
- "Erase" on page 214

- "Load Tape" on page 214
- "Unload Tape" on page 214
- "Write Filemarks" on page 215
- "Synchronize Buffers" on page 215
- "Query/Set Parameter" on page 215
- "Query/Set Position" on page 215
- "Query Encryption Status" on page 215
- "Display Message" on page 215
- "Display All Paths" on page 211
- "Report Density Support" on page 216
- "Test Encryption Path" on page 216

Tape library-specific commands

- "Element Information" on page 217
- "Position to Element" on page 217
- "Element Inventory" on page 217
- "Exchange Medium" on page 217
- "Move Medium" on page 217
- "Initialize Element Status" on page 217
- "Prevent/Allow Medium Removal" on page 218
- "Initialize Element Status Range" on page 218
- "Read Device IDs" on page 218
- "Read Cartridge Location" on page 218

Service aid commands

- "Configure TCP/IP Ports" on page 218
- "Dump/Force Dump/Dump" on page 219
- "Firmware Update" on page 219

Note: When a command is issued in Tapeutil mode for ITDT GE, **Execute** must be pressed before the action takes place.

Open

When you select the **Open** command:

1. ITDT checks if a device is already opened.
2. Under **Device Name:**, enter the name of the device in the box.
3. In the **Open Mode** menu, select how to open the device (rw, ro, wo, append).
4. ITDT opens the device that you selected.

Note: Always use the Read Only mode when you are working with write-protected media.

Close

When you select the **Close** command

1. ITDT checks if the device is already closed.
2. ITDT closes the device.

Inquiry

When you select the **Inquiry** command

1. You are prompted for page code.
2. ITDT then displays a decoded format of a hexadecimal dump and prints a hexadecimal dump of the inquiry data.

Test Unit Ready

When you select the **Test Unit Ready** (TUR) command, ITDT issues the **Test Unit Ready** *ioctl* command.

Reserve Device

When you select the **Reserve Device** command, ITDT issues a reserve command for the device.

Release Device

When you select the **Release Device** command, ITDT issues a release command for the device.

Request Sense

When you select the **Request Sense** command

1. ITDT issues a **Request Sense** command.
2. ITDT then displays a decoded format of hexadecimal dump sense data and prints hexadecimal dump sense data.

Log Sense

When you select the **Log Sense** command

1. Enter the page number, in hexadecimal, in the **Page-Code** field.
2. ITDT issues a **Log Sense** command and outputs a hexadecimal dump of that page.

Mode Sense

When you select the **Mode Sense** command

1. Enter the page number, in hexadecimal, in the **Page-Code** field.
2. ITDT issues a **Mode Sense** command and outputs a hexadecimal dump of that page.

Query Driver Version

When you select the **Query Driver Version** command

1. ITDT issues the required command to get the driver version.
2. ITDT prints the driver version.

Display All Paths

When you select the **Display All Paths** command

1. ITDT issues an *ioctl* command.
2. ITDT outputs decoded path information for all paths.

Rewind

When you select the **Rewind** command, ITDT issues the *ioctl* rewind command for the device.

Forward Space Filemarks

When you select the **Forward Space Filemarks** command

1. Enter the amount of filemarks to forward space, in the **Filemark-Count** box.
2. ITDT issues (extrinsic) *ioctl* command.
3. The tape is positioned on the first block of the next file.

Backward Space Filemarks

When you select the **Backward Space Filemarks** command

1. Enter the amount of filemarks to backward space, in the **Filemark-Count** box.

2. ITDT issues (extrinsic) *ioctl* command.

3. The tape is positioned on the last block of the previous file.

Servo Channel Calibration

When you select the **Servo Channel Calibration** command:

1. ITDT issues the self diagnostic command for drive servo channel calibration.

2. The channel calibration returns PASSED or FAILED regarding the result of the command.

Forward Space Records

When you select the **Forward Space Records** command

1. Enter the amount of records to forward space, in the **Record-Count** box.

2. ITDT issues (extrinsic) *ioctl* command.

Backward Space Records

When you select the **Backward Space Records** command

1. Enter the amount of records to backward space, in the **Record-Count** box.

2. ITDT issues (extrinsic) *ioctl* command.

Space to End of Data

When you select the **Space to End of Data** (EOD) command, ITDT issues the (extrinsic) *ioctl* command.

Read and Write Tests

When you select the **Read and Write Tests** command, ITDT runs the following functions (Read and Write Test, Read Only Test, and Write Only Test). Three parameter fields have default values already in them. Next, a **Test** menu that gives you the option of **Read Data from Tape**, **Write Data to Tape**, and **Read/Write/Verify**.

Note: The default is a block size of 10240 bytes, a count of 20 blocks, and a repetition of 1. If the block size is zero, variable mode is used. With a fixed block size, a data amount of (block size * blocks) is transferred with a single operation. This operation might get rejected if the total amount exceeds the transfer size of the system.

In *SCSI Generic mode*, the actual transfer size equals to **blocksize**. In *IBM Device Driver mode*, the transfer size is **blocksize * blocks per read/write**. In either case, the blocksize must be equal to or less than the maximum Host Bus Adapter supported transfer size. The maximum supported transfer size for *SCSI Generic* is 1048576 Bytes and for *IBM Device Driver* is 500 MB.

The following steps are run, depending on which test is selected.

- The Read/Write steps:

  1. Issues a Read Position.

  2. Sets block size.

  3. Generates special pattern.

  4. Puts block id in bytes 0-3 of each block.

  5. Prints current block number, number of bytes and blocks.

  6. Issues write command.

  7. Prints updated statistics.

8. If number of bytes written is different from requested bytes to write, stop (go to Step 19).

9. Writes two filemarks.

10. Backward spaces two filemarks.

11. Backward spaces number of records written.

12. Prints amount of data to read.

13. Issues read command.

14. If read error occurred or number of bytes read is different from requested number of bytes to read, go to Step 19.

15. Compares data that is read with data written, show miscompares and if miscompares exist, stop (go to Step 19).

16. If compare is OK, print OK message.

17. Forward space one file mark.

18. Repeat Steps 10 - 24 until all blocks are written, or go to Step 4 until all blocks are written.

19. Prints current block id and total number of bytes written.

- The Read Only steps:

    1. Issues a Read Position.

    2. Sets block size.

    3. Generates special pattern.

    4. Print amount of data to read.

    5. Issues read command.

    6. If read error occurred or number of bytes read is different from requested number of bytes to read, stop (go to Step 19).

    7. Compares data that is read with buffer data, show miscompares and if miscompares exist, stop (go to Step 19).

    8. If compare is OK, print OK message.

    9. Repeat Steps 10 - 15 until all blocks are written, or go to Step 4 until all blocks are written.

    10. Prints current block id and total number of bytes read.

    11. Backward spaces number of records written.

    12. Prints amount of data to read.

    13. Issues read command.

    14. If read error occurred or number of bytes read is different from requested number of bytes to read, go to Step 19.

    15. Compares data that is read with data written, show miscompares and if miscompares exist, stop (go to Step 19).

    16. If compare is Ok, print OK message.

    17. Forward space one file mark.

    18. Repeat Steps 10 - 24 until all blocks are written, or go to Step 4 until all blocks are written.

    19. Prints current block id and total number of bytes written.

- The Write Only steps:

    1. Issues a Read Position.

    2. Sets block size.

    3. Generates special pattern.

    4. Put block id in bytes 0-3 of each block.

    5. Prints current block number, number of bytes and blocks.

    6. Issues write command.

7. Prints updated statistics.

8. If number of bytes written is different from requested bytes to write, stop (go to Step 10).

9. Repeat Steps 5 - 9 until all blocks are written, or to Step 4 until all blocks are written.

10. Print current block ID and total number of bytes written.

Read or Write Files

When **Read or Write Files** is selected, a box under **File Name:** is where the path and name of the file is entered. Under that is a box named **Number of records to read (0 for entire file)**. The default amount in the box is 100. Next, a menu bar under **Test:** gives you the choice of **Read File from Tape** or **Write File to Tape**. Once the Test is selected, **Browse** appears next to the **File Name** box to allow browsing for the needed file. When you select the **Read or Write Files** command, ITDT runs the following functions:

- Read steps:

    1. Prompts if to read a file from tape

    2. You are prompted for destination file name

    3. You are prompted for number of records to read (If you press **Enter**, the entire file is read.)

    4. Prints the file name to be opened

    5. Opens the file (r/w with large file support, 666 umask)

    6. Issues **Query Parameters** *ioctl* command, if it fails, quit

    7. Sets blocksize to maximum, variable blocksize mode

    8. Calculates the number of blocks to read.

    9. Prints number of records to read.

    10. ITDT read from tape.

    11. Writes to file, stop if data count is not equal to data count requested.

    12. If more data to read, go to Step 10.

    13. Prints statistics.

- Write steps:

    1. Prompts if to write a file to tape.

    2. You are prompted for the source file name.

    3. Prints the file name to be opened.

    4. Opens the file (r/o with large file support).

    5. Issues **Query Parameters** *ioctl* command, if it fails, quits.

    6. Sets blocksize to maximum, variable blocksize mode

    7. Prints write statement.

    8. Reads from file.

    9. Writes to tape, stop if data counts written is not equal to data count requested.

    10. Prints statistics.

Erase

When you select the **Erase** command, ITDT issues the (extrinsic) *ioctl* command.

Load Tape

ITDT issues a SCSI **Load** command to load a tape.

Unload Tape

When you select the **Unload Tape** command

1. ITDT issues the (extrinsic) *ioctl* command.
2. The tape rewinds and then unloads.

Write Filemarks

When you select the **Write Filemarks** command

1. In the **Filemark-Count** box, enter the number of filemarks to write.
2. ITDT issues the (extrinsic) *ioctl* command.

Synchronize Buffers

When you select the **Synchronize Buffers** command, ITDT issues the *ioctl* command.

Query/Set Parameter

When you select the **Query/Set Parameter** command

1. ITDT shows the changeable parameters.

   Note: The list of changeable parameters are operating system specific. For a list of changeable parameters, refer to .
2. Select from the list of parameters that can be changed by clicking the choice.
3. ITDT requests prompt for parameter value (if required).
4. ITDT requests safety prompt (if required).
5. ITDT issues the *ioctl* command.

Query/Set Position

When you select the **Query/Set Position** command

1. ITDT prints the current position and requests the new position.

   Note: ITDT does not distinguish between logical and physical position. It shows the current position and queries for the one to set, then sets the new position.
2. Enter the block id for where the tape must go. This block id must be entered in decimal. When the tape is set, the block id is printed in decimal with hexadecimal in parentheses.
3. ITDT issues the **Set Position** *ioctl* and returns the pass or fail results.
4. ITDT prints decoded logical position details.
5. ITDT issues **Query Physical Position** *ioctl* command.
6. ITDT prints decoded physical position details.
7. You are prompted for position to set (logical or physical) or to stop.
8. You are prompted for the block id in decimal or hexadecimal.
9. ITDT prints a summary.
10. ITDT issues the **Set Position** *ioctl* command.
11. Repeat steps 2 - 5.

Query Encryption Status

When you select the **Query Encryption Status** command

1. ITDT issues **Get Encryption State** *ioctl* command.
2. ITDT displays encryption settings (Drive EC, Encryption Method, Encryption state).

Display Message

When you select the **Display Message** command

1. ITDT provides **Parameter** boxes in which you can enter 1 or 2 messages up to 8 characters.

Note: `Display Message` works only on drives that have a display pane, the 3590 and 3592 drives.

2. In the **Type:** menu, select which message (0 or 1) you want shown and if you want it to flash. There is also an alternate (alt) selection that alternates between messages.

3. ITDT issues the *ioctl* command.

4. ITDT prints the displayed message.

Display All Paths

When you select the **`Display All Paths`** command

1. ITDT issues an *ioctl* command.

2. ITDT outputs decoded path information for all paths.

Report Density Support

When you select the **`Report Density Support`** command

1. ITDT prints report status text for all supported media.

2. ITDT issues **`Report Density Support`** *ioctl* command to retrieve all supported media.

3. ITDT prints all requested reports. Data is printed in a decoded way. Scroll the screen to print each one of the following status texts:

   - Density name
   - Assigning organization
   - Description
   - Primary density code
   - Secondary density code
   - Write OK
   - Duplicate
   - Default
   - Bits per MM
   - Media Width
   - Tracks
   - Capacity (megabytes).

4. ITDT prints report status text for current media.

5. ITDT issues **`Report Density Support`** *ioctl* command to retrieve current media.

6. ITDT prints report data in a decoded way.

Test Encryption Path

When you select the **`Test Encryption Path`** command

Note: Not supported for the HP-UX operating system.

1. ITDT prints status message that server configuration and connections are tested.

2. ITDT issues the **`Encryption Diagnostics`** *ioctl* command, **Ping Diag**.

3. ITDT prints number of servers available or error message.

4. ITDT issues the **`Encryption Diagnostics`** *ioctl* command, **Basic Encryption Diag**.

5. ITDT prints completion code or error message.

6. ITDT issues the **`Encryption Diagnostics`** *ioctl* command, **Full Encryption Diag**.

7. ITDT prints completion code or error message.

Element Information

When you select the **Element Information** command:

1. ITDT issues the *ioctl* command.
2. ITDT shows
   - Number of robots
   - First robot address
   - Number of slots
   - First slot address
   - Number of I/E elements
   - First element address
   - Number of drives
   - First drive address

Position to Element

When you select the **Position to Element** command:

1. In the **Parameter** boxes, the Transport element address must be entered, in decimal (picker).
2. Insert the Destination element address in decimal.
3. ITDT issues the *ioctl* command.

Element Inventory

When you select the **Element Inventory** command:

1. ITDT issues the **Element Info** *ioctl* command.
2. ITDT issues the **Element Inventory** *ioctl* command.
3. ITDT displays decoded element inventory information.

Exchange Medium

When you select the **Exchange Medium** command:

1. Insert source address into the **Source** address box in Decimal.
2. Insert the first destination address in decimal in the **First destination address** box.
3. Insert the second destination address in decimal in the **Second destination address** box.
4. ITDT issues the *ioctl* command.

Move Medium

When you select the **Move Medium** command:

1. Insert source element address into the **Source** element address box in Decimal.
2. Insert the first destination element address in decimal in the **First destination element address** box.
3. Insert the second destination element address in decimal in the **Second destination element address** box.
4. ITDT issues the *ioctl* command.

Initialize Element Status

When you select the **Initialize Element Status** command:

1. ITDT issues the *ioctl* command.
2. ITDT prints the command summary.

Prevent/Allow Medium Removal

When you select the **Prevent/Allow Medium Removal** command:

1. Use the menu to either prevent or allow.
2. ITDT issues the *ioctl* command.

Initialize Element Status Range

When you select the **Initialize Element Status Range** command:

1. Insert the first slot address in decimal in the provided box.
2. Insert the number of slots in the provided box.
3. ITDT issues the *ioctl* command.

Read Device IDs

When you select the **Read Device IDs** command:

1. ITDT issues the **Element Info** *ioctl* command.
2. If no drive is present, ITDT prints NO DRIVE PRESENT and exits.
3. ITDT prints information for all drives.

Read Cartridge Location

When you select the **Read Cartridge Location** command:

1. You are prompted for address of the first element.
2. If address is zero, print the error message and exit.
3. You are prompted for the number of elements.
4. If the number of elements is zero, print the error message and exit.
5. ITDT issues the **Element Info** *ioctl* command.
6. ITDT verifies that the address range is valid. Otherwise, print the error message and exit.
7. If no slots are found in **Element Info** data; print the error message and exit.
8. ITDT issues the **READ_CARTRIDGE_LOCATION** *ioctl* command.
9. ITDT prints decoded storage element information.

Configure TCP/IP Ports

For LTO 5, TS1140, and later drives, the ethernet port settings can be configured with the **Configure TCP/IP Port** command. The **Configure TCP/IP Port** command displays the current settings:
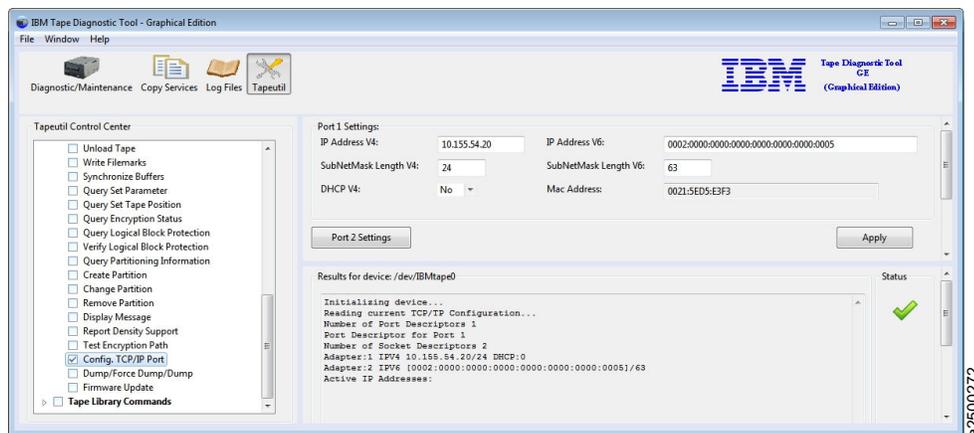

Figure 62. Configure TCP/IP Ports command in the Graphical Edition

After you click **Apply**, the new values are set and the updated values display.

Note: Because earlier drive generations do not have an ethernet port, the **Configure TCP/IP Ports** command is rejected for these devices with the following message:

```
TCP/IP configuration is not supported on this product.
```

Dump/Force Dump/Dump

When you select the **Dump/Force Dump/Dump** command:

1. ITDT retrieves the dump.
2. ITDT issues the **Force Dump** command.
3. ITDT retrieves the second dump.
4. ITDT displays the name of stored dump files and the output directory where they are stored. The dump filenames start with the serial number of the device.

Firmware Update

When you select the **Firmware Update** command, browse to the microcode file to be used. ITDT runs the firmware update and displays progress status and result.

Note: See "3576/TS3310 tape library" on page 190 for information on how to update the firmware on a 3576/TS3310 tape library.

The following site is available for the latest firmware files: http://www.ibm.com/support/fixcentral/. Select **System Storage** > **Tape Systems** > **Tape autoloaders and libraries** or **Tape drives**.

Chapter 8. HP-UX Tape and Medium Changer device driver

This chapter provides an overview of the IBM Tape and Medium Changer device driver for HP-UX that provides support for IBM tape drives and medium changer devices.

For tape diagnostic and utility functions refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Purpose

This device driver product provides SCSI-3 attachment for the IBM tape devices to selected Hewlett-Packard Precision Bus and PCI-based operating systems that run HP-UX 11i v2, and 11i v3.

The HP-UX installed name of this device driver is Advanced Tape Device Driver (ATDD). ATDD is used throughout this chapter to identify this driver.

ATDD is designed specifically to take advantage of the features that are provided by the IBM tape devices (refer to "Hardware requirements" on page 1). The goal is to give applications access to the functions required for basic operations (such as backup and restore) and the advanced functions that are needed by full tape management systems. Whenever possible, the device driver is designed to take advantage of the IBM tape system features transparent to the application.

Data flow

Both data and commands flow between the application program and the tape subsystem by way of the IBM Tape and Medium Changer device driver for HP-UX (ATDD). Figure 63 on page 221 shows the relationships between the IBM Tape and Medium Changer device driver for HP-UX, the application program, the SCSI or Fibre Channel adapter device driver, and the IBM tape subsystem.
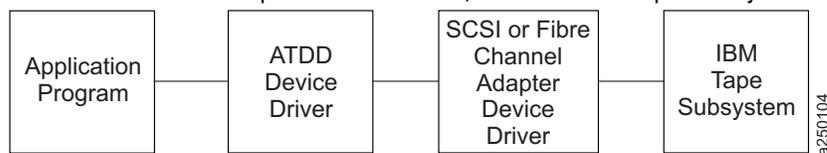

Figure 63. Data flow for HP-UX device driver (ATDD)

Product requirements

ATDD implementation

ATDD is a set of device driver implementations for operation in the following HP-UX operating system environments:

- HP PCI Bus - HP-UX 11i v1 (64 bit) - versions of this driver are identified by levels ATDD 3.x.x.x.

  Note: The 11i v1 driver is no longer currently supported. A stable version is available on http://www.ibm.com/support/fixcentral.
- HP PCI Bus - HP-UX 11i v2 (64-bit for Itanium 2) - versions of this driver are identified by levels ATDD 5.5.x.x.
- HP PCI Bus - HP-UX 11i v2 (64-bit for PA-RISC) - versions of this driver are identified by levels ATDD 5.6.x.x.
- HP PCI Bus - HP-UX 11i v3 (64-bit for Itanium 2) - versions of this driver are identified by levels ATDD IA.6.x.x.x.

- HP PCI Bus - HP-UX 11i v3 (64-bit for PA-RISC) - versions of this driver are identified by levels ATDD PA.6.x.x.x.

Hardware requirements

For current hardware requirements, refer to the "Hardware requirements" on page 1.

Note:

1. ATDD does not support tape devices that are attached to HSC/GSC bus architectures.

2. For attachment of Enterprise Tape System 3590 and IBM Magstar MP devices to HP rp8400 (formerly V-Class) platforms, a feedthrough SCSI terminator, which attaches to the A4800A Host Bus Adapter, is required. This feedthrough SCSI terminator is available as FC 9798 for Enterprise Tape System 3590 and FC 5098 for the 3575 Tape Library Dataserver or MP 3570 C model tape subsystem. Attach the male end of the feedthrough SCSI terminator to the host adapter and connect the host end of the standard FC 51xx SCSI cable to the feedthrough terminator. Terminate the SCSI bus at the last device on the bus as usual.

3. The low-level FC-Tape protocol standard is not supported in the HP A5158A HBA firmware and users must restrict their SAN configurations. The jobs are aborted with HP-UX A5158A HBA configurations when errors are detected in the SAN.

   The HP A5158A host adapter is not compliant with the Fibre Channel Protocol for SCSI, second version (FCP-2), dated 17 November 2000, a draft that is proposed by the American National Standard of Accredited Standards Committee (NCITS).

4. The HP A6826A HBAs need the QLogic firmware level B.11.11.02 or later. If the adapter is directly connected to a 3592 without a switch, then the topology on the drive port must be set to L-port.

Software requirements

For current software requirements, refer to the "Software requirements" on page 1.

⚠️ **Attention:** To install ATDD in HP-UX 11i v3, some HP-UX patches must be applied first on the system. For information, refer to the **atdd.Readme** file that is downloaded with the driver.

Software interface to the device driver

The IBM Tape and Medium Changer device driver for HP-UX provides the following standard HP-UX entry points for IBM tape systems:

Open
    This entry point is driven by the *open* system function call.

Write
    This entry point is driven by the *write* system function call.

Read
    This entry point is driven by the *read* system function call.

Close
    This entry point is driven explicitly by the *close* system function call and implicitly by the operating system at program termination.

IOCTL
    This entry point is driven by the input/output control (*ioctl*) system function call. It provides a set of tape device, medium changer device, and SCSI-specific operations. It allows HP-UX applications to access and control the features and attributes of IBM SCSI tape subsystems programmatically.

For programming information, refer to the *IBM Tape Device Drivers Programming Reference*, GA32-0566.

Installation and configuration instructions

The following sections describe the installation and configuration for three types of HP-UX devices.

Configuration limitations

Maximum supported number of tape devices	1000
Maximum supported number of HBA ports	128
Maximum supported number of paths for a device (DPF/CPF)	16/16
Maximum LUNs per system	32

Every attached tape or library device uses a certain amount of resources. The user must consider resources such as physical memory and virtual space on the system, which can further limit the number of devices that can be attached.

Installing and configuring PCI drivers

This chapter describes how to install, configure, and uninstall the IBM Tape and Medium Changer device driver for HP-UX (ATDD) for PCI-based systems. By default, ATDD automatically configures all supported IBM tape drives that are attached and powered On when the system starts. ACDD, the changer part of ATDD, does not configure IBM Medium Changer devices by default because many applications use either their own changer drivers or the native **schgr** or **sctl** drivers. In HP-UX 11i v1 and v2, the ATDD package includes with atdd tape driver and acdd changer driver dynamic loadable kernel modules (DLKM). In HP-UX 11i v3, the ATDD package consists of five modules in the kernel.

- atdd - static tape driver kernel module
- acdd - static changer driver kernel module
- atdd_leg - static legacy tape driver kernel module
- acdd_leg - static legacy changer driver kernel module
- atdd_core - DLKM core kernel module

Overview of the installation process

During and after the ATDD is installed, ACDD, the changer part of ATDD, can be set to configure (CLAIM) all attached IBM Medium Changer devices. Additionally, selected IBM Medium Changer devices can be configured by running the **swinstall** command with the **-x ask=true** command option, or by running **/opt/atdd/bin/atdd_claim –c c** in 11i v2. The installation process depends on whether all IBM tape drives are to be configured by ATDD or only selected ones. Also, whether configured tape drives exhibit default behavior or require specific configuration settings. Additionally, for IBM Medium Changers, installation selection or post-installation configuration can determine whether all IBM Medium Changers must be configured, selectively configured, or NOT configured at all.

Preinstallation considerations

Make sure that your system is ready to install ATDD before you begin. Follow these steps to complete the installation.

1. Copy the software from the distribution medium to the depot.
2. Check the readme file and verify that your system is configured appropriately for installing ATDD.
3. Ensure that the tape drives to be managed by ATDD are powered on.
4. Install and configure the software.

The following describes facts about the command sequences.

- In some of the examples, file names that are given on the command line must be referenced with an absolute path. Using **'pwd'/filename** to reference a file instead of **filename** ensures this.
- All the software distributor commands (for example, **swinstall** or **swcopy**) can be run first with the **-p** flag to preview the command. After the preview output is observed, you can reissue the command without the **-p** flag to complete the actual operation.
- The software distributor commands are moderately complex scripts that frequently require several steps. The steps are typically **Selection**, **Analysis**, and **Execution**. Each step can produce useful information and error messages. It is a good idea to carefully observe the results of the installation process as it occurs.

If you encounter unexpected results during the installation, check the associated log file.

While the software distributor commands are used, you might encounter the following error about mounted file systems:

```
ERROR: "hostname/": One or more filesystems that appear in the
filesystem table are not mounted and cannot be mounted.
```

Many commands (for example, **swinstall** and **swremove**) attempt to mount all file systems in the /etc/fstab file at the start of the analysis phase. This action ensures that all listed file systems are mounted before proceeding. This action also helps ensure that files are not loaded into a directory that might be below a future mount point. But, it often causes an error with NFS mounted file systems.

This error can be overridden with **'-x'** to set the mount_all_filesystems option to FALSE. When this option is used, the command finishes with a warning that indicates no attempt is made to mount all file systems. For example,

```
# swinstall -x mount_all_filesystems=false -x ask=true -x autoreboot=true atdd
```

```
WARNING: "hostname:/": There will be no attempt to mount filesystems
that appear in the filesystem table.
```

Creating the Drive Configuration File (optional)

If you are not using the standard device driver defaults, you must create a configuration file that directs the device driver on how to customize driver behavior for particular IBM devices. If all configured devices are to use the device driver configuration defaults, it is not necessary to create a configuration file before the driver for ATDD is installed.

The Drive Configuration File is required if you do not use the device driver configuration defaults.

If you do not need to create a Drive Configuration File, skip to the instructions in "Powering Off the tape drives" on page 226.

If you do must create a Drive Configuration File, consult the following instructions.

The configuration file is named **sbin/init.d/atdd** and has the following syntax:

```
ATDD_global_parameter=value
ATDD_device_parameter[index]=value
```

Note:

- Blank lines and lines that start with # are ignored.
- No spaces can appear within each entry.
- No trailing comments can appear on a variable definition line.

Determining the device hardware path for IBM tape drives

To determine the device hardware path for IBM tape drives with a SCSI attachment, complete the following steps.

1. Run **ioscan** to determine the hardware path (the SCSI adapter) the tape drive is connected to.

   ```
   # ioscan -f -C ext_bus
   ```

2. Record the hardware path entry of the adapter:

   For example: *0/10/0/0*

3. Determine the SCSI target address of the tape drive.

   ```
   HWPATH = adapterpath.drivetargetaddress.0 (tape drive)
   ```

   For a tape drive at SCSI target address 3, the device hardware path is 0/10/0/0.3.0

To determine the device hardware path for IBM tape drives with the Fibre Channel attachment, complete the following steps.

1. Run **ioscan** to determine the hardware path (the Fibre Channel) the tape drive is connected to

   ```
   # ioscan -f -C tape
   ```

2. Record the hardware path entry of the Fibre Channel. For example,

   ```
   HWPATH = 0/5/0/0.8.0.255.7.9.0
   ```

Creating the hardware path entry

You must tell the driver which hardware path you want to attach to if you are not using the installation defaults for driver behavior. Create an entry in the **/etc/rc.config.d/atdd** configuration file for each device you want the driver to attach. For example:

```
ATDD_HWPATH[0]=0/10/0/0.1.0
ATDD_HWPATH[1]=0/10/0/0.6.0
ATDD_HWPATH[2]=0/5/0/0.8.0.255.6.14.0
```

Creating the device-specific configuration entries (optional)

The ATDD is shipped with default settings for all configuration parameters. To change these settings, an entry is made in the configuration file that assigns an appropriate value to the wanted configuration variable. Each device can have a different value for each configuration variable. The index number that is associated with the configuration variable associates the parameter setting with the device at the hardware path with the same index.

Example 1:

```
ATDD_IMMEDIATE[0]=1
```

This parameter allows application control to return from the device before the rewind completes for the device at hardware path 0/10/0/0.1.0 (based on the hardware path entry in "Creating the hardware path entry" on page 225).

Example 2:

```
ATDD_TRAILER[1]=1
```

This parameter allows write operations after an early end-of-tape warning for the device at hardware path 0/10/0/0.6.0. Refer to Table 26 on page 231 and Table 27 on page 233 for a description of all configuration parameters.

Note: If you experience difficulties with your tape device, check the **/etc/rc.log** for errors and correct the problem.

Powering Off the tape drives

When the ATDD software is initially installed, it attaches itself to all tape drives that are in the CLAIMED state as shown by entering the command

```
# ioscan -fk -C tape
```

Before you continue, make sure that all devices CLAIMED with the preceding command are devices that you want this device driver to manage.

To list device file names in the **/dev** directory and its subdirectories, enter

```
# ioscan -funC tape
```

In HP-UX 11i v3, you can also enter

```
# ioscan -funNC tape
```

To remove a tape drive from the CLAIMED state so it is not configured by this driver, power Off the tape drive and run **ioscan** without the **-k** argument as follows.

```
# ioscan -f -C tape
```

Installing the driver with the ATDD installation script

An installation script (**InstallAtdd**) is provided to automate driver installation and run some checking functions. It copies the latest version of the driver to the software depot and installs the latest driver version.

To install ATDD with the script, download the installation script with the driver at Fix Central, then run the installation script.

When the installation script runs, the customer is prompted with the question, Would you like to activate the Medium Changer support by ATDD (Y/N)?. Enter Y to allow the ATDD to configure all attached IBM Medium Changer devices. Or, answer N to allow the HP native changer driver to configure these Medium Changer devices.

Note:

1. If a previous version of ATDD is installed on your system, uninstall it before you attempt to install the latest version. Refer to "Uninstalling the software" on page 230.
2. The system reboot is required to install ATDD in HP-UX 11i v3.

To install ATDD manually, follow the steps in "Installing drivers manually" on page 226.

Installing drivers manually

Installing the drivers manually requires the steps that are detailed in the following sections.

1. "Copying the software to the Software Depot" on page 226.
2. "Installing the ATDD software" on page 227.
3. If a previous version of ATDD is installed on your system, uninstall it before you attempt to install the latest version. Refer to "Uninstalling the software" on page 230.

Copying the software to the Software Depot

⚠️ **Attention:** If you do not copy the ATDD software into a depot, you cannot readily uninstall the product.

Copy the appropriate driver to the Software Depot. For example:

```
# swcopy -p -s /driver_location/atdd.x.x.x.x atdd (preview option)
# swcopy -s /driver_location/atdd.x.x.x.x atdd
```

Use **swlist** to verify that the ATDD software is in the depot:

```
# swlist -d atdd
```

Installing the ATDD software

When the software is in the depot and only the appropriate drives are powered on, the ATDD software can be installed to the root file system with the HP-UX **swinstall** command. If the target root file system is the primary, the ATDD software is configured automatically upon installation.

If the target is an alternate root file system, then the ATDD software is not configured automatically.

Note: If an earlier version of the product is already installed on the target root file system, the existing version is replaced. This replacement is true even if the version already installed is more recent than the version being installed.

The following commands install ATDD from the depot to the default root file system by issuing the **swinstall** command with the ask options that are set as follows:

```
# swinstall -p -x ask=true  atdd (preview option)
# swinstall -x ask=true  atdd in HP-UX 11i v1, and v2
# swinstall -x autoreboot=true -x ask=true atdd in HP-UX 11i v3
```

Running the **swinstall** command with the ask option set to TRUE prompts the customer, Would you like to activate the Medium Changer support by ATDD (Y/N)?. Enter Y to allow the ATDD to configure all attached IBM Medium Changer devices, or answer N to allow the HP native changer driver to configure these Medium Changer devices.

You can use **swlist** to list the software that is installed on the default root file system as follows:

```
# swlist atdd
```

You can verify correct installation to the default root file system with the **swverify** command as follows:

```
# swverify atdd
```

```
# ioscan -fknC tape
Class I  H/W Path                   Driver     S/W State      H/W Type     Description
=========================================================================================
tape  0  0/3/0/0.5.0               atdd       CLAIMED        DEVICE       IBM 03590E11
   /dev/rmt/0m   /dev/rmt/0mn   /dev/rmt/c4t5d0BEST   /dev/rmt/c4t5d0BESTn
   /dev/rmt/0mb  /dev/rmt/0mnb  /dev/rmt/c4t5d0BESTb  /dev/rmt/c4t5d0BESTnb
tape  1  0/3/0/0.6.0               atdd       CLAIMED        DEVICE       IBM 03590B11
   /dev/rmt/1m   /dev/rmt/1mn   /dev/rmt/c4t6d0BEST   /dev/rmt/c4t6d0BESTn
   /dev/rmt/1mb  /dev/rmt/1mnb  /dev/rmt/c4t6d0BESTb  /dev/rmt/c4t6d0BESTnb
tape  4  0/5/0/0.1.23.232.0.0.2  atdd       CLAIMED        DEVICE       IBM ULT3580-TD1
   /dev/rmt/4m   /dev/rmt/4mn   /dev/rmt/c6t0d2BEST   /dev/rmt/c6t0d2BESTn
   /dev/rmt/4mb  /dev/rmt/4mnb  /dev/rmt/c6t0d2BESTb  /dev/rmt/c6t0d2BES
```

If you enabled ACDD, run the following **ioscan** command to view the medium changers found:

```
# ioscan -fnkC autoch
Class   I  H/W Path               Driver S/W State  H/W Type   Description
======================================================================
autoch  0  0/3/0/0.5.1            acdd   CLAIMED    DEVICE     IBM  03590E11
      /dev/rmt/0chng
autoch  2  0/6/0/0.1.17.255.5.10.1 acdd  CLAIMED    DEVICE     IBM  03590E11
       /dev/rmt/2chng
autoch  4  0/5/0/0.1.23.232.0.0.1 acdd   CLAIMED    DEVICE     IBM  ULT3583-TL
      /dev/rmt/4chng
```

In HP-UX 11i v3, run **# ioscan -funNC tape** or **autoch** to display the tape devices that are configured with ATDD and ACDD drivers. Run **# ioscan -funNC tape** or **autoch** to show the tape devices that are bound with the legacy atdd_leg and acdd_leg drivers.

Configuring all IBM tape drives/Media Changers with ATDD/ACDD

By default, ATDD automatically configures all supported IBM tape drives that are attached and powered on when the ATDD package is installed. The ACDD driver does not configure IBM Medium Changer devices by default. To configure all IBM Medium Changer devices on the system during the installation of ATDD package, run the **swinstall** command with the -x ask=true command option and answer Yes to allow the ACDD to claim these devices.

- In HP-UX 11i v1 and v2, run the command:

  ```
  # /opt/atdd/bin/atdd_claim -c
  ```

- In HP-UX 11i v3, do the following steps:

  1. Bind each changer device with the ACDD driver:

     ```
     # ioscan -b -M acdd -H hw_path
     ```

  2. Reboot the system to configure the changer devices:

     ```
     # shutdown -ry now
     ```

To remove the claim with ACDD after the next reboot:

- In HP-UX 11i v1 and v2, run the command:

  ```
  # /opt/atdd/bin/atdd_claim -u
  ```

- In HP-UX 11i v3, do the following steps.

  1. Bind each changer device with a changer driver. For example, to bind the changer device with **eschgr** driver:

     ```
     # ioscan -b -M eschgr -H hw_path
     ```

  2. Reboot the system to unconfigure the changer devices:

     ```
     # shutdown -ry now
     ```

Configuring selected IBM tape devices with ATDD/ACDD in HP-UX 11i v1 and v2

Attaching selected IBM tape devices to ATDD/ACDD during auto booting

To claim a specific tape device with atdd/acdd during reboot, edit the "Claiming Device" section in the **/sbin/init.d/atdd** file.

For example, to attach IBM 3590E11 medium changer with **acdd** driver:

1. To determine the HW path:

```
# ioscan -fnk|grep IBM
        autoch    0  0/3/0/0.5.1   schgr    CLAIMED   DEVICE    IBM   03590E11
```

2. Comment out the command lines in the init script of **/sbin/init.d/atdd**:

   • For tape drives:

   ```
   /opt/atdd/bin/atdd_claim -t
   ```

   • For medium changers:

   ```
   /opt/atdd/bin/atdd_claim -c
   ```

3. Add a command line in the **Configuring Device** section in **/sbin/init.d/atdd**:

   ```
   /opt/atdd/bin/atdd_claim -H 0/3/0/0.5.1
   ```

Attaching selected IBM tape devices to ATDD/ACDD dynamically

To dynamically attach selected IBM tape device after the ATDD installation, run the following commands.

1. To determine the HW path of the device:

   ```
   # ioscan -fnk|grep IBM
       autoch    0  0/3/0/0.5.1   schgr    CLAIMED   DEVICE    IBM   03590E11
   ```

2. To claim the device with ATDD/ACDD:

   ```
   # /opt/atdd/bin/atdd_claim -H 0/3/0/0.5.1
   ```

   Note: The dynamic attachment might be lost after the system reboots.

Attaching selected IBM tape device with a particular driver

Use the system **ioscan** and **rmsf** commands to force a non-atdd/acdd driver to bind an IBM tape device. For example, force bind the IBM 3590E media changer with the HP native changer driver **schgr** with these steps:

1. Determine the HW path of the device:

   ```
   # ioscan -fnk |grep IBM
   tape      0  0/3/0/0.5.0   atdd    CLAIMED     DEVICE      IBM     03590E11
   autoch    0  0/3/0/0.5.1   acdd    CLAIMED     DEVICE      IBM     03590E11
   ```

2. Remove the I/O configuration from the system:

   ```
   # rmsf -H 0/3/0/0.5.1
   ```

3. Force binding:

   ```
   # ioscan -M schgr -H 0/3/0/0.5.1
   ```

4. Create the device special files:

   ```
   # insf -H 0/3/0/0.5.1
   ```

5. Verify the force binding:

   ```
   # ioscan -fnk |grep IBM
   tape      0  0/3/0/0.5.0   atdd    CLAIMED     DEVICE      IBM     03590E11
   autoch    0  0/3/0/0.5.1   schgr   CLAIMED     DEVICE      IBM     03590E11
   ```

Note: The force binding is lost after the system reboots. To keep the binding to a selected device with a particular driver after a reboot, add these command-lines in steps 2–4 in **Claiming Device** section in **/sbin/init.d/atdd** file. For example,

```
# Configuring Device Section:
# add specific device claim here, for example
# /opt/atdd/bin/atdd_claim -H 0/3/0/0.5.1
# /opt/atdd/bin/atdd_claim -H 0/6/0/0.1.30.255.0.0.1
rmsf -H 0/3/0/0.5.1
ioscan -M schgr -H 0/3/0/0.5.1
insf -H 0/3/0/0.5.1
```

Configuring selected IBM tape devices with ATDD/ACDD in HP-UX 11i v3

By default, **atdd** driver automatically configures all supported IBM tape drives that are attached and powered on when the ATDD package is installed. The **acdd** driver does not configure IBM medium changer devices by default. All of IBM medium changers are claimed if you use **acdd** and **acdd_leg** as the changer drivers during ATDD are installed. To attach a selected IBM tape device with a particular driver, run the system **ioscan** command to force a non-ATDD/ACDD driver to bind an IBM tape device, and then reboot the system. For example, to force bind the IBM 3592 E05 tape drive with the HP native tape driver **estape**, complete these steps:

1. Determine the HW path of the device:

   ```
   # ioscan -fNk | grep IBM
   tape   1  64000/0xfa00/0x7  atdd  CLAIMED  DEVICE  IBM 03592E05
   ```

2. Force the binding:

   ```
   # ioscan -b -M estape -H 64000/0xfa00/0x7
   ```

3. Reboot the system:

   ```
   # shutdown -ry now
   ```

4. Create the device special files if it does not exist after the system bootup:

   ```
   # insf -H 64000/0xfa00/0x7
   ```

5. Verify the force binding:

   ```
   # ioscan -fNk | grep IBM
   tape   1  64000/0xfa00/0x7  estape  CLAIMED  DEVICE  IBM 03592E05
   ```

Uninstalling the software

⚠️ **Attention:** Do not try to uninstall the **ATDD** software by deleting the files that make up the **ATDD** file set. This action causes a number of inconsistencies on the system. It is best to use the **swremove** command.

To uninstall **ATDD** (from the root file system):

```
# swremove atdd in HP-UX 11i v1 and v2
# swremove -x autoreboot=true atdd in HP-UX 11i v3
```

Other administrative tasks

To determine whether the current version of **ATDD** is installed or configured on the default root file system:

```
# swlist -a state atdd
```

To determine the versions of **ATDD** stored in the default depot:

```
# swlist -d atdd
```

To remove **ATDD** from the depot:

```
# swremove -d atdd
```

If more than one level of **ATDD** exists in the depot, explicitly specify the level to remove it. For example:

```
# swremove -d atdd,r=3.5.0.0
```

To view the file set of **ATDD** installed on the system:

```
# swlist -l file atdd
```

To display and manage **ATDD** kernel modules and kernel-tunable parameters, run **kmadmin**, **kmsystem**, **kmtute**, and **kmadmin** commands in HP-UX 11i v1 and **kcmodule**, **kctune** commands in HP-UX 11i v2 and v3, or go to the **Kernel Configuration** in the **sam** utility. Refer to the system manual for detail.

For an example, print the **ATDD** driver module status, entering the command:

```
# kcmodule -d atdd
Module  State   Cause      Description
atdd    static  explicit   Advanced Tape Device Driver
```

Supported configuration parameters

This chapter describes the supported configuration values for multiple device types that are configured on the same system. The configuration parameters are global. Because the configuration parameters are global to all devices, it is necessary to use configuration values that run reliably on all devices that are attached to your system. If you are experiencing difficulties, ensure that your driver is configured properly. To check your current configuration, use the **atdd_cfg** program that is in /opt/OMImag/bin for the static PB driver and in /opt/atdd/bin for the PCI driver. For program usage, run as follows:

For PB driver:

```
# /opt/OMImag/bin/atdd_cfg -h
```

For PCI driver:

```
# /opt/atdd/bin/atdd_cfg -h
```

Configuration parameter definitions

This section describes the configuration parameters and values. Modifying the default settings is not recommended unless instructed to do so. The **ATDD** is shipped with default values that allow the most reliable execution across various device types.

Device-specific parameters

Some of the configuration parameters are device-specific, while others are driver-specific. shows the parameters that are device-specific, what they mean, and their values.

Table 26. HP-UX: Device-specific parameter definitions

Parameter	Meaning	Values
DENSITY	Density to use when writing/reading tape	In hexadecimal

Table 26. HP-UX: Device-specific parameter definitions (continued)		
Parameter	**Meaning**	**Values**
SILI	Suppress Incorrect Length Indicator	• 0=Off (do not suppress, by default) • 1=On (suppress)
BLOCKSIZE	Block Size	Size in bytes, 0 by default.
COMPRESSION	Compression Mode	• 0=Off (do not use compression at drive) • 1=On (use compression at drive, by default)
BUFFERING	Buffering Mode	• 0=Off (do not buffer data) • 1=On (buffer data to hardware buffers, by default)
IMMEDIATE	Immediate Mode	• 0=Off (wait for rewind completion, by default) • 1=On (return before rewind is complete)
TRAILER	Trailer Label Processing	• 0=Off (do not allow writes past early EOT warning, by default) • 1=On (allow writes past early EOT warning)
ERRNO_LEOT	Error Number return for Logical End Of Tape)	Value that is returned for writes past EOM, 28 by default.
RESERVE	Multiple open for the device	• 1=On (reserve the device after to open, by default) • 0=Off (do not reserve the device after to open) (multiple open support)
RESERVE_KEY	The user specifies the Persistent Reservation key that is used by the device driver when the Persistent Reservation is used.	• 0 (the driver assigns the key by default) • A string of 1-8 character ASCII alphanumeric key such as "key12345". If fewer than 8 characters are used, the remaining characters are set to 0x00(NULL)
WFM_IMMEDIATE	Immediate Mode for Write File Mark	• 0=Off (wait for write file mark completion, by default) • 1=On (return before write file mark is complete)
PRE_V3_COMPAT	Use to share tapes with blocksize > 256 kb with HP-UX 11i v2 or earlier. Supported in HP-UX 11i v3 only.	• 0=Off (always write or read the date with the blocksize defined by user, by default) • 1=On (split the blocksize less than 256 kb during the read or write)

Driver-specific parameters

Some of the configuration parameters are device-specific, while others are driver-specific.Table 27 on page 233 shows the parameters that are driver-specific, what they mean, and their values.

Table 27. HP-UX: Driver-specific parameters (Global)		
Parameter	**Meaning**	**Values**
INSTANCE	ATDD Device Number	(Read Only)
DEVICES	Number of Configured Devices	(Read Only)

Modifying configuration parameters

To change a configuration parameter, use the **atdd_cfg** program in /opt/OMImag/bin for the PB driver and in /opt/atdd/bin for the PCI driver. You can update the current value.

- In HP-UX 11i v1 and v2:

  For example, if you want to change the COMPRESSION parameter to 0 for the device at hardware path 0/4/0/0.1.0, do the following step:

  ```
  # atdd_cfg -g INSTANCE 0/4/0/0.1.0
  INSTANCE: 2
  ```

  The ATDD instance number for this device is returned. You must use this INSTANCE value (1) to set the COMPRESSION value for this device.

  ```
  # atdd_cfg -s COMPRESSION 0 2
  ```

  Or, to get or modify COMPRESSION by using the hardware path:

  ```
  # atdd_cfg -g COMPRESSION 0/4/0/0.1.0
  # atdd_cfg -s COMPRESSION 0 0/4/0/0.1.0
  ```

- In HP-UX 11i v3:

  The usage of **atdd_cfg** command is:

  ```
  atdd_cfg -d special_file [-o parameter [-w value]]
  ```

  All configurable parameters for the specified device are displayed by entering #atdd_cfg -d special_file only

  For instance:

  ```
  # /opt/atdd/bin/atdd_cfg -d /dev/rtape/tape14_BEST
  DENSITY=0
  SILI=1
  BLOCKSIZE=0
  COMPRESSION=1
  BUFFERING=1
  REWIND_IMMEDIATE=0
  TRAILER=1
  SCALING=0
  WRITEPROTECT=0
  ERRNO_LEOT=28
  WFM_IMMEDIATE=0
  RESERVE=1
  PRE_V3_COMPAT=0
  ```

  To display a specific parameter, run #atdd_cfg -d special_file -o parameter

  For example,

  ```
  #/opt/atdd/bin/atdd_cfg -d /dev/tape/tape14_BESTn -o COMPRESSION
  COMPRESSION=1
  ```

To set a specific parameter, run #`atdd_cfg -d special_file -o parameter -w value`

For example,

```
# atdd_cfg -d /dev/rtape/tape14_BESTn -o  COMPRESSION -w 0
Success
```

To set a new BOOT default value for the configuration parameter, you must modify or add an entry in the **atdd.cfg** configuration file in `/etc/rc.config.d` for the static driver or the **atdd configuration** file in `/sbin/init.d`.

For example, if you want the COMPRESSION default set to 0 for the device at `ATDD_HWPATH[0]` or `tape14_BESTn`, add the following line to your configuration file:

- In HP-UX 11i v1 and v2:

```
ATDD_COMPRESSION[0]=0
```

- In HP-UX 11i v3:

```
/opt/atdd/bin/atdd_cfg -d /dev/rtape/tape14_BESTn -o COMPRESSION -w 0
```

Note: The configuration parameters are prefixed with ATDD_ in the configuration file. For instructions about using the configuration program, use the -h option as follows:

```
# atdd_cfg -h
```

Configurable kernel parameters (tunable)

ATDD provides the following variety of configurable kernel parameters that allow the users to customize for specific setup:

atdd_log_trace
Log the sense data in syslog when a hardware or medium error is occurred, see "Sense data logging" on page 241 for details. This parameter is enabled by default on 11i v3 and later, but disabled by default in 11i v2 and earlier.

alternate_pathing/atdd_alternate_pathing
Enable or disable the alternate path support for CPF/DPF (see the specific operating system section that covers CPF and DPF support for detail). This parameter is enabled by default.

atdd_disable_reserve/atdd_disable_res
Allows the user to disable the reservation management from ATDD. This parameter is Off by default.

atdd_loadbalance
Allows the user to disable automatic load balancing from ATDD. This parameter is On (1) by default and supported on 11i v3 only.

atdd_reserve_type
The drive is reserved in the **SCSI-2 Reserve** command when Data Path failover (DPF) is disabled by default. To reserve the drive with Persistent Reserve In and Out commands, the user can set the value of *atdd_reserve_type* to 3. The default values for the tunable:

- 1 - **Reserve(6)** command.
- 2 - **Reserve(10)** command (Unsupported).
- 3 - **Persistent Reserve In/Out** commands.

To change the value of tunable, run the command **kctune/kmtune** or the SAM (System Administration Manager) tool.

Special files

For each drive configured by ATDD, 12 or 13 special files are created. 12 special files are generated for a 3590 with ACF set to **Manual**, **Automatic**, **System**, **Accumulate**, **Random**, or **Library** mode. A 13th special file is created for independent operation of the ACF, if the 3590 mode is set to Random 2 LUN operation (`/dev/rmt/<instance#>chng`).

ATDD creates the tape device special files in three forms -

- The standard or long file name.
- An alternative short file name that is based on the instance number.
- An alternative short file name that is not based on the instance number.

BEST represents the operational capabilities likely to be required, including the highest density/format and data compression, if supported by the device. Each set of special file names (long and short) contains four special files that have all combinations of n and b options, as shown in and . For information, refer to the **mt(7) man** pages.

Table 28. Special files		
Special file name	**BSD compatibility**	**Rewind on close**
/dev/rmt/<instance#>m	No	Yes
/dev/rmt/<instance#>mb	Yes	Yes
/dev/rmt/<instance#>mn	No	No
/dev/rmt/<instance#>mnb	Yes	No
/dev/rmt/s<#>m	No	Yes
/dev/rmt/s<#>mb	Yes	Yes
/dev/rmt/s<#>mn	No	No
/dev/rmt/s<#>mnb	Yes	No
/dev/rmt/<instance#>t<target>d<LUN>BEST	No	Yes
/dev/rmt/<instance#>t<target>d<LUN>BESTb	Yes	Yes
/dev/rmt/<instance#>t<target>d<LUN>BESTn	No	No
/dev/rmt/<instance#>t<target>d<LUN>BESTnb	Yes	No
/dev/rmt/<instance#>chng	N/A	N/A

Table 29. New special files in HP-UX 11i v3		
Special file name	**BSD compatibility**	**Rewind on close**
/dev/rtape/tape#_BEST	No	Yes
/dev/rtape/tape#_BESTb	Yes	Yes
/dev/rtape/tape#_BESTn	No	No
/dev/rtape/tape#_BESTnb	Yes	No

Table 29. New special files in HP-UX 11i v3 (continued)		
Special file name	**BSD compatibility**	**Rewind on close**
/dev/rchgr/autoch#	N/A	N/A

- In HP-UX 11i v1 and v2:

  atdd_lssf in /opt/OMImag/bin for the static driver and in /opt/atdd/bin for the DLKM driver lists information about a special file. For example,

  ```
  #atdd_lssf     /dev/rmt/393mnb
  atdd card instance 30 available at address        Major = 79     Minor = 0x1E90C0
  settings = No Rewind, Berkeley, Best Format,
  IBM 03590H1A /dev/rmt/393mnb
  ```

- In HP-UX 11i v3:

  ATDD supports the HP-UX **lssf**, **insf**, and **rmsf** commands. To display special file information, enter the **lssf** command. For example,

  ```
  # lssf /dev/rtape/tape14_BESTnb
  atdd Berkeley No-Rewind best density available at address 64000/0xfa00/0x32
  /dev/rtape/tape14_BESTnb

  # lssf /dev/rchgr/autoch1
  acdd section 0 at address 64000/0xfa00/0x21 /dev/rchgr/autoch1
  ```

  If the device special files are not created on the system, use the **# insf** command to generate them.

Persistent Naming Support

Persistent Naming Support is used to ensure that attached devices are always configured with the same logical name across system reboots. For this purpose, the HP-UX tape driver creates an extra set of device special files with a prefix of "s" for the configured tape drives in HP-UX 11i v1 and v2, such as **s55m** in the following example.

```
# ioscan -funC tape
Class  I   H/W Path                Driver S/W State   H/W Type       Description
===============================================================================
tape   103 1/0/0/0.97.25.255.2.7.0   atdd    CLAIMED    DEVICE    IBM   03592E05
           /dev/rmt/103m           /dev/rmt/c10t7d0BESTn              /dev/rmt/s55mb
           /dev/rmt/103mb          /dev/rmt/c10t7d0BEST               /dev/rmt/s55mn
           /dev/rmt/103mn          /dev/rmt/c10t7d0BESTb              /dev/rmt/s55m
           /dev/rmt/103mnb         /dev/rmt/c10t7d0BESTnb             /dev/rmt/s55mnb
```

In HP-UX 11i v3, HP introduces the native multi-pathing and path-independent persistent Device Special Files (DSFs) and the auto discovery of devices to enhance overall manageability. The ATDD does not create the additional set of device special files with a prefix of "s".

The persistent DSF format for tape devices that are introduced with the Agile view in HP-UX 11i v3 is

```
# ioscan -funNC tape
Class    I H/W Path  Driver S/W State   H/W Type      Description
==================================================================
tape     1 64000/0xfa00/0x7   estape   CLAIMED    DEVICE  IBM 03592E05
                 /dev/rtape/tape1_BEST    /dev/rtape/tape1_BESTn
                 /dev/rtape/tape1_BESTb   /dev/rtape/tape1_BESTnb

# ioscan -funNC autoch
Class    I H/W Path  Driver S/W State   H/W Type      Description
==================================================================
autoch   8 64000/0xfa00/0xa   acdd   CLAIMED    DEVICE  IBM 03584L22
                 /dev/rchgr/autoch8
```

To map a persistent DSF to its legacy DSF, enter the following -

```
# ioscan -m dsf /dev/rtape/tape1_BESTb
Persistent DSF          Legacy DSF(s)
=========================================
/dev/rtape/tape1_BESTb   /dev/rmt/c3t15d0BESTb
                         /dev/rmt/c9t6d0BESTb
```

Control Path failover support for tape libraries

Note:

1. The library control path failover feature code must be installed before the path failover support is enabled in the HP-UX ATDD device driver. Refer to"Automatic failover" on page 3 for what feature code might be required for your machine type.

2. It is a requirement that applications must open the primary path for CPF.

Configuring and unconfiguring path failover support

Path failover support is enabled automatically when the device driver is installed. However, the driver provides a kernel parameter that you can use to enable library control path failover. To enable the failover support in the ATDD driver, complete the following steps after the driver is installed.

- In HP-UX 11i v1 and v2:

  1. Set the **alternate_pathing** parameter.

     ```
     #  /opt/atdd/bin/atdd_failover -a 1
     ```

  2. Reconfigure CPF for the devices.

     ```
     #  /opt/atdd/bin/atdd_claim
     ```

- In HP-UX 11i v3:

  Run **kctune** to enable the kernel tunable of **atdd_alternate_pathing**. ATDD handles the CPF in the next open.

  ```
  # kctune atdd_alternate_pathing=1
        * The automatic 'backup' configuration has been updated.
        * The requested changes have been applied to the currently
          running configuration.
  Tunable                            Value     Expression      Changes
  atdd_alternate_pathing  (before)    0             0            Immed
                          (now)       1             1
  ```

  You can check whether the driver recognized multiple control paths for your library by running

  ```
  #ioscan -funC autoch
  ```

If you see .altpath next to one of the special files in HP-UX 11i v1 and v2, then you successfully enabled the control path failover feature for your library. In HP-UX 11i v3, use the **# ioscan -m dsf** command and "[11] Display All Paths" on page 155 or "Display All Paths" on page 211 in ITDT to verify that the multiple path is configured by the system and ATDD.

After the path failover support is enabled, it remains set until **atdd_claim** is run with the **alternate_pathing** driver parameter set to OFF. The path failover setting is retained even if the system is rebooted. If you want to turn off the control path failover feature in the ATDD driver, complete the following steps.

- In HP-UX 11i v1 and v2:

  1. Clear the **alternate_pathing** parameter.

     ```
     #  /opt/atdd/bin/atdd_failover -a 0
     ```

2. Reconfigure CPF for the devices.

```
#  /opt/atdd/bin/atdd_claim
```

- In HP-UX 11i v3:

    Run **kctune** to disable the kernel tunable of **atdd_alternate_pathing**. ATDD manages the CPF in the next open.

```
# kctune atdd_alternate_pathing=0
       * The automatic 'backup' configuration has been updated.
       * The requested changes have been applied to the currently
         running configuration.
Tunable                           Value  Expression          Changes
atdd_alternate_pathing  (before)   1          1                Immed
                        (now)      0          0
```

Primary and alternative paths

When ATDD is loaded into the kernel, the first logical medium changer device that it sees in the system is the primary path for that medium changer. The other logical medium changers that ATDD attached for the same medium changer is configured as alternative paths. The device driver supports up to 16 physical paths for a single device.

On HP-UX 11i v3, the HP-UX system always selects the best path for ATDD to open so the primary path is dynamically assigned from the system. ATDD does not provide any **.altpath** special file.

The primary and alternative path information can be obtained by using the following command on HP-UX 11i v1 and v2.

```
#  ioscan -funC autoch
```

The following is an example of what you might see:

```
autoch   0  0/1/0/0.101.22.255.1.1.1  acdd   CLAIMED     DEVICE       IBM      ULT3582-TL /dev/rmt/
0chng
autoch   1  0/1/0/0.101.22.255.1.2.1  acdd   CLAIMED     DEVICE       IBM      ULT3582-TL /dev/rmt/
1chng.altpath
```

Querying primary and alternative path configurations

You can display the primary and alternative path configuration for all devices by running the **ioscan** command, as explained in "Determining the device hardware path for IBM tape drives" on page 224.

Note: To display the primary and alternative path configuration for any device by using tape diagnostic and utility functions, refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

When you load the ATDD device driver with the **alternate_pathing** parameter set to ON, by default, all the available paths for a physical device are enabled.

If it is necessary to disable a path and not complete path failover (for example due to maintenance), run commands to disable and then later enable the primary and alternative paths.

The commands to enable and disable primary and alternative paths are tape diagnostic and utility functions.

Note: See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Data Path failover and load balancing support for tape drives

The HP-UX device driver path failover support configures multiple physical paths to the same device within the device driver and provides two basic functions.

1. Automatic failover to an alternative physical path when a permanent error occurs on one path.
2. Dynamic load balancing for devices with multiple Host Bus adapters (HBA). On HP-UX 11i v3, HP-UX system always picks up a best path for ATDD to open. ATDD does not run a dynamic load balancing in open.

Note:

1. Data Path failover is not supported when block sizes greater than 256 K are used, except in HP-UX 11i v3.
2. It is required that applications must open the primary path for Data Path failover (not in HP-UX 11i v3).
3. Data Path failover is supported for 3592 tape drives on HP-UX 11i v2 and v3, and for Ultrium 3, Ultrium 4, Ultrium 5, and Ultrium 6 drives on HP-UX v2 and v3.

Configuring and unconfiguring path failover support

Path failover support is turned on automatically when the device driver is installed. However, you must provide the data path failover feature key and reclaim the devices by using the **atdd_claim** script. The feature key is a string with 16 characters and numbers.

1. Edit the following line in your **/sbin/init.d/atdd** file.

   ```
   DPF_KEYS="1234567890123456; 0987654321123456 "
   ```

   Note:

   a. 1234567890123456 is an example of a data path failover feature key. If you have multiple 3584 libraries and multiple data path failover feature keys, input your keys as follows:

   ```
   DPF_KEYS="key1; key2; ..."
   ```

   b. A DPF key is required for Ultrium 3 tape drives only. No DPF key must be added into the **/sbin/init.d/atdd** file if you are running the most recent drive code.

2. Save the file, then run the following command in HP-UX 11i v1 and v2:

   ```
   #  /opt/atdd/bin/atdd_claim
   ```

3. In HP-UX 11i v1 and v2, you can check whether the driver recognized multiple data paths for your drives by running:

   ```
   #ioscan -funC tape
   ```

   If you see "`.altpath`" next to one of the special files, then you successfully enabled control path failover feature for your library.

In HP-UX 11i v3, use the **# ioscan -m dsf** command to verify that the multiple path is configured by the system and ATDD.

Note: See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

After path failover support is enabled, it remains set until **atdd_claim** or **kctune** is run with the **alternate_pathing** driver parameter set to OFF. The path failover setting is retained even if the system is rebooted. If you want to turn off the data path failover feature in the ATDD driver, complete the following steps.

In HP-UX 11i v1 and v2:

1. Clear the **alternate_pathing** parameter. (You can ignore the message about rebooting the system.)

   ```
   #  /opt/atdd/bin/atdd_failover -a 0
   ```

2. Reconfigure DPF for the devices.

   ```
   #  /opt/atdd/bin/atdd_claim
   ```

In HP-UX 11i v3:

Run kctune to disable the kernel tunable of **atdd_alternate_pathing**. ATDD handles the DPF in the next open.

```
# kctune atdd_alternate_pathing=0
      * The automatic 'backup' configuration has been updated.
      * The requested changes have been applied to the currently
        running configuration.
Tunable                                     Value  Expression  Changes
atdd_alternate_pathing  (before)      1               1            Immed
                        (now)         0               0
```

If you want to turn the data path failover feature back on in the ATDD driver, complete the following steps.

In HP-UX 11i v1 and v2:

1. Set the **alternate_pathing** parameter. (You can ignore the message about rebooting the system.)

   ```
   #  /opt/atdd/bin/atdd_failover -a 1
   ```

2. Reconfigure DPF for the devices.

   ```
   #  /opt/atdd/bin/atdd_claim
   ```

In HP-UX 11i v3:

Run **kctune** to enable the kernel tunable of **atdd_alternate_pathing**. ATDD handles the DPF in the next open.

```
# kctune atdd_alternate_pathing=1
      * The automatic 'backup' configuration has been updated.
      * The requested changes have been applied to the currently
        running configuration.
Tunable                                     Value  Expression  Changes
atdd_alternate_pathing  (before)      0               0            Immed
                        (now)         1               1
```

Primary and alternative paths

When ATDD is loaded into the kernel, the first logical device that it sees in the system is the primary path for that medium changer. The other logical paths that ATDD attached for the same tape drive is configured as alternative paths. The device driver supports up to 16 physical paths for a single device. In HP-UX 11i v3, the HP-UX system always picks up the best path for ATDD to open so the primary path is dynamically assigned from the system. ATDD does not provide any `.altpath` special file.

The primary and alternative path information can be obtained by issuing the following command except in HP-UX 11i v3.

```
#  ioscan -funC tape
```

The following is an example of the output for this command.

```
home/root# ioscan -funC tape
Class I  H/W Path                 Driver S/W State H/W Type     Description
=======================================================================
tape  0  0/1/0/0.101.22.255.1.1.1 atdd  CLAIMED DEVICE  IBM ULT3580-TD3 /dev/rmt/0m
tape  1  0/1/0/0.101.22.255.1.2.1 atdd  CLAIMED DEVICE  IBM ULT3580-TD3 /dev/rmt/1m.altpath
```

Querying primary and alternative path configuration

You can display the primary and alternative path configuration for all devices by running **ioscan**, as explained in "Primary and alternative paths" on page 240.

Note: To display the primary and alternative path configuration for any device by using tape diagnostic and utility functions, refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Disabling and enabling primary and alternative paths

If it is necessary to disable a path and not complete path failover (for example due to maintenance), run commands to disable and then later enable the primary and alternative paths.

The commands to enable and disable primary and alternative paths are tape diagnostic and utility functions.

Note: See Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123.

Problem determination

A set of tools is provided with the device driver to determine if the device driver and the tape device are functioning correctly.

Error logging

Read the system log file (typically **/var/adm/syslog/syslog.log**) and the ATDD log file (**/var/adm/atdd/atdd_d.log**) if you are having problems. The ATDD logs messages to this file that provides information about the problem.

Sense data logging

When the tape drive responds with CHECK CONDITION status and associated sense keys of 0x1 (Recovery Error), 0x3 (Medium Error), 0x4 (Hardware Error), and 0xB (Aborted Command) for a hardware or medium error, the sense data is logged in to the system log file (typically **/var/adm/syslog/syslog.log**). The sense data logging feature is disabled by default on 11i v1 and 11i v2 and enabled by default on 11i v3. To enable the support dynamically, run **/opt/atdd/bin/atdd_cfg** with the -c option.

```
# /opt/atdd/bin/atdd_cfg -c 1
      * The requested changes have been applied to the currently running system.
Tunable                          Value   Expression  Changes
atdd_log_trace  (before)         0       Default     Immed
                (now)            1       1
```

Support_info script

Run the **support_info** script, in the /opt/OMImag/bin directory for the static driver and in /opt/atdd/bin for the DLKM driver. This script gathers important system and configuration information. There are several sections with the keyword VERIFY, indicating information that must be verified for correctness.

Log in as user ID "root" on the system that experienced a problem. Then, run the script and redirect the output to an end of a file.

Static

```
/opt/OMImag/bin/support_info > support_info.out
```

DLKM

```
/opt/atdd/bin/support_info > support_info.out
```

Tracing facility

Running the **ATDD_trace** utility, in the /opt/OMImag/bin for the static driver and in /opt/atdd/bin for the DLKM driver, displays debug information. The utility traces can be started at any time before an operation on a tape device. The default debug level is 0x00001003, which shows driver configuration and per instance drive attribute configuration and errors. You can increase the amount of debug information that is displayed by enabling more trace flags. Issuing **atdd_trace -f 0x1ffffff** turns on every trace.

1. Determine which items must be traced and set the trace flags by using the **atdd_trace** command. For example, to trace everything -

   For the Static driver:/opt/OMImag/bin/atdd_trace -f 0x1ffffff

   For the DLKM driver:/opt/atdd/bin/atdd_trace -f 0x1ffffff

   In HP-UX 11i v3, run the **sam** utility or **# kctune atdd_trace_level=1** command to set the trace level to 1. The default set is 3. The different levels of tracing for 11iv3 are

   - Full trace = 1
   - Messages = 2
   - Warnings = 3
   - Errors = 4

   The set of trace flags is displayed in .

Table 30. Trace flags

COMMAND	VALUE
Configuration	0x00000001
General errors	0x00000002
Routine entry points	0x00000004
Returns	0x00000008
TRACE_DBG information	0x00000010
Open/Close routine	0x00000020
Trace motion commands	0x00000040
Read/Write	0x00000100
Strategy	0x00000200
Open/Close states	0x00000400
IOCTLs	0x00000800
Trace device config routines	0x00001000
Trace SCSI level stuff	0x00004000
Configuration	0x10000000
Entry point	0x01000000
General information	0x00400000
Memory	0x00200000

2. Clear the trace buffer.

   For the Static driver:/opt/OMImag/bin/atdd_trace -c

   For the DLKM driver:/opt/atdd/bin/atdd_trace -c

3. To have trace data that is displayed immediately in a readable format as it is collected.

   For the Static driver:`/opt/OMImag/bin/atdd_trace -b`

   For the DLKM driver:`/opt/atdd/bin/atdd_trace -b`

4. Start the operations on a tape device.

5. To display collected trace data in a readable format at any time:

   For the Static driver:`/opt/OMImag/bin/atdd_trace -d`

   For the DLKM driver:`/opt/atdd/bin/atdd_trace -d`

6. The atdd_trace output can be redirected to place the trace data in a readable format into a file, by entering

   For the PB driver:`/opt/OMImag/bin/atdd_trace >trace.txt`

   For the PCI driver:`/opt/atdd/bin/atdd_trace >trace.txt`

7. In HP-UX 11i v3, the ATDD trace is logged in to syslog of **/var/adm/syslog/syslog.log** when the kernel tunable of **atdd_direct_trace** is enabled. To set a value (0 or 1) to **atdd_direct_trace**, run `# kctune atdd_direct_trace=value`. To turn on the trace `#kctune atdd_direct_trace=1` and set to 0 to turn off.

Problems and solutions

describes problems and possible solutions for errors you might encounter with the DLKM driver.

Table 31. Problems, reasons, and solutions	
Problem	**Reason and solution**
The system hangs when it runs **`rmsf -H`** on HP-UX 11i.	DLKM Infrastructure does not set the correct flag in the device switch table entry for a DLKM driver that uses. Install HP patch PHKL_29818.
ATDD DLKM modules are not loaded in the running kernel.A message in the file /var/adm/syslog/syslog.log `"vmunix: WARNING: modpath: DLKM is not initialized"`	The current kernel is not matching the symbol table (DLKM) in **/stand/dlkm** Must rebuild the kernel by running the following commands: ```#cd /stand/build #/usr/lbin/sysadm/system_prep -s /stand/build/ system #/usr/sbin/mk_kernel -s /stand/build/system #mv /stand/system /stand/system.prev #mv /stand/build/system /stand/system #kmupdate /stand/build/vmunix_test #shutdown -ry now```
A message in the file /var/adm/syslog/syslog.log `"modld: Attempt to load unregistered module "`	ATDD DLKM Module's component files are not copied to certain subdirectories of /usr/conf and /stand. Remove ATDD and try to install it again.
# kmtune | grep atdd `kmtune: Cannot open file -- /stand/.kmsystune_lock`	The file **.kmsystune_lock** was removed manually. Use the following command to create the **.kmsystune_lock** file again: ```# touch /stand/.kmsystune_lock```

Table 31. Problems, reasons, and solutions (continued)

Problem	Reason and solution
IBM tape devices not claimed in **ioscan -fnk** display	As "root", verify the drivers that are loaded in the running kernel by using `kmadmin -s`. If status is "LOADED", run **'atdd_claim -b'** to claim all IBM devices, run **'atdd_claim -t'** to claim the tape drives, then run **'atdd_claim -c'** to claim the changers. If status is "UNLOADED", run **'kmadmin -L atdd'** to load the ATDD, run **'kmadmin -L acdd'** to load the ACDD, then run **'atdd_claim'** to claim the tape devices. If status is still "UNLOADED", check the entries of the files 'atdd' or 'acdd' in /etc/loadmods. If no atdd or acdd file entries exist, the driver might be statically bound to the kernel, or the ATDD package might not be installed. Check the installation by running the following command: `# swlist atdd`
No special files that are found in **/dev/rmt**	Run the atdd_mksf and acdd (if you have changers that are managed by the acdd driver) scripts that are found in /opt/atdd/bin `atdd_mksf and acdd_mksf` **Note:** The script prints the commands that are necessary to create the special files. To create the files you must "pipe" the output to shell (sh), with the following commands:**atdd_mksf | sh acdd_mksf | sh**.
The special files for a device are duplicates.	Remove all of the special files for the device in **/dev/rmt** Create the special files again by running the commands **atdd_mksf** or **acdd_mksf**.
No special files are created by HP Stape and Schgr after ATDD is installed	Create the special files by running the command: **# insf -e**.
Cannot open Special File and the system log has the following message: `Invalid SCSI request in data at bit 7 of byte 4`	Wrong DENSITY setting. Check the current value by running the command:**atdd_cfg -g DENSITY** Try setting value to 0 (zero) by running the command: **atdd_cfg -s DENSITY 0**.
An attempt to read data times out and returns an error and the system log has the following messages: `A SCSI command timed out and was aborted.`	Make sure that the SILI configuration parameter is "1". This configuration can be checked by running the command: **atdd_cfg -g SILI** If the value of SILI = 0, try setting the value to 1, by running the following command: **atdd_cfg -s SILI 1**.

describes problems and possible solutions for errors you might encounter with the static driver.

Table 32. Troubleshooting (problems and solutions)

Problem	Solution
No special files that are found in `/dev/rmt`	Issue the following commands: **/opt/OMImag/ bincd /opt/OMImag/binatdd_mksf | sh**.
If you are using the PB drivers or are not using the standard device driver defaults with PCI drivers:	Verify that the hardware path for the device is listed in the configuration file `/etc/rc.config.d/atdd.cfg` If the hardware path is missing or incorrect, the driver was not installed properly.

Claimed by HP Stape driver	Run the command: **# lsdev** to check that the atdd is in the current kernel.
	
	1. If the atdd is not in the output, rebuild the kernel or reinstall atdd.
	2. If the atdd is in the output -
	
	    a. Rebuild the system I/O configuration.
	
	        1) Remove `/stand/ioconfig` and `/etc/ ioconfig` after to back up the files.
	        2) Reboot the system.
	        3) On System Console, enter the command **# / sbin/ioinit -c** while the autobooting is halted.
	        4) Run the command: **# /sbin/insf -e**.
	        5) Enter the command: **# ^D** to exit the I/O configuration.
	
	    b. Reinstall the HP-UX operating system if the system is new or is a new update.

Cannot open Special File. The system log has the following message:
`Invalid SCSI request in data at bit 7 of byte 4`
	Wrong DENSITY setting. Check the current value by:
	
	`atdd_cfg -g DENSITY <atdd_inst>`
	
	Try setting it to 0 (zero):
	
	`atdd_cfg -s DENSITY 0 <atdd_inst>`

An attempt to read data times out and returns an error. The system log has the following messages:
`A SCSI command timed out and was aborted.`
`LLIO: Detected PowerFail`
`(probably caused by SCSI bus or device reset).`
	Check that the SILI configuration parameter is 1 by running
	
	`atdd_cfg -g SILI <atdd_inst>`
	
	If the SILI parameter is zero, try setting it to 1:
	
	`atdd_cfg -s SILI 1 <atdd_inst>`

Table 32. Troubleshooting (problems and solutions) (continued)	
Problem	**Solution**

An attempt to read data times out and returns an error. The system log has the following messages:
 	
`A SCSI command timed out and was aborted.`
`scsi3: ....date code...`
`scsi3: ....timestamp...`
	Check that the FORCE_NARROW parameter is valid for this device by running
	
	`atdd_cfg -g FORCE_NARROW <atdd_inst>`
	
	If FORCE_NARROW is 1, try setting it to 0:
	
	`atdd_cfg -s FORCE_NARROW 0 <atdd_inst>`

Chapter 9. 3494 Enterprise Tape Library support

Purpose

The IBM 3494 Library device driver is a device driver providing attachment for the IBM 3494 Enterprise Automated Tape Library and IBM Virtual Tape Server (VTS) to a server. The programs that are described in this chapter support the 3494 Enterprise Automated Tape Library on the following operating systems:

- AIX on IBM POWER-based servers
- HP-UX
- Linux
- Solaris
- Microsoft Windows

   Note: Check the versions of operating system that is supported by the IBM tape driver on each platform.

MTLIB program

The **mtlib** program is a command-line interface used to control the 3494 Enterprise tape library and is installed, by default, for execution by all users on the system. This program provides the full interface (except for the MTIOCLEW library system call) as specified in the *IBM Tape Device Drivers: Programming Reference*, GA32-0566. Refer to "MTEVENT program" on page 257.

The **mtlib** program provides an interface to the physical tape drives and volumes within a 3494 tape library and also to the virtual tape drives and volumes within an attached IBM Virtual Tape Server (VTS).

To issue commands to the physical tape drives and volumes, specify a device special file name, such as **/dev/lmcp0** or the logical name of the library, such as **libmgrc7**.

To issue commands to the virtual tape drives and volumes in an attached VTS library, specify a device special file name or the logical name of the library with the name of the logical VTS library that is appended with a slash·(/). For example, to issue commands to the first attached VTS library, use **/dev/lmcp0/vts1** or **libmgrc7/vts1**. The attached VTS libraries are named logically **vts1**, **vts2**, and so on. They correspond to the order in which they were configured in the tape library. The **-D** flag, with the **-E** flags, can be used to display the attached VTS devices and the number of the VTS library.

Syntax and examples

Figure 64 on page 248 shows the syntax for the **mtlib** program.

```
                                    ┌─ A ─┐
              ┌─ -m ──┬─ -f filename ─┬─────┬─ -V volser ──┬──────────────┬──────────┐
              │       └─ -x number ───┘     └─ -s category ┘ └─ -t category ┘  └─ -n ─┘
              │       ┌─ -E ─┐
              │  ┌─ -D ┘
mtlib ─── -l filename ┤  ┌─ -d ──┬─ -f filename ─┬──────────────┬──────────────┬────────┐
              │       │         └─ -x number ───┘ └─ -V volser ─┘ └─ -t category ┘ └─ -n ┘
              │       ├─ -qV ── -V volser
              │       ├─ -qL
              │       ├─ -qS
              │       ├─ -qI
              │       ├─ -qC ── -s category
              │       ├─ -qD ──┬─ -f filename
              │       │        └─ -x number
              │       ├─ -qE ── -V volser
              │       │                      ┌─ -u ─┐
              │       │                      └─ -F ─┬─ I ─┬─ p ─┐
              │       │                             ├─ E ─┤─ d ─┤
              │       │                             └─ U ─┘─ s ─┘
              │       ├─ -qK ── -s category
              │       ├─ -qR ──┬──────────────┐
              │       │        └─ -h hostid ──┘
              │       ├─ -qA ──┬──────────────┐
              │       │        └─ -h hostid ──┘
              │       ├─ -qM
              │       ├─ -a ──┬─ -V volser
              │       │       └─ -L list
              │       ├─ -c ──┬─ filename
              │       │       └─ requestid
              │       ├─ -i requestid
              │       ├─ -C ──┬─ -V volser ──┬─ -s category ─┬─ -t category ─┬── -n ─┐
              │       │       └─ -L list
              │       ├─ -k ──┬─ O ──┬─ -f filename ─┬─ -s category
              │       │       ├─ G   └─ -x number ──┘
              │       │       ├─ A
              │       │       ├─ OG
              │       │       ├─ OA
              │       │       ├─ GA
              │       │       ├─ OGA
              │       │       ├─ C
              │       │       └─ X
              │       ├─ -r ──┬─ -s category ──────── -h hostid
              │       │       └─ -# num_categories
              │       ├─ -R ── -s category ── -h hostid
              │       └─ -S ── -s category ── -N name
              └─ -? ──┘                                          └─ -v ─┘
```

*Figure 64. Syntax diagram for **mtlib** program*

The **mtlib** program has the following flags:

-f[filename]
Device special file for the drive, for example, /dev/rmt0 (AIX), /dev/rmt/0st
(Solaris), /dev/rmt/0m (HP), /dev/IBMtape0 (Linux), \\.\tape0 (Windows).

-x[number]
Device number of the drive, for example, 518350.

-l[filename]
On AIX, library special file name, for example, /dev/lmcp0, /dev/lmcp0/vts1. For non-AIX, the
logical name of the library, for example, **libmgrc7**.

-q[type]
Query the library information option:

V
Volume data.

L
Library data.

S
Statistical data.

I
Inventory data.

C
Category inventory data.

D
Device data.

E
Expanded volume data.

K
Inventory volume count data.

R

Reserved category list.

A

Category attribute list.

M

All mounted volumes.

-D

Return an array of devices that are configured in the specified library.

-E

Return (if used with the -D option) an array of expanded information for all devices that are configured in the specified library, including the control unit ID, device, and VTS library number.

-m

Mount option.

-d

Demount option.

-c[requestid]

Cancel the pending request option.

-n

No wait mode.

-i[requestid]

Query the request ID status option.

-C

Change the category of a volume.

-a

Audit the specified volume.

-k[flags]

Assign a category (with one of the following flags) to a device in the library:

O

Enable the category order.

C

Clear the cartridge loader.

G

Generate the first mount.

A

Enable the auto mount.

X

Remove the device category assignment.

Note: Valid combinations are OG, OA, GA, and OGA.

-r

Reserve the category.

-R

Release the category.

-S

Set the category attribute.

Note: The categories must be reserved before this option is used.

-s[category]

Source or starting category.

-t[category]

Target category.

-V[volser]

Volume serial number.

-L[list]

Filename containing a list of the volume serial numbers. Each Volume Serial must be entered as one per line in the file.

-N[name]

Category name to assign to the category (valid characters are uppercase A-Z, 0-9, -, *, or blank).

-h[hostid]

Host ID for the reserve or release category or the R/A option for the query command.

-u

Include usage date in the expanded volume data (used with the-qE option). The default is the ISO format with a period separator. The format can be specified with the -F option.

-F[flags]

Format or separator for volume usage and date with the -u option:

I

ISO/Japan yyyy.mm.dd.

E

Europe dd.mm.yyyy.

U

US mm.dd.yyyy.

p

Period separator mm.dd.yyyy.

d

Dash separator mm-dd-yyyy.

s

Slash separator mm/dd/yyyy.

-v

Verbose.

-#[num_categories]

Number of categories to reserve.

-A

Query library addresses and status.

-?

Help text.

Note: The·-l argument is required.

The report in was produced by

```
mtlib -l /dev/lmcp0 -f /dev/rmt5 -qD (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -f /dev/rmt5 -qD (for AIX VTS library 1)
mtlib -l libmgrc7 -f /dev/rmt/5st -qD (for Solaris)
mtlib -l libmgrc7 -f /dev/rmt/5m -qD (for HP)
mtlib -l libmgrc7 -f /dev/IBMtape5 -qD (for Linux)
mtlib -l libmgrc7 -f \\.\tape0 -qD (for Windows)
```

Table 33. Device query

```
Device Data:
   mounted volser............TAF500
   mounted category..........FF00
   device category...........0000
   device state..............Device installed in Library.
                             Device available to Library.
                             Volume is loaded.
                             ACL is installed.
   device class..............3590-B1A
   extended device status....00
```

The report in Table 34 on page 251 was produced by

```
mtlib -l /dev/lmcp0 -qV -VCS2000 (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qV -VCS2000 (for AIX VTS library 1)
mtlib -l libmgrc7 -qV -VCS2000 (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 34. Volume query

```
Volume Data:
   volume state.........00
   logical volume.......No
   volume class.........3590 1/2 inch cartridge tape
   volume type..........HPCT 320m nominal length
   volser...............CS2000
   category.............FE00
   subsystem affinity...04 03 05 06 01 02 00 00
                        00 00 00 00 00 00 00 00
                        00 00 00 00 00 00 00 00
                        00 00 00 00 00 00 00 00
```

The report in Table 35 on page 251 was produced by

```
mtlib -l /dev/lmcp0 -qE -VCS2000 (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qE -VCS2000 (for AIX VTS library 1)
mtlib -l libmgrc7 -qE -VCS2000 (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 35. Expanded volume query

```
Expanded Volume Data:
   volume status........00
   logical volume.......No
   volume class.........3590 1/2 inch cartridge tape
   volume type..........HPCT 320m nominal length
   volser...............CS2000
   device category......FF00
```

The report in Table 36 on page 252 was produced by

```
mtlib -l /dev/lmcp0 -qE -u -VCS2000 (for AIX physical library)
mtlib -1 libmgrc7 -qE -u -VCS2000 (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 36. Expanded volume data with usage

```
Expanded Volume Data with Usage:
    volume status............00
    logical volume...........No
    volume class.............3590 1/2 inch cartridge tape
    volume type..............HPCT 320m nominal length
    volser...................CS2000
    device category..........FF00
    last used (yyyy.mm.dd)...2001.08.26
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -qK -v (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qK -v (for AIX VTS library 1)
mtlib -l libmgrc7 -qK -v (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 37. Inventory count data

```
Performing Query Inventory Volume Count Data using /dev/lmcp0
Inventory Volume Count Data:
    sequence number......12345
    number of volumes....207
    category.............0000
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -D (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -D  (for AIX VTS library 1)
mtlib -l libmgrc7 -D  (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Refer also to the *tapeutil* subcommand **mtdevice**.

Table 38. Tape library device number

```
0, 00515820 003490C2A00
1, 00515821 003490C2A01
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -DE (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -DE (for AIX VTS library 1)
mtlib -1 libmgrc7 -DE (for Solaris, HP, Linux, SGI, Tru64, and Windows))
```

Refer also to the *tapeutil* subcommand **mtdevice**.

Table 39. Expanded tape library device list

```
 Type    Mod  Serial #  Devnum    Cuid  Device  VTS Library
 003590  B1A  13-10800  00108000   1     0
 003590  B1A  13-10800  00108001   1     1
 003590  B18  13-01817  00018170   2     0        1
 003590  B18  13-01817  00018171   2     1        1
 003590  B18  13-01817  00018172   2     2        1
 003590  B18  13-01817  00018175   2     3        1
 003490  C2A  13-01817  00FF0100   3     0        1
 003490  C2A  13-01817  00FF0101   3     1        1
 003490  C2A  13-01817  00FF0110   3     2        1
 003490  C2A  13-01817  00FF0111   3     3        1
 003490  C2A  13-01817  00FF0120   3     4        1
 003490  C2A  13-01817  00FF0121   3     5        1
 003490  C2A  13-01817  00FF0130   3     6        1
 003490  C2A  13-01817  00FF0131   3     7        1
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -qL (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qL  (for AIX VTS library 1)
mtlib -l libmgrc7 -qL  (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 40. Library data

```
Library Data:
   Operational state..........Paused Operational State
                              Intervention Required
   functional state...........00
   input stations.............1
   output stations............1
   input/output status........All input stations empty
                              All output stations empty
   machine type...............3494
   sequence number............10491
   number of cells............1056
   available cells............1014
   subsystems.................6
   convenience capacity.......30
   accessor config............01
   accessor status............Accessor available
                              Gripper 1 available
                              Gripper 2 installed
                              Vision system operational
   comp avail status..........Primary library manager installed.
                              Primary library manager available.
                              Secondary library manager installed.
                              Secondary library manager available.
                              Primary hard drive installed.
                              Primary hard drive available.
                              Secondary hard drive installed.
                              Secondary hard drive available.
                              Convenience input station installed.
                              Convenience input station available.
                              Convenience output station installed.
                              Convenience output station available.
   library facilities.........00
   bulk input capacity........0
   bulk input empty cells.....0
   bulk output capacity.......0
   bulk output empty cells....0
   avail 3490 cleaner cycles..0
   avail 3590 cleaner cycles..91
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -qS (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qS  (for AIX VTS library 1)
mtlib -l libmgrc7 -qS  (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 41. Statistical data

```
Statistical Data:
    hour index...........10
    machine type.........003494
    model number.........L10
    manufacturer.........IBM
    plant................13
    sequence number......000000010491
    drives...............6
    mounted drives.......1
    max mounted drives...2
    min mounted drives...1
    avg mounted drives...1
    max mounted time.....22
    min mounted time.....16
    avg mounted time.....19
    pending mounts.......0
    max pending mounts...2
    min pending mounts...0
    avg pending mounts...0
    mounts/hour..........18
    index mounts/hour....0
    pre-mounts/hour......0
    max mount time.......27
    min mount time.......16
    avg mount time.......19
    pending demounts.....0
    max pending demounts.2
    min pending demounts.0
    avg pending demounts.0
    demounts/hour........16
    index demounts/hour..0
    post-demounts/hour...0
    max demount time.....28
    min demount time.....19
    avg demount time.....24
    pending ejects.......0
    max pending ejects...0
    min pending ejects...0
    avg pending ejects...0
    ejects/hour..........0
    max eject time.......0
    min eject time.......0
    avg eject time.......0
    pending audits.......0
    max pending audits...0
    min pending audits...0
    avg pending audits...0
    audits/hour..........0
    max audit time.......0
    min audit time.......0
    avg audit time.......0
    input stores/hour....0
```

The report in was produced by

```
mtlib -l /dev/lmcp0 -qI-v (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qI -v (for AIX VTS library 1)
mtlib -l libmgrc7 -qI -v (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 42. Inventory query

```
Performing Query Inventory Data using /dev/lmcp0
Inventory Data:
    sequence number......10491
    number of volumes....44
    inventory records
        record   1......category............012C
                        volser..............008273
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record   2......category value......FF00
                        volser..............064435
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record   3......category value......FF00
                        volser..............ALTML1
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
                        .
                        .
                        .
        record  42......category............FF00
                        volser..............TST039
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record  43......category............FF00
                        volser..............TST182
                        volume state........Volume present in Library,
                                                   but Inaccessible
        record  44......category value......FF00
                        volser..............XYZ464
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length

 Note:  All available records are produced as output per request.
        Fewer records are shown here for the sake of brevity.
```

The report in Table 43 on page 256 was produced by

```
mtlib -l /dev/lmcp0 -qC -sFF00 -v (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qC -sFF00 -v  (for AIX VTS library 1)
mtlib -l libmgrc7 -qC -sFF00 -v  (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 43. Category inventory query

```
Performing Query Category Inventory Data using /dev/lmcp0
Inventory by Category Data:
    sequence number......10491
    number of volumes....30
    category............FF00
    inventory records
        record   1......category ...........FF00
                        volser..............CS2017
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record   2......category ...........FF00
                        volser..............FVT896
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record   3......category ...........FF00
                        volser..............IHG319
                        volume state........00
                        logical volume......No
                        volume class.......3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
                        .
                        .
                        .
        record  28......category ...........FF00
                        volser..............SLT500
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record  29......category ...........FF00
                        volser..............TAF195
                        volume state........00
                        logical volume......No
                        volume class........3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length
        record  30......category ...........FF00
                        volser..............MOO801
                        volume state........00
                        logical volume......No
                        volume class.......3590 1/2 inch cartridge tape
                        volume type.........HPCT 320m nominal length

Note:  All available records are produced as output per request.
       Fewer records are shown here for the sake of brevity.
```

The report in Table 44 on page 256 was produced by

```
mtlib -l /dev/lmcp0 -r -#2 -h roadster (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -r -#2 -h roadster (for AIX VTS library 1)
mtlib -l libmgrc7 -r -#2 -h roadster (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 44. Reserve category command

```
Reserved Category List:
    sequence number............10491
    system token...............roadster
    total number reserved......0002
                        category......0101
                        category......0102
```

The report in Table 45 on page 257 was produced by

```
mmtlib -l /dev/lmcp0 -qR -h roadster (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -qR -h roadster (for AIX VTS library 1)
mtlib -l libmgrc7 -qR -h roadster (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 45. Reserve category list

```
Reserved Category List:
    sequence number............10491
    system token...............roadster
    total number reserved......0002
                        category......0101
                        category......0102
```

The report in Table 46 on page 257 was produced by

```
mtlib -l /dev/lmcp0 -S -S101 -NSCRATCH (for AIX physical library)
mtlib -l /dev/lmcp0 -S -S102 -NWORKING (for AIX physical library)
mtlib -l /dev/lmcp0 -qA -h roadster (for AIX physical library)
mtlib -l /dev/lmcp0/vts1 -S -S101 -NSCRATCH (for AIX VTS library 1)
mtlib -l /dev/lmcp0/vts1 -S -S102 -NWORKING (for AIX VTS library 1)
mtlib -l /dev/lmcp0/vts1 -qA -h roadster (for AIX VTS library 1)
mtlib -l libmgrc7 -S -S101 -NSCRATCH (for Solaris, HP, Linux, SGI, Tru64, and Windows)
mtlib -l libmgrc7 -S -S102 -NWORKING (for Solaris, HP, Linux, SGI, Tru64, and Windows)
mtlib -l libmgrc7 -qA -h roadster (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 46. Category attribute list

```
Category Attribute List:
    sequence number............10491

    system token...............roadster
                        category 0101 -- name: SCRATCH
                        category 0102 -- name: WORKING
```

The report in Table 47 on page 257 was produced by

```
mtlib -l /dev/lmcp0 -A (for AIX physical library)
mtlib -l tire -A (for Solaris, HP, Linux, SGI, Tru64, and Windows)
```

Table 47. Library address information

```
Library Address Information:
    library name...............tire
    host identification........roadster
    primary address............9.115.45.52
    primary status.............Online
    alternate address..........9.115.45.51
    alternate status...........Offline
```

MTEVENT program

The **mtevent** program is a command-line interface to the **MTIOCLEW** command.

The **mtevent** program has the following flags:

-l[filename]
> Library special file name or logical name of the library, for example, **/dev/lmcp0**, **/dev/lmcp0/vts1**, or **libmgrc7**.

-t[timeout]
> Number of seconds to wait for the event to occur.
>
> (0=no timeout).

Note:

1. The **-l** flag is required.
2. If the **-t** flag is not supplied, then no timeout is completed.

Library driver information

The **lmcpd** communicates to the tape library through symbolic names that are defined in the **/etc/ibmatl.conf** file. One or more symbolic names can be configured for each tape library online to the system. A symbolic name is used to run the various library functions (such as mounting and unmounting volumes).

Software interface

The **C·object** module provides three subroutines for communicating with the IBM 3494 Enterprise tape library. These subroutines are **open_ibmatl**, **close_ibmatl**, and **ioctl_ibmatl**. The **open_ibmatl** and **close_ibmatl** routines are used to open and close communication with the library. Similarly, the **open** and **close** system calls are used to open and close communication with a file. The **ioctl_ibmatl** subroutine is used to send commands to the Library Manager on the 3494 tape library.

To send commands to the 3494 tape library, one symbolic name must be defined for use on the library.

Library Manager event notification

In addition to completing library operations, the **lmcpd** is responsible for receiving the various Library Manager notifications. The daemon monitors several types of events. When the daemon receives an event, it checks a list of processes that are waiting for an event to determine where to deliver it. If no process is waiting for the event that arrived, then the event is discarded. The applications can use the **Library Event Wait** call to request notification of all Library Manager events. Refer to the *IBM Tape Device Drivers: Programming Reference* for information.

Synchronous and asynchronous operations

Two types of library operations are supported: synchronous and asynchronous. The Library Manager responds to the synchronous operation immediately. These operations are completed when the library responds to the request. An example of a synchronous operation is the **Library Query** call. An asynchronous operation (such as a mount operation) takes longer to complete. In an asynchronous operation, the library returns an initial response when the command is accepted for execution. When the command is completed, it returns a delayed response message that indicates the status of the operation.

Operation Complete notification

When the **Mount**, **Demount**, **Audit**, or **Set Volume** category operation is sent to the library, a message identifier is assigned to the operation. This identifier is returned to **lmcpd**. When the operation is completed, an operation complete notification is sent to the daemon. The daemon makes a determination (based on the initial message identifier) as to which user process to notify that the operation is complete. The **Mount**, **Demount**, **Audit**, or **Set Volume** category operations have an option that allows the user process to wait or not wait for the operation complete message. If the user process does not wait for the final complete, the initial message identifier is returned to the caller. It can be used in subsequent **Library Query Message ID** operations to solicit the status of the asynchronous operation.

Unsolicited notification

There are situations when the Library Manager has a condition to report that is not related to any I/O operation. In this case, an unsolicited notification is sent to the device daemon. If a notification is received, then any process that is waiting with the Library Event Wait call is notified. An example of an unsolicited notification is the operational state change of the library (from the Auto mode to the Pause

mode). Refer to the *IBM Tape Device Drivers: Programming Reference* for a list of unsolicited notifications that are received by the **lmcpd**.

Driver message queue

The driver maintains a message queue for any process that has an open LMCP file descriptor. This queue, which has a depth of four entries, is implemented on a first-in, first-out basis. The purpose of this message is to reduce the possibility of missing a message when several messages occur in a short time. All queue entries are discarded when the LMCP file descriptor is closed. When an application issues the **MTIOCLEW** input/output control *(ioctl)* call, the driver returns the oldest entry from the message queue and deletes it. If no entries are in the queue, then the calling process is put to sleep until a message is received.

Volume categories

To facilitate the management of the tape volumes within the 3494 tape library, the capability to associate the tape volumes into logical groupings is provided. Each logical grouping is known as a category. For example, an installation can have one or more scratch categories that are assigned by media type or class of user. Another potential use is managing volumes for daily, weekly, and monthly backups or volumes that are owned by a specific user. The **lmcpd** also allows a user process to assign a particular category to a tape device in the library. This process allows all the volumes that are associated with the category to be mounted as determined by the flags of the command on the specified device.

A category is a four digit hexadecimal number in the X'0000'-X'FFFF' range. The assigned categories are

X'0000'
> NULL category (not usable or not assigned).

X'0001'-X'FEFF'
> General programming use.

X'FFFF'
> VOLSER specific.

The X'FF00'-X'FFFE' categories are reserved for hardware functions.

X'FF00'
> Insert.

X'FF01'-X'FF0F'
> Reserved.

X'FF10'
> Eject.

X'FF11'
> Bulk eject.

X'FF12'-X'FFF8'
> Reserved.

X'FFF9'
> Service volume.

X'FFFA'
> Manually ejected.

X'FFFB'
> Purge volume.

X'FFFE'
> Cleaner volume.

The following three categories are available for programming use.

Insert
> When a tape volume is received in the input station, the volume label is read and assigned to this category. This category cannot be assigned by a user process.

Eject

The volumes that are assigned to this category are moved from their cell into the output station. After the volume is delivered, it is removed from the inventory. The `Library Set Volume Category` command is the only command that can change the category of a volume to the eject category.

Bulk eject

The volumes that are assigned to this category are moved from their current cell to the bulk output area in the 3494 tape library. Refer to the *IBM Enterprise Automated Tape Library Operator Guide* for information about the bulk output area. The `Library Set Volume Category` command is the only command that can change the category of a volume to the bulk eject category.

The X'FFFF' category is available for general programming use. However, any mount request to this category must apply to a specific volume that is assigned to the category (and not based on the category alone).

IBM TotalStorage Virtual Tape Server subsystem attachment

The device driver supports the IBM TotalStorage™ Virtual Tape Server (VTS) subsystem attachment with a 3494 Enterprise tape library on AIX, HP-UX, Windows, and Oracle Solaris systems. An attached VTS subsystem provides virtual tape drives that are accessible with the VTS SCSI attachment feature. Volumes within the VTS subsystem are logical tape volumes. A logical tape volume appears to the host as a normal physical tape volume. However, the VTS logical volumes are unique to the VTS subsystem and are accessible only by virtual tape drives within the VTS subsystem.

Access to a VTS subsystem is specified to the device driver as a logical library within the attached tape library as **vts1**, **vts2**, and so on. For example, issuing a `Query Inventory` command to the **3494 lib** returns the physical volumes in the 3494 tape library, where **3494 lib** is a library that is configured in the **/etc/ibmat1.conf** file. Issuing a `Query Inventory` command to **3494 lib/vts1** returns the logical volumes in the first VTS subsystem that is attached to the 3494 Enterprise tape library.

3494 Library emulation

With 3494 Library emulation support, you can use applications that were written for the 3494 API on host attached SCSI Medium Changer libraries. Specifically, you can use migration to the 3584 Ultra Scalable library with 3592 drives.

Overview

Existing customer scripts that use the **mtlib** program and customer or ISV applications require no or minor changes to use, depending on the 3494 functions that are used. Customer and ISV applications must be recompiled only with the new **libibm.o** object module to use the emulation support. The mtlib 3494 user command line interface program has the same syntax and output on every operating system. It also provides a common utility for SCSI Medium Changer libraries. Current operating system device driver utilities vary by syntax or output. They require a knowledge of SCSI Medium Changers to use, and require multiple commands to run a single `mtlib` command.

3494 Emulation design

The 3494 Emulation support adds a **libsmc** extension to the current **libibm.o** object module that applications compile with for existing 3494 support. The **libsmc** extension contains the 3494 API Emulation support. The extension issues SCSI Medium changer commands to the library by using the operating system SCSI Medium Changer device driver.

Figure 65 on page 261 and Figure 66 on page 261 show the 3494/SMC data flow between existing applications and components and the new **libsmc** extension.

3494/ SMC Library Data Flow
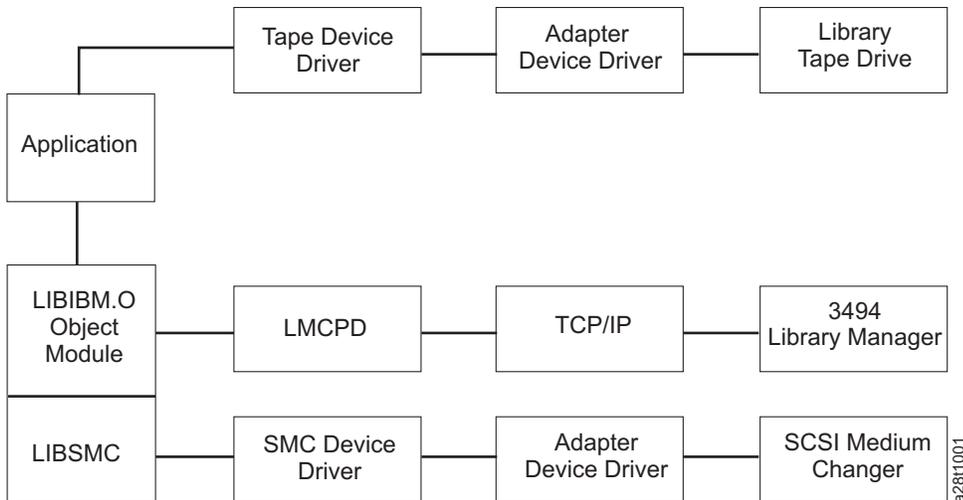
Figure 65. 3494/SMC library data flow

LIBSMC and O/S Components
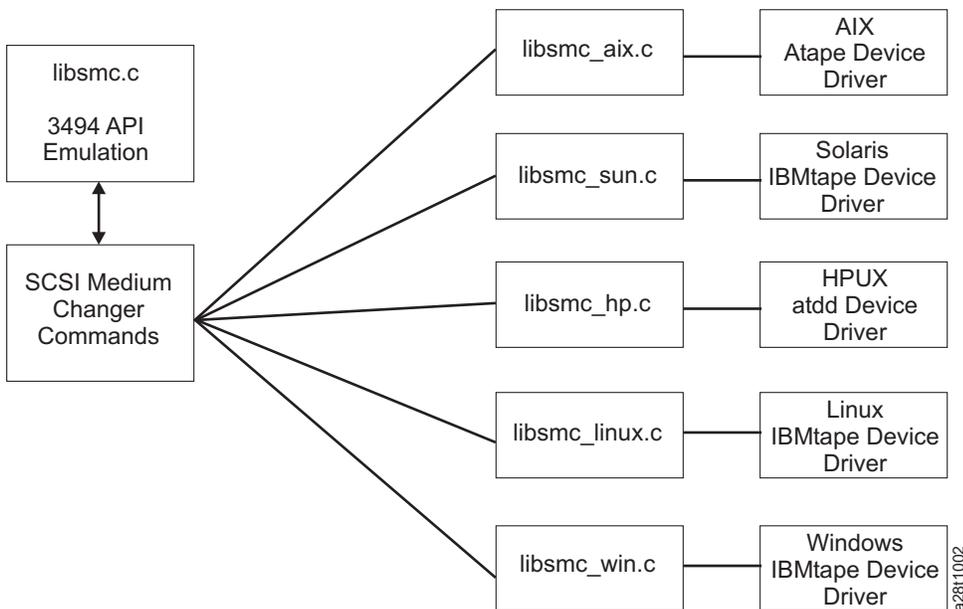
Figure 66. LIBSMC and OS components

3494 API Emulation and MTLIB program

Refer to the *IBM Tape Device Drivers Installation and User's Guide* and the *IBM Tape Device Drivers Programmer's Reference* for the complete description of 3494 library support and the **mtlib** program and syntax.

SMC library names

The library name on the **open_ibmatl** ("libname") or **mtlib -l libname** parameter determines whether a 3494 library or an SMC library is being used. If the library name is a logical operating system SMC library name, then the **libsmc** support is used. Otherwise, the **lmcpd** support is used.

For example, SMC libraries on AIX are named **smc0**, **smc1**, and so on. To issue an **mtlib** query library command on AIX to a 3584 library named **smc0**,

```
mtlib -l smc0 -qL
```

To issue an **mtlib** command on Linux to a 3584 library named **IBMchanger0**,

```
mtlib -l IBMchanger0 -qL
```

Volume categories

The 3494 library supports the grouping of one or more volumes into categories that can be assigned by an application and operations that can specify a category only rather than a specific volume. SCSI Medium Changers do not provide a similar function. All volumes in an SMC library are category 0000, the NULL category.

Because volume categories are not supported, the following API and **mtlib** command options cannot be used. Applications and **mtlib** scripts that use these functions might require changes.

- Reserve category mtlib -r option
- Release category mtlib -R option
- Change a volume category mtlib -C option
- Set category attribute mtlib -S option
- Assign a category mtlib -k option
- Mount from a category mtlib -m -s option

Asynchronous library operations

The 3494 library runs all mount, demount, audit, and eject operations asynchronously and initially returns a request id to the host for the operation. The request id can then be queried at any time to determine whether the operation is still pending, completed, or is unknown. SMC libraries run these operations synchronously and do not support a request id.

An application can select to wait for an asynchronous operation to complete by setting the API **wait_flg** to one or by using **mtlib** without the -n option. The operation is synchronous on both a 3494 and SMC library and no request id is returned to the application. These applications and **mtlib** scripts do not require any changes.

If an application selects to not wait for an asynchronous operation to complete by setting the API **wait_flg** to zero or by using **mtlib** with the -n option, the operation on an SMC library is still synchronous. A request id 0 is returned to the application.

Most applications and scripts do not use the return request id to determine when the operation completes and uses the no wait option for performance only. For example, by using the no wait option on a demount operation so the application can continue while the library is demounting the volume. These applications and **mtlib** scripts do not require any changes but do take the same amount of time as the wait option.

Applications that use the Query Message ID or **mtlib** -i option to determine when the return request id operation completes might require changes. One change is polling for a mount that is issued with the no wait option since any request id is always unknown on an SMC library because the operation is already complete.

Performance considerations

The performance time of **mtlib** commands that are issued to a SCSI 3584 library versus a 3494 vary and some performance times might be higher. The **mtlib** commands, such as **-qV** and **-qI** that require reading all the slot information from the library also vary in the amount of time it takes for the command to complete. The fewer the number of slots that are in the library, the shorter time it takes to complete the **mtlib** command and a larger number of slots in the library takes longer.

The software consists of an Automated Tape Library Device Driver (**atldd**), an application daemon (**lmcpd**) that communicates with the 3494 Library Manager (LM), and a utility program (**mtlib**), which provides a command-line interface to the library. Either an ethernet, token-ring LAN, or an RS-232 serial connection can be used for the physical connection between the host and the 3494 LM.

The daemon, which is known to AIX specifically as the IBM Library Manager Control Point Daemon (**lmcpd**), communicates with tape libraries that are defined in a configuration file. This file, **ibmatl.conf**, is placed in the /etc directory when the software package is installed. Customization of this file is described in "Defining tape libraries to the daemon" on page 265. A typical environment for the AIX 3494 Enterprise Library Driver is an RS/6000 or System p (also known as pSeries) server on a local area network (LAN) with SCSI- or fibre-attached tape drives that provide backup and restore functions.

Data flow

The software described in this chapter covers the library device driver and the interface between the application and the library device driver. For information, refer to Figure 67 on page 263.
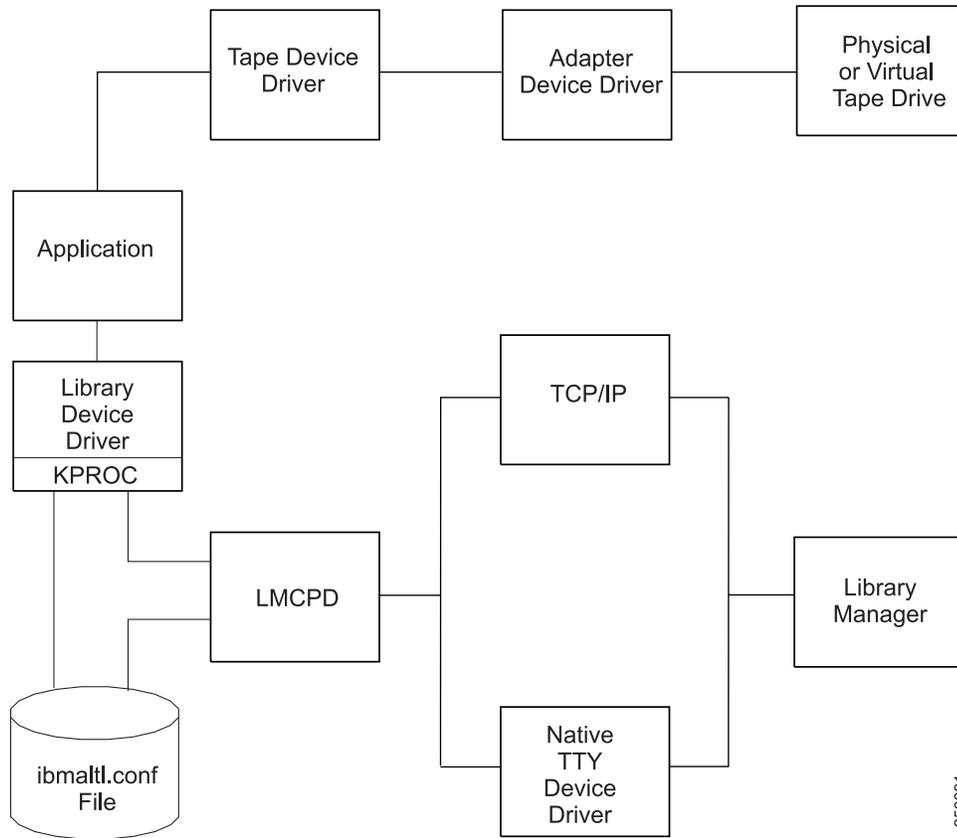
Figure 67. Data flow for AIX 3494 Enterprise Tape Library Driver

Product requirements

The following hardware and software components are supported by IBM.

Hardware requirements

The library driver supports the following hardware.

- One of the following options, depending on the connection (RS-232 or LAN) required for the Library Manager,

- RS-232
  - One standard 25 pin null modem D-shell RS-232 cable
  - (maximum of 15.24 meters [50 feet])
- LAN
  - Token Ring or Ethernet Adapter support in an RS/6000 or pSeries workstation that is attached to the Library Manager
  - LAN cabling (as required)
- IBM TS1120 Tape Drive Model EO5
- IBM TS1130 Tape Drive Model E06
- 3592 Tape Drive Model J1A

Software requirements

The following software is required for the library driver:

- AIX 5L, Version 5.3, and later releases on IBM POWER-based servers.
- AIX Tape and Medium Changer Device Driver (Atape)

To obtain the most current service and documentation for this software, refer to

Installation instructions

Use the standard set of AIX methods to install and configure the LMCP devices. You must have *root* authority to complete these operations.

Installation procedure

Refer to for information on obtaining the latest versions of the device driver and the latest documentation.

Enter the following command to list the currently installed version of the 3494 Enterprise Library Driver:

```
lslpp -l atldd.driver
```

Connecting the IBM Enterprise tape library

If a tty connection is needed, use a standard 25 pin null modem D-shell RS-232 cable to connect the workstation to the 3494 Enterprise tape library. Place the cable on the native serial port or on the 8 port or 16 port asynchronous adapter.

If a LAN connection is needed, connect the LAN cable from the Token Ring or Ethernet adapter card in the workstation to the 3494 tape library.

Note: The cable (RS-232 or LAN) must be in place before the software is installed to ensure correct initialization of the driver.

Configuring the serial port

After the 3494 tape library is connected to the workstation, you must configure the serial port to which it is connected. Use **smit** to configure the serial port. Enter the following command:

```
smit tty
```

Select the following options.

1. TTY menu: Add a tty device.
2. Selection menu: Select the appropriate parent serial adapter.

3. Add TTY menu: Enter the port number.

   Press **F4** to generate a list of possible values.

4. Add TTY menu: Set baud rate to 9600.

5. Add TTY menu: eight data bits, one stop bit, no parity.

6. Add TTY menu: Set Enable program to Off.

   Press **F4** to generate a list of possible values.

7. Add TTY menu: Set Enable LOGIN to **disable**.

   Use **Tab** to toggle the value.

8. Press **Return** to configure the tty device.

   Repeat steps 1 - 8 for each tape library that is connected to the workstation.

Configuring the IBM 3490E or 3590 tape drive

To operate the 3494 Enterprise tape library successfully through the configured LMCPs, you must configure all 3490E or 3590 tape drives in the 3494 tape library. Refer to "Configuring the Library Manager Control Point" on page 266 for instructions.

Defining tape libraries to the daemon

After the software is installed and the tape libraries are connected to the system, the **/etc/ibmatl.conf** file must be edited to define the tape libraries to the **lmcpd**. The format of the file is

```
Symbolic name      Connection type      Identifier      Alternate LAN Connection
```

`Symbolic name` is used to identify each library. The symbolic names must be unique across all libraries that are defined in the **/etc/ibmatl.conf** file.

`Connection type` is used to define the type of connection to the library (either RS-232 or TCP/IP). For RS-232 connections, this type is the device special file name of the tty device (for example, **/dev/tty0** or **/dev/tty1**). For TCP/IP connections, this type is the IP address of the Library Manager. If the library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first IP address.

Note: Ensure that duplicate IP addresses are not used in this file or unpredictable results can occur.

`Identifier` is used to specify a name by which the Library Manager identifies the host machine. This identifier has a maximum of 8 characters. The host name of the workstation is usually the best name to use (although it is not necessary). This parameter is used only to identify a particular host to the 3494 Enterprise Library Manager.

`Alternate LAN Connection` is used to specify an alternate IP address for a 3494 High Availability LAN attached configuration. If the High Availability Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first alternate LAN connection IP address.

Note: For RS-232 attachments, the alternate LAN connection is not applicable. Failover for RS-232 connections proceeds over the single serial line.

The following examples show how to define the library name.

```
libmgrc7        /dev/tty0                  mercury
```

This stanza defines the **libmgrc7** library that is connected by **/dev/tty0** to the workstation. The library uses the `mercury` identifier for the host.

```
libmgrc8        9.115.32.21                jupiter
```

This stanza defines the **libmgrc8** library that is connected through TCP/IP to the workstation. The address of the Library Manager on the 3494 Tape Library is **9.115.32.21**. The library uses the **jupiter** identifier for the host.

```
libmgrc9          9.115.46.15                    telos          9.115.46.17
```

This stanza defines the **libmgrc9** High Availability library that is connected through TCP/IP to the workstation. The IP addresses of the dual Library Managers are **9.115.46.15** and **9.115.46.17**.

```
libmgrc7     9.115.32.21  9.115.32.22      mercury
```

This stanza defines **libmgrc7** with a dual LAN card connected through TCP/IP to the workstation. The first address of the Library Manager on the 3494 Tape Library is **9.115.32.21** and the second address is **9.115.32.22**. The library uses the mercury identifier for the host.

The following stanza defines the **libmgrc7** High Availability library with dual LAN cards connected through TCP/IP to the workstation. The IP addresses of the first Library Manager are **9.115.32.21** and **9.115.32.22**. The IP addresses of the second Library Manager are **9.115.26.13** and **9.115.26.14**. The library uses the mercury identifier for the host.

```
libmgrc7     9.115.32.21  9.115.32.22      mercury  9.115.26.13    9.115.26.14
```

Configuring the Library Manager Control Point

After the driver is installed, a tape library is connected to the workstation, and the serial port is configured, you can configure the instances of the LMCP. Complete the following procedure to define and configure the LMCP:

1. Enter the following command:

```
smit
```

The system management interface tool (`smit`) main menu is displayed (refer to).

Table 48. SMIT main menu

```
                        System Management

Move cursor to desired item and press Enter.

   Software Installation and Maintenance
   Devices
   Physical & Logical Storage
   Security & Users
   Diskless Workstation Management & Installation
   Communications Applications and Services
   Spooler (Print Jobs)
   Problem Determination
   Performance & Resource Scheduling
   System Environments
   Processes & Subsystems
   Applications
   Using SMIT (information only)


 F1=Help            F2=Refresh         F3=Cancel          F8=Image
 F9=Shell           F10=Exit           Enter=Do
```

2. Select **Devices** (item 2) from the **smit** main menu.

   Use the up (↑) arrow and down (↓) arrow keys to move the cursor to the wanted item on the menu.

   Press **Enter** or click **Do** if you are processing **smit** in a windowed environment.

3. Select **Tape Drive** from the **Devices** menu (refer to).

Table 49. SMIT devices menu

```
                             Devices

Move cursor to desired item and press Enter.

   Configure Devices Added after IPL
   Printer/Plotter
   TTY
   Asynchronous Adapters
   PTY
   Console
   Fixed Disk
   CD ROM Drive
   Optical Disk Drive
   Diskette Drive
   Tape Drive
   •
   •
   •
```

The **Tape Drive** menu is displayed (refer to Table 50 on page 267).

Table 50. SMIT tape drive menu

```
                           Tape Drive

Move cursor to desired item and press Enter.

   List All Defined Tape Drives
   List All Supported Tape Drives
   Add a Tape Drive
   Change / Show Characteristics of a Tape Drive
   Remove a Tape Drive
   Configure a Defined Tape Drive
   Generate Error Report
   Trace a Tape Drive
```

4. Select **Add a Tape Drive** from the **Tape Drive** menu (Table 50 on page 267). The **Tape Drive Type** menu is displayed (refer to Table 51 on page 267).

5. Select the Library Manager control point from the **Tape Drive Type** menu (refer to Table 51 on page 267).

Table 51. SMIT tape drive type menu

```
                          Tape Drive Type

    Move cursor to desired item and press Enter.

     8mm   scsi     2.3 GB 8 mm Tape Drive
     9trk  scsi     1/2 Inch 9 Track Tape Drive
     150mb scsi     150 MB 1/4 Inch Tape Drive
     ost   scsi     Other SCSI Tape Drive
     drive 3420     3420 Tape Drive
     drive 3480     3480 Tape Drive
     drive 3490     3490 Tape Drive
     atl   library  LAN/TTY Library Manager Control Point
```

The **Add an LMCP Logical Device** menu is displayed (refer to Table 52 on page 268).

The **Logical Name** field for the Library Manager control point is optional. If the field remains blank, a unique name is assigned automatically. The assigned name is **lmcpn**, where: **n** is a number that indicates the LMCP entry and starts with zero for the first LMCP defined.

The **Library Name** field must be one of the library names that are defined in the **/etc/ibmatl.conf** file. Refer to "Defining tape libraries to the daemon" on page 265 for a description of this file.

The **Command Timeout in Minutes** field is optional and is used to specify the maximum amount of time an application waits for commands to complete, including **mount** and **demount** commands. The default is to wait forever until the command completes.

Table 52. Add an LMCP Logical Device menu

```
                          Add an LMCP Logical Device

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                               [Entry Fields]
   Logical Name of LMCP (optional)          []
   Library Name (F4 to list library names)  [libmgrc7]          +
   Command Timeout in Minutes               []
```

6. The **COMMAND STATUS** window opens with the **Command: OK** status. The logical name of the Library Manager control point is displayed as **Defined** (refer to Table 53 on page 268).

Table 53. LMCP COMMAND STATUS window

```
                          COMMAND STATUS

Command: OK            stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

lmcp0   Defined
```

7. Repeat steps 4 - 6 to define any additional Library Manager control points.

8. Return to the **smit Tape Drive** menu (refer to Table 50 on page 267).

9. Select **Configure a Defined Tape Drive** from the **smit Tape Drive** menu. A list of LMCP devices is displayed (refer to Table 54 on page 268).

Table 54. Configure an LMCP selection list

```
                          Tape Drive

   Move cursor to desired item and press Enter.

      rmt0     Available 00-00-0S-50 2.3 GB 8 mm Tape Drive
      rmt1     Defined   00-01-01-20 IBM SSD 3490E Tape Drive
      lmcp0    Defined               LAN/TTY Library Manager Control Point

   F1=Help               F2=Refresh            F3=Cancel
   F8=Image              F10=Exit              Enter=Do
```

10. Select a defined Library Manager control point to configure from the **LMCP Selection** list.

    The **COMMAND STATUS** window opens with the **Command: OK** status, and the Library Manager control point is shown as **Available** (refer to Table 55 on page 268).

Table 55. Configure a Defined LMCP COMMAND STATUS window

```
                          COMMAND STATUS

Command: OK            stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

lmcp0  Available
```

11. Cancel the **COMMAND STATUS** window by pressing **F3**. The **LMCP Selection** window opens again.
12. Continue selecting the Library Manager control points for configuration until all the devices are configured.
13. Exit from the **smit** menu.

You completed the configuration of Library Manager control points to the system.

Loading the daemon

The **lmcpd** is loaded during the system initialization. During the initial installation of the driver, you must load the daemon manually by using the following command,

```
cfgmgr
```

You can access the 3494 Enterprise Tape Library after the command is completed.

To verify that the daemon is loaded correctly, enter the following command,

```
ps -efa | grep lmcpd
```

You can see multiple instances of the daemon running (which is typical), but only one instance has a parent process ID of 1.

Deconfiguring the Library Manager Control Point

In the following examples, replace the letter *n* with the appropriate number for the chosen device.

Deconfigure the LMCP device by using one of the following procedures:

1. The first method deconfigures the device but leaves the device that is defined in the configuration database. It is similar to taking the device offline.

   Enter the following command to deconfigure the **/dev/lmcpn** device but leave it defined in the device database.

   ```
   rmdev -l lmcpn
   ```

2. The second method takes the device offline and removes the device definition from the device database.

   Enter the following command,

   ```
   rmdev -l lmcpn -d
   ```

   The device driver modules are not unloaded from the kernel until the last tape device is deconfigured.

Uninstall procedure

All devices that use the **atldd** driver must be closed and not in use when **atldd** is uninstalled or the uninstall fails.

You can uninstall the **atldd** by using the **smit** command menu to uninstall software and selecting **atldd.driver** or use the following **installp** command,

```
installp -u atldd.driver
```

Special files

After the driver is installed and a Library Manager control point is configured and made available for use, access is provided through the special files. These special files are in the **/dev** directory. Each instance of an LMCP has exactly one special file (for example, **/dev/lmcp0**) associated with it.

3494 Enterprise tape library attachment test

The following procedure tests the attachment of a 3494 Enterprise Tape Library to an AIX system. The procedure assumes that your device is defined as **/dev/lmcp0**.

1. Open an AIX window.
2. Enter `mtlib -l` */dev/lmcp0*`-qI`
3. Enter `mtlib -l` */dev/lmcp0* `-qL`

Problem determination

A set of tools is provided with the device driver to determine whether it is functioning correctly. The standard AIX interface is provided for problem determination.

Error logging

The driver provides logging to the system error log for various errors. View the error log by using the **smit** or the **errpt** command. The error templates follow the same form as the default AIX error log entries.

AIX device driver trace facility

The AIX trace facility is supported for the device driver. The trace event is identified with a *hookword*. The *hookword* that is used by the device driver is 426. The trace can be initiated at any time before an operation on a tape device.

Enter the following command to start the trace.

```
trace -a -j 426
```

This command starts the trace in the background and collects only the trace events with the 426 *hookword*.

Enter the following command to stop the trace.

```
trcstop
```

This command stops the trace after the tape operations are completed.

Enter the following command to view the trace.

```
trcrpt > lmcp.trace.out
```

This command formats the trace output into a readable form and places it in a file for viewing. The **/etc/lmcp.trcfmt** file is installed into /etc during installation. It provides the formatting statements that are needed by **trcrpt**.

Daemon trace facility

The following trace facility is available for the **lmcp** daemon and device driver:

```
trcatl -[ald]
```

Arguments:

```
-a              (trace all libraries defined in /etc/ibmatl.conf)
-l <name>       (name of library)
-d              (delete all log files; requires root authority)
```

Examples:

```
trcatl -a >/tmp/trace-out
trcatl -l libmgrc7
```

Note: The **-a** argument takes precedence over the **-l** argument.

HP-UX

The software consists of a daemon that communicates directly with the Library Manager of the 3494 Enterprise tape library through Ethernet or Token Ring LAN, a utility program that provides a command line interface to the daemon, and a C object module that can be linked with user applications to provide a communication interface with the daemon.

Note: In the HP-UX operating system, this daemon is a program that runs unattended in the background to run a standard service. Some daemons are triggered automatically to complete their task, others operate periodically.

This software is known as a *driver* throughout this document because it provides the software and interface necessary to *drive* the 3494 tape library. However, the product does not consist of a *device driver* in the true sense of the term. That is, it is not an extension of the operating system kernel, such as a SCSI tape device driver.

A typical environment for the HP-UX Automated Tape Library Driver is an HP workstation that acts as a data server on a network with SCSI tape devices that provides backup or restore and data server functions.

The Library Manager control point daemon (**lmcpd**) is provided in the package. The **lmcpd** is a process that is always running on the system. It provides direct communication with the 3494 Enterprise Library Manager. An application links with the supplied C object module by using the interface that is described in the *IBM Tape Device Drivers: Programming Reference*. The subroutines in this module communicate with the **lmcpd** to run the various library operations by using standard UNIX namespace sockets.

The **lmcpd** communicates with the Library Manager through TCP/IP. The **/etc/ibmatl.conf** configuration file is used to define the attachment for each library. Refer to "Defining the library device to LMCPD" on page 274 for information.

Data flow

The software described in this chapter covers the library driver. The interface between the application and the library driver is described in the *IBM Tape Device Drivers: Programming Reference*. Figure 68 on page 271 illustrates the data flow.
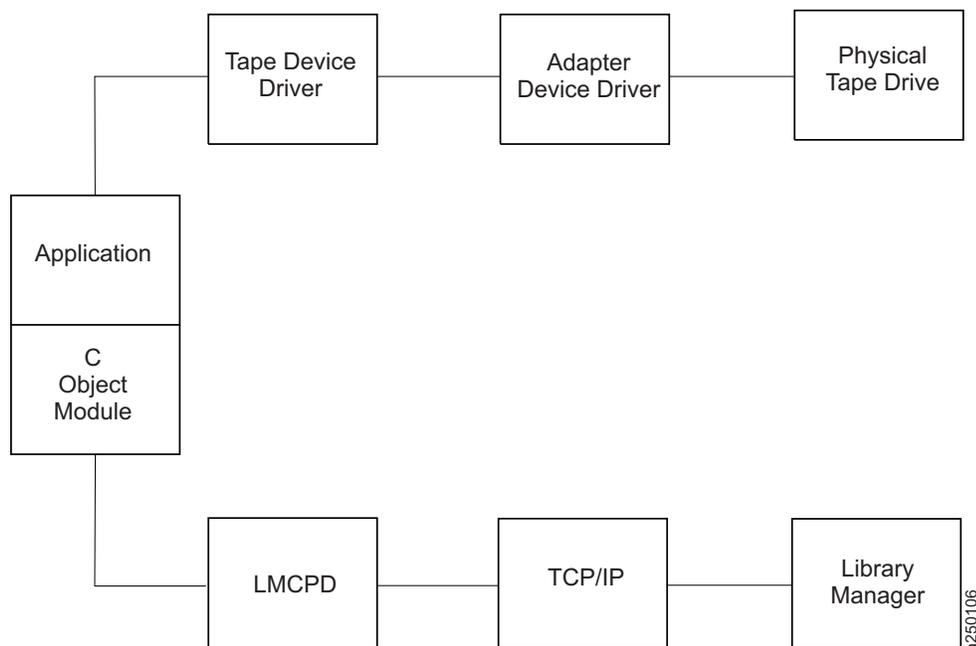
Figure 68. Data flow for HP-UX 3494 Enterprise tape library driver

Product requirements

The following software and hardware are required to use this product.

Hardware requirements

The following hardware is required for the library driver.

- 3494 Enterprise Tape Library with 3590 and 3592 drives.
- IBM Virtualization Engine TS7510 and TS7520
- Enterprise Model B10, B18, and B20 Virtual Tape Server (direct attached only)
- One of the following options, depending on which LAN connection is used for the Enterprise Library Manager
  - Token-Ring Attach -
    - Enterprise FC 5219 (Token-Ring Adapter)
    - Token-Ring adapter card for HP workstation
    - Token-Ring cables (as required)
  - Ethernet Attach -
    - Enterprise FC 5220 (Ethernet Adapter)
    - Ethernet port or adapter for HP workstation
    - Ethernet cables (as required)

Software requirements

The following software is required for the library driver.

- HP-UX operating system

  Note: For information, refer to Chapter 8, "HP-UX Tape and Medium Changer device driver," on page 221.
- IBM Tape and Medium Changer Device Driver for HP-UX

To obtain the most current service and documentation for this software, refer to Appendix A, "Accessing documentation and software online," on page 293.

Software compatibility

The following *optional* software is supported by the library driver:

IBM Tivoli Distributed Storage Manager for HP-UX

Installation instructions

This chapter describes how to install, configure, and uninstall the HP-UX Automated Tape Library Support for the 3494 Enterprise tape library. The IBM tape library driver for HP-UX is installed by using the standard **swinstall** process. The IBM tape library driver for HP-UX is the **lmcpd** package.

Installation overview

LAN support must exist on the machine before the IBM tape library driver for HP-UX is installed. Install and configure the LAN support before you proceed with the installation of the **lmcpd** package. For information, refer to the HP-UX documentation appropriate for the LAN support that you are using.

1. Copy the software from the distribution medium to the depot.
2. Check the readme file and verify that your system is configured appropriately for installing the **lmcpd** software.
3. Install and configure the software.

You must have *root* authority to run this installation procedure.

The distribution diskette contains a **swinstall** process that includes the **lmcpd** daemon with other associated files and utilities.

Command sequence information

Take note of the following facts about the command sequences described in this section:

- In some of the examples, file names that are given on the command line must be referenced with an absolute path. Using **'pwd'/filename** to reference a file instead of **filename** ensures the absolute path.
- All the SD commands (for example, `swinstall, swcopy`) can be run initially with the **'-p'** flag to preview the command. After the preview output is observed, you can reissue the command without the **'-p'** flag to run the actual operation.
- The SD commands are moderately complex scripts that usually proceed in several steps. The steps are typically **Selection**, **Analysis**, and **Execution**. Each step might produce useful information and error messages. It is a good idea to observe carefully the results of the installation process as it occurs.

If you run into unexpected results during the installation, check the associated log file.

Note: If an earlier version of the product is installed on the machine, run the uninstallation procedure before you enter the following commands. Refer to "Uninstallation procedure" on page 275 for information.

The following files are installed on the system:

- **/etc/lmcpd** (Library Manager control point daemon)
- **/etc/ibmatl.conf** (configuration file)
- **/usr/lib/libibm.o** (32-bit application interface object module)
- **/usr/lib/libibm64.o** (64-bit application interface object module)
- **/usr/lib/libibmz.0** (32-bit application interface object module with +z option)
- **/usr/lib/libibm64z.0** (64-bit application interface object module with +Z option)
- **/usr/lib/libibm_ia64.0** (64-bit application interface object module with +z option for Itanium system)
- **/usr/lib/libibm_ia64z.0** (64-bit application interface object module with +Z option for Itanium system)
- **/usr/include/sys/mtlibio.h** (application interface header file)
- **/usr/bin/mtlib** (tape library driver utility program)
- **/usr/bin/intlib64** (64-bit tape library driver utility program)
- **/usr/bin/mtevent** (tape library driver utility program)
- **/usr/bin/trcatl** (tape library driver diagnostic program)
- **/opt/lmcpd** (subdirectory)
- **/opt/lmcpd/ibmatl.conf** (backup configuration file)

Note: If you are updating the **lmcpd** package, the existing **/etc/ibmatl.conf** file is preserved. It is not overwritten. A copy of **ibmatl.conf** is also installed in the /opt/lmcpd directory.

Installing the product manually

Installing the product manually requires two steps, detailed in the following sections.

1. "Copying the software to the Software Depot" on page 273
2. "Installing the product" on page 274

Copying the software to the Software Depot
If you do not copy the **lmcpd** software into a depot, you cannot easily uninstall the software.

Copy the appropriate driver to the Software Depot. For example,

```
# swcopy -p -s /driver_location/lmcpd.hpux.x.x.x.x lmcpd (preview option)
# swcopy -s /driver_location/lmcpd.hpux.x.x.x.x lmcpd
```

Use **swlist** to verify that the **lmcpd** software is in the depot.

```
# swlist -d lmcpd
```

Installing the product

When the software is in the depot, the **lmcpd** software can be installed to the root file system by using the HP-UX **swinstall** command.

The following commands install **lmcpd** from the depot to the default root file system.

```
# swinstall -p lmcpd (preview option)
# swinstall  lmcpd
```

Use **swlist** to list the software that is installed on the default root file system as follows,

```
# swlist lmcpd
```

Verify correct installation to the default root file system with the **swverify** command,

```
# swverify lmcpd
```

Connecting the IBM 3494 Enterprise automated tape library

You can use a LAN connection (either Ethernet or Token Ring) through a TCP/IP connection. The connection must be in place before the software is installed to ensure correct initialization of the daemon. For each 3494 Enterprise tape library that is connected through TCP/IP, ensure that your machine has access to the Library Manager on the 3494 Enterprise tape library. Use the **ping** utility to verify that you have network connectivity to the Library Manager. Consult your network administrator if you need help with this task.

Defining the library device to LMCPD

After the software is installed and all tape libraries are connected to the system, the **/etc/ibmatl.conf** file must be edited to define the library devices to the **lmcp** daemon. The format of the file is

```
Symbolic name     Connection type     Identifier     Alternate LAN Connection
```

`Symbolic name` is used to identify each tape library. The symbolic names must be unique across all libraries that are defined in the **ibmatl.conf** file.

`Connection type` defines the type of connection to the library. For TCP/IP connections, this type is the IP address of the 3494 Enterprise Library Manager. If the Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first IP address.

`Identifier` is used to specify a name by which the Library Manager identifies the host machine. This identifier has a maximum length of 8 characters. The symbolic network name of the host is usually the best name to use, although any name is acceptable. This parameter is used only to identify a particular host to the 3494 Library Manager.

`Alternate LAN Connection` is used to specify an alternate IP address for an Enterprise High Availability LAN configuration. If the High Availability Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first alternate LAN connection IP address.

The following examples show how to define the library name.

```
3494a              9.115.32.21          jupiter
```

This stanza defines the **3494a** library that is connected to the host. The address of the Enterprise Library Manager is **9.115.32.21**. The tape library uses **jupiter** as the identifier for the host.

```
libmgrc9           9.115.46.15          telos          9.115.46.17
```

This stanza defines the **libmgrc9** High Availability library that is connected through TCP/IP to the workstation. The IP addresses of the dual Library Managers are **9.115.46.15** and **9.115.46.17**.

```
libmgrc7    9.115.32.21  9.115.32.22     mercury
```

This stanza defines **libmgrc7** with a dual LAN card connected through TCP/IP to the workstation. The first address of the Library Manager on the 3494 Tape Library is **9.115.32.21** and the second address is **9.115.32.22**. The library uses the **mercury** identifier for the host.

The following stanza defines the **libmgrc7** High Availability library with dual LAN cards connected through TCP/IP to the workstation. The IP addresses of the first Library Manager are **9.115.32.21** and **9.115.32.22**. The IP addresses of the second Library Manager are **9.115.26.13** and **9.115.26.14**. The library uses the **mercury** identifier for the host.

```
libmgrc7    9.115.32.21  9.115.32.22     mercury  9.115.26.13   9.115.26.14
```

Adding or deleting entries in the library device

You can add or delete entries in **/etc/ibmatl.conf** at any time. However, changes do not take effect until the daemon is started again. Use the UNIX **kill** command (kill -kill <pid>) to stop the **lmcpd** process, then enter the **/etc/lmcpd** command to start the daemon again.

Ensure that the library activity on all of the libraries is completed before **lmcpd** is started again.

Uninstallation procedure
Do not try to uninstall the **lmcpd** software by deleting the files that make up the **lmcpd** file set. It is best to use the **swremove** command.

Halt all library activity before the uninstallation procedure is started. **Kill** the **lmcpd** daemon if it is running.

To remove the **lmcpd** software from the root file system, enter

```
# swremove -p lmcpd
# swremove lmcpd
```

Other administrative tasks

To determine what versions of the **lmcpd** software are currently installed on the default root file system,

```
# swlist -a state lmcpd
```

To determine what versions of the **lmcpd** software are stored in the default depot,

```
# swlist -d state lmcpd
```

To view the set of files that are installed with the **lmcpd** software,

```
# swlist -l file lmcpd
```

To remove the **lmcpd** software from the depot,

```
# swremove -d lmcpd
```

If more than one level of **lmcpd** exists in the depot, explicitly specify the level to remove it. For example,

```
# swremove -d lmcpd,r=4.1.8.0
```

3494 Enterprise tape library attachment test

The following procedure tests the attachment of a 3494 Enterprise tape library to an HP-UX system. The procedure assumes that your device is defined in **/etc/ibmatl.conf** as **L3494**.

1. Enter a shell prompt.
2. Enter `mtlib -l L3494 -qI`.
3. Enter `mtlib -l L3494 -qL`.

Problem determination

A set of tools is provided with the software to determine whether the **lmcpd** is functioning correctly.

Error logging

The **lmcpd** uses the **syslog** facility to log the errors. Errors are logged according to the **/etc/syslog.conf** file. The **lmcpd** uses the daemon facility for logging errors. Only errors are logged with this facility. For information about using **syslog**, refer to your system administration manuals.

Daemon trace facility

The following trace facility is available for the **lmcpd** daemon.

```
trcatl -[ald]
```

Arguments:

```
-a               (trace all libraries defined in /etc/ibmatl.conf)
-l <name>        (name of library)
-d               (delete all log files; requires root authority)
```

Examples:

```
trcatl -a >/tmp/trace-out
trcatl -l libmgrc7
```

Note: The **-a** argument takes precedence over the **-l** argument.

Linux

The software consists of a daemon that communicates directly with the Library Manager of the 3494 Enterprise Tape Library through Ethernet or Token Ring LAN. It also provides a utility program that provides a command line interface to the daemon, and a C object module that can be linked with user applications to provide a communication interface with the daemon.

Note: In the Linux operating system, this program runs unattended, in the background, to complete a standard service. Some daemons are triggered automatically to complete their task; others operate periodically.

This software is known as a *driver* throughout this document because it provides the software and interface necessary to *drive* the 3494 tape library. However, the product does not include a *device driver*

in the true sense of the term. That is, it is not an extension of the operating system kernel, such as a tape device driver.

A typical environment for the Linux Automated Tape Library Driver is a Linux workstation that acts as a data server on a network. Tape devices provide backup or restore and data server functions.

The Library Manager control point daemon (**lmcpd**) is provided in the package. The **lmcpd** is a process that is always running on the system. It provides direct communication with the Library Manager. An application links with the supplied C object module by using the interface that is described in the *IBM Tape Device Drivers: Programming Reference*. The subroutines in this module communicate with the **lmcpd** to run the various library operations with standard UNIX namespace sockets.

The **lmcpd** communicates with the Library Manager through TCP/IP. The **/etc/ibmatl.conf** configuration file is used to define the attachment for each library. Refer to "Defining the library device to the lmcpd" on page 279 for information.

Data flow

The software described in this chapter covers the library driver. The interface between the application and the library driver is described in the *IBM Tape Device Drivers: Programming Reference*.Figure 69 on page 277 illustrates the data flow.
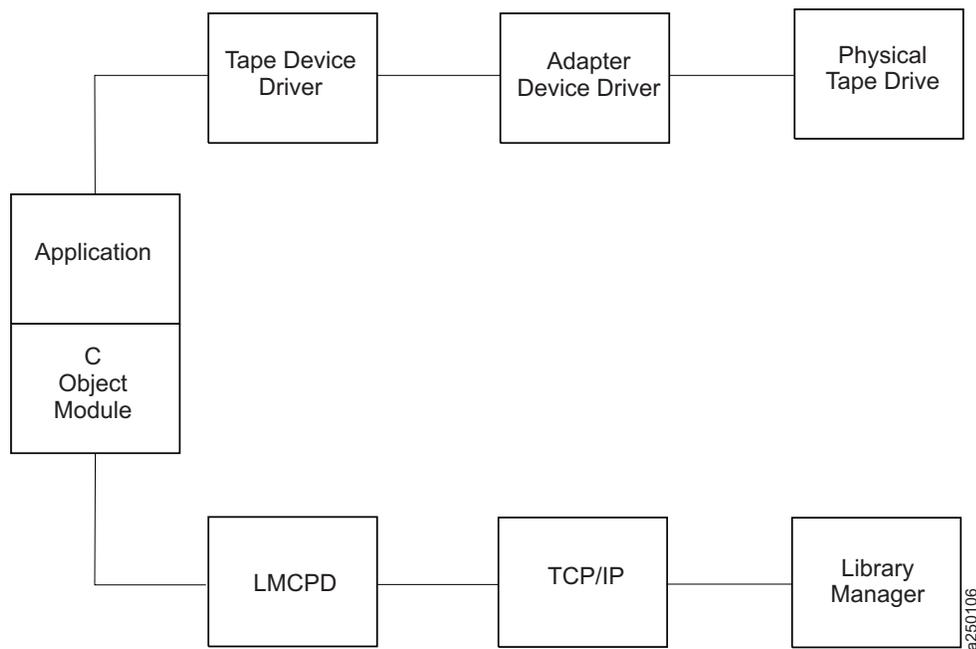
Figure 69. Data flow for Linux 3494 Enterprise tape library driver

Product requirements

The following hardware and software components are required and supported by IBM.

Hardware requirements

The following hardware is required for the library driver:

- IBM TotalStorage 3494 Enterprise Tape Library with IBM 3590 and 3592 drives with the Fibre Channel Attachment
- IBM System Storage TS1120 Tape Drive
- IBM Virtualization Engine TS7510
- One of the following options, depending on which LAN connection is used for the Enterprise Library Manager:

- Token-Ring Attach:

    - Enterprise FC 5219 (Token-Ring Adapter)
    - Token-Ring adapter card for Linux workstation
    - Token-Ring cables (as required)

- Ethernet Attach:

    - Enterprise FC 5220 (Ethernet Adapter)
    - Ethernet port or adapter for Linux workstation
    - Ethernet cables (as required)

Software requirements

The following software is supported by the library driver:

- For Linux distribution support, refer to "Product requirements" on page 41.
- IBM Tape and Medium Changer Device Driver (IBMtape) for Linux

To obtain the most current service and documentation for this software, refer to Appendix A, "Accessing documentation and software online," on page 293.

Installation instructions

The IBM tape library driver for Linux (**ibmatl**), is supplied in an **rpm** package. The following sections describe installation, removal, configuration, and verification procedures for **ibmatl**. Refer to any Linux distribution that supports **rpm** for **rpm** command information. You must have root authority to proceed with the installation of the driver.

In the subsequent pages, you can see file names with xxxx or x.x.x.x in them. The xxxx or x.x.x.x refers to the version of the driver, which changes as IBM releases new driver levels. Use the actual driver version numbers as you complete the procedures.

Install and configure the LAN support before you proceed with the installation of the **ibmatl** package. For information, refer to the Linux documentation appropriate to the LAN support you are using.

The following files are installed on your system:

```
/etc/lmcpd (library manager control point daemon)
/etc/ibmatl.conf (configuration file)
/usr/lib/libibm.o (application interface object module)
/usr/lib/libibm64.o (64-bit application interface object module for 64-bit
      IBM zSeries system only)
/usr/include/sys/mtlibio.h (application interface header file)
/usr/bin/mtlib (tape library driver utility program)
/usr/bin/mtlib64 (64-bit tape library driver utility program for 64-bit IBM
      zSeries system only)
/usr/bin/mtevent (tape library driver utility program)
/usr/bin/trcatl (tape library driver diagnostic program)
```

On the IBM Linux for IBM S/390 and zSeries systems, documentation files are installed at

```
/usr/share/doc/packages/ibmatl/README (readme file)
/usr/share/doc/packages/ibmatl/license (license file)
```

On Red Hat Linux for Intel PC-based systems, documentation files are installed at

```
/usr/share/doc/ibmatl-x.x.x.x/README (readme file, where x.x.x.x is the version)
/usr/share/doc/ibmatl-x.x.x.x/license (license file, where .x.x.x.x is the version)
```

Note: If you are updating the **ibmatl** package, the existing **/etc/ibmatl.conf** file is preserved (it is not overwritten).

Installation procedure

If **ibmatl** is already installed on your system, refer to . This section assumes that you are installing **ibmatl** on a system where it is not installed.

Run the following command to install **ibmatl rpm** package,

```
>rpm -ivv ibmatl.x.x.x.x.os.rpm
```

Connecting the Enterprise 3494 tape library

Use a LAN connection (either Ethernet or Token Ring) through TCP/IP. The connection must be in place before the software is installed to ensure correct initialization of the daemon. For each 3494 tape library that is connected through TCP/IP, ensure that your machine has access to the Library Manager on the 3494 tape library. Use the **ping** utility to verify that you have network connectivity to the Library Manager. Consult your network administrator if you need help with this task.

Defining the library device to the lmcpd

After the software is installed and tape libraries are connected, the **/etc/ibmatl.conf** file must be edited to define the library devices to the **lmcpd**. The format of the file is

```
Symbolic name    Connection type    Identifier    Alternate LAN Connection
```

`Symbolic name` is used to identify each tape library. The symbolic names must be unique across all libraries that are defined in the **ibmatl.conf** file.

`Connection type` is used to define the type of connection to the library. For TCP/IP connections, this type is the IP address of the 3494 Library Manager. If the Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first IP address.

`Identifier parameter` is used to specify a name by which the Library Manager identifies the host machine. This identifier has a maximum length of 8 characters. The symbolic network name of the host is usually the best name to use, although any name is acceptable. This parameter is used only to identify a particular host to the 3494 Library Manager.

`Alternate LAN Connection` is used to specify an alternate IP address for a 3494 High Availability LAN configuration. If the High Availability Library has a dual LAN card, the second IP address of the dual LAN card must be entered after the first alternate LAN connection IP address.

The following examples show how to define the library name.

```
3494a          9.115.32.21                      jupiter
```

This stanza defines the **3494a** library that is connected to the host. The address of the 3494 Library Manager is **9.115.32.21**. The tape library uses **jupiter** as the identifier for the host.

```
libmgrc9    9.115.46.15    telos    9.115.46.17
```

This stanza defines the **libmgrc9** High Availability library that is connected through TCP/IP to the workstation. The IP addresses of the dual Library Managers are **9.115.46.15** and **9.115.46.17**.

```
libmgrc7    9.115.32.21  9.115.32.22    mercury
```

This stanza defines **libmgrc7** with a dual LAN card connected through TCP/IP to the workstation. The first address of the Library Manager on the 3494 Tape Library is **9.115.32.21** and the second address is **9.115.32.22**. The library uses the **mercury** identifier for the host.

```
libmgrc7    9.115.32.21  9.115.32.22    mercury  9.115.26.13    9.115.26.14
```

This stanza defines the **libmgrc7** High Availability library with dual LAN cards connected through TCP/IP to the workstation. The IP addresses of the first Library Manager are **9.115.32.21** and **9.115.32.22**. The IP addresses of the second Library Manager are **9.115.26.13** and **9.115.26.14**. The library uses the **mercury** identifier for the host.

Adding or deleting entries in the library device

You can add or delete entries in **/etc/ibmatl.conf** at any time. However, changes do not take effect until the daemon is started again. Use the UNIX **kill** command (kill -kill <pid>) to stop the **lmcpd** process, and enter the **/etc/lmcpd** command to start the daemon again.

Ensure that activity on all libraries is completed before the **lmcpd** is restarted.

Updating procedure

If your current **ibmatl** was installed from an **rpm** package previously, issue the following command.

```
rpm -Uvv  ibmatl.x.x.x.x.s390.rpm      --for IBM Linux on S/390 systems
rpm -Uvv  ibmatl.x.x.x.x.i386.rpm      --for Red Hat Intel PC based systems
```

Querying the installed package

The query function is supported for the **ibmatl rpm** package only.

The installed **rpm** package can be queried by running the following commands to display information that is associated with the package.

To display information about **ibmatl**,

```
>rpm -qi ibmatl
```

To display the package's file list, enter the command

```
>rpm -ql ibmatl
```

To display the states of files in the package, for example, *normal*, *not installed*, or *replaced*.

```
>rpm -qs ibmatl
```

Verifying the install/update

If the **IBMtape** device driver is installed from the **rpm** package, issue the following command,

```
>rpm -V ibmatl
```

Starting ibmatl

Start the daemon by using the following command,

```
/etc/lmcpd
```

Uninstallation procedure

⚠️ **Attention:** Do not try to uninstall the **ibmatl** software by removing the files that make up the **ibmatl** file set. It is best to use the **rpm -e** command or the **uninstall** script.

Note: Halt all library activity before the uninstall procedure is started.

For the **rpm** package, run the command **rpm -e**.

```
rpm -evv  ibmatl
```

If more than one level of **ibmatl** exists on the system, explicitly specify the level to remove it.

```
rpm -evv  ibmatl-5.0.7.0
```

3494 Enterprise tape library attachment test

The following procedure tests the attachment of a 3494 Enterprise tape library to a Linux system. The procedure assumes that your device is defined in **/etc/ibmatl.conf** as **L3494**.

1. Enter a shell prompt.
2. Enter `mtlib -l L3494 -ql`
3. Enter `mtlib -l L3494 -qL`

Problem determination

A set of tools is provided with the software to determine whether the **ibmatl** is functioning correctly.

Error logging

The **ibmatl** uses the **syslog** facility to log the errors. Errors are logged according to the **/etc/syslog.conf** file. The **ibmatl** uses the daemon facility for logging errors. Only errors are logged with this facility. For information about using **syslog**, refer to your system administration manuals.

Daemon trace facility

The following trace facility is available for the **lmcpd**.

```
daemon:trcatl -[ald]
```

Arguments:

```
-a               (trace all libraries defined in /etc/ibmatl.conf)
-l <name>        (name of library)
-d               (delete all log files; requires root authority)
```

Examples:

```
trcatl -a >/tmp/trace-out
trcatl -l libmgrc7
```

Note: The **-a** argument takes precedence over the **-l** argument.

Solaris

The software consists of a daemon that communicates directly with the Library Manager of the 3494 tape library through RS-232 or LAN. It also has a utility program that provides a command line interface to the daemon, and a C object module that can be linked with user applications to provide a communication interface with the daemon.

This software is known as a *driver* throughout this document because it provides the software and interface necessary to *drive* the tape library. However, the product does not consist of a *device driver* in the true sense of the term. That is, it is not an extension of the operating system kernel, such as a SCSI tape device driver.

A typical environment for the IBM Oracle Automated Tape Library Driver is an Oracle workstation that acts as a data server on a network with SCSI tape devices that provide backup or restore and data server functions.

The Library Manager control point daemon (**lmcpd**) is provided in the package. The **lmcpd** is a process that is always running on the system. It provides direct communication with the 3494 Library Manager. An

application links with the supplied C object module by using the interface that is described in the*IBM Tape Device Drivers: Programming Reference*. The subroutines in this module communicate with the **lmcpd** to run the various library operations with standard UNIX namespace sockets.

The **lmcpd** communicates with the Library Manager either through a standard 25 pin null modem D-shell RS-232 cable or through TCP/IP. The **/etc/ibmatl.conf** configuration file is used to define the type of attachment for each library. Refer to "Defining the symbolic name to the lmcpd" on page 285 for information.

Data flow

The software described in this chapter covers the library driver. The interface between the application and the library driver is described in the *IBM Tape Device Drivers: Programming Reference*. Figure 70 on page 282 illustrates the data flow.
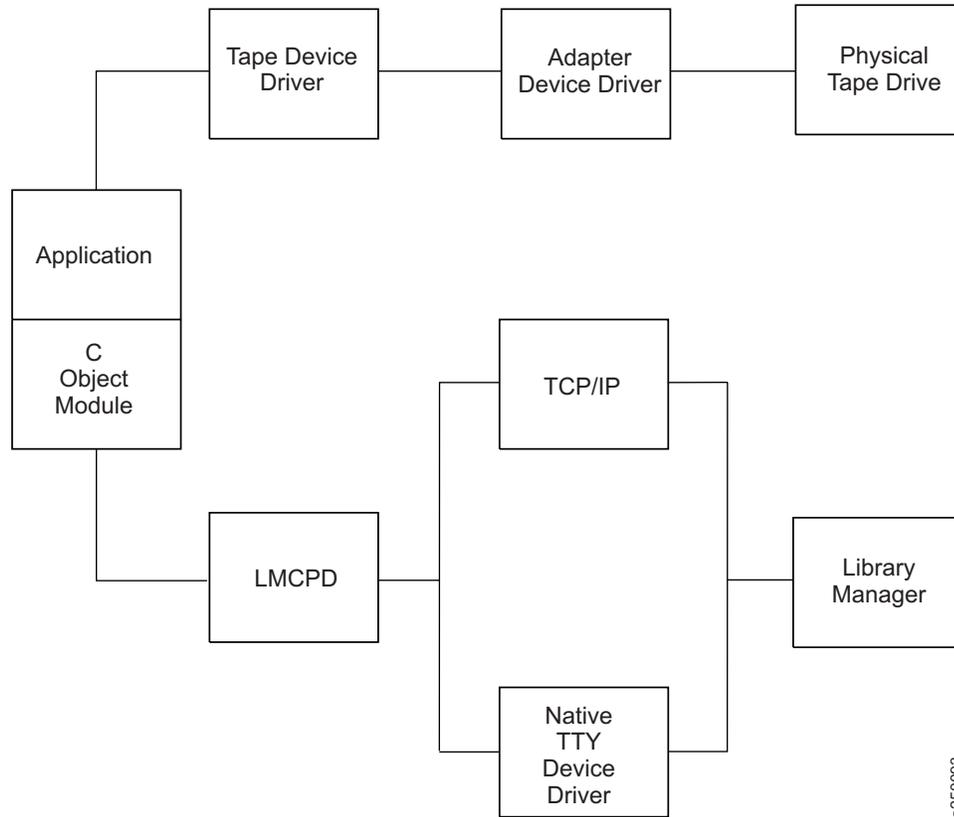
Figure 70. Data flow for Solaris 3494 Enterprise tape library driver

Product requirements

The following software and hardware are supported by this product.

Hardware requirements

The following hardware is supported by the library driver:

- 3494 Enterprise Tape Library with SCSI-attached 3490E (Model C1A or C2A), 3590 and 3592 drives
- IBM TS1120 Tape Drive
- IBM Virtualization Engine TS7510
- IBM Virtual Tape Server (Models B10, B18, and B20)
- One of the following options, depending on which connection (RS-232 or LAN) is required for the Enterprise Library Manager.
  - RS-232:

One standard 25 pin null modem D-shell RS-232 cable

(maximum of 15.24 meters [50 feet])

– LAN:

- Token-Ring or Ethernet adapter card in a Solaris workstation that is attached to the 3494 Enterprise Library Manager
- LAN cable

Software requirements

The following software is required for the library driver:

• Solaris Operating System

> **Note:** For information, refer to Chapter 5, "Solaris Tape and Medium Changer Device Driver," on page 69.

• IBM Tape and Medium Changer Device Driver for Solaris

To obtain the most current service and documentation for this software, refer to Appendix A, "Accessing documentation and software online," on page 293.

Software compatibility

The following *optional* software is supported by the library driver:

IBM Tivoli Distributed Storage Manager for Solaris

Installation instructions

The IBM tape library driver for Solaris is installed by using the standard Solaris *package* facility. The IBM Tape Library Driver for Solaris is the **lmcpd** package.

Preinstallation considerations

The LAN or tty support must exist on the machine before the IBM Tape Library daemon for SunOS is installed. Install and configure the LAN or tty adapter and the associated LAN or tty adapter device driver before you proceed with the installation of the **lmcpd** package. For information, refer to the documentation appropriate for the LAN or tty adapter and the LAN or tty adapter device driver that you are using.

You must have *root* authority to complete this installation procedure.

Note: If an earlier version of the product is installed on the machine, run the uninstallation procedure before you enter the following commands. Refer to "Uninstallation procedure" on page 286 for information.

The following files are installed on the system:

• **/etc/lmcpd** (Library Manager control point daemon)
• **/etc/ibmatl.conf** (configuration file)
• **/usr/lib/libibm.o** (application interface object module)
• **/usr/lib/libibm64.o** (64-bit application interface object module)
• **/usr/include/sys/mtlibio.h** (application interface header file)
• **/usr/bin/mtlib** (tape library driver utility program)
• **/usr/bin/mtevent** (tape library driver utility program)
• **/usr/bin/trcatl** (tape library driver diagnostic program)
• **/opt/lmcpd** (subdirectory)
• **/opt/lmcpd/ibmatl.conf** (backup configuration file)

Note: If you are updating the **lmcpd** package, the existing **/etc/ibmatl.conf** file is preserved. It is not overwritten. A copy of **ibmatl.conf** is also installed in the `/opt/lmcpd` directory.

Installation procedure

Use the following commands to install the **lmcpd** package. Substitute the device special file name for the installation source device that is appropriate for your system.

If a previous version is installed on the system, uninstall the previous version first, then enter the following command,

```
/usr/sbin/pkgrm  lmcpd
```

To install the package from the directory where the driver is located, enter the following command,

```
/usr/sbin/pkgadd -d lmcpd.x.x.x.x
```

To verify that the installation was successful, enter the following command,

```
/usr/bin/pkginfo lmcpd
```

Connecting the 3494 Enterprise tape library

Use one of the following methods to connect the workstation to the 3494 tape library.

- Use a standard 25 pin null modem D-shell RS-232 cable. Place the cable on the native serial port or on the eight-port or 16 port asynchronous adapter.
- Use a LAN connection (either Ethernet or Token-Ring) through TCP/IP.

In either case, the connection must be in place before the software is installed to ensure correct initialization of the daemon.

For each 3494 tape library that is connected with an RS-232 cable, follow the directions in "Configuring the serial port" on page 284. For each 3494 tape library that is connected through TCP/IP, ensure that your machine has access to the Library Manager on the Enterprise device. Use the **ping** utility to verify that you have network connectivity to the Library Manager. Consult your network administrator if you need help with this task.

Identify the host name of your workstation to the Enterprise Library Manager. Follow the instructions in the *IBM Enterprise Automated Tape Library Operator Guide,* in the **Add LAN Host** section.

Configuring the serial port

After the 3494 tape library is connected to the workstation, you must configure the serial port to which it is connected.

Set the following tty port attributes.

Baud rate
  9600.
Data bits
  8.
Stop bits
  1.
Parity
  None.

Defining the symbolic name to the lmcpd

After the software is installed and all tape libraries are connected to the system, the **/etc/ibmatl.conf** file must be edited to define the tape libraries to the **lmcpd**. The format of the file is

```
Symbolic name     Connection type     Identifier     Alternate LAN Connection
```

`Symbolic name` is used to identify each tape library. The symbolic names must be unique across all libraries that are defined in the **/etc/ibmatl.conf** file.

`Connection type` is used to define the type of connection to the library (either RS-232 or TCP/IP). For RS-232 connections, this type is the device special file name of the tty device (for example, **/dev/ttya** or **/dev/tty1**). For TCP/IP connections, this type is the IP address of the Library Manager. If the Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first IP address.

`Identifier` is used to specify a name by which the Library Manager identifies the host machine. This identifier has a maximum length of 8 characters. The host name of the workstation is usually the best name to use (although it is not necessary). This parameter is used only to identify a particular host to the 3494 Enterprise Library Manager.

`Alternate LAN Connection` is used to specify an alternate IP address for an Enterprise High Availability LAN-attached configuration. If the High Availability Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first alternate LAN connection IP address.

Note: For RS-232 attachments, the alternate LAN connection is not applicable. Failover for RS-232 connections proceeds over the single serial line.

The following examples show how to define the library name.

```
3494a              /dev/ttya              mercury
```

This stanza defines the **3494a** library that is connected by **/dev/ttya** to the workstation. The library uses the **mercury** identifier for the host.

```
3494b              9.115.32.21           jupiter
```

This stanza defines the **3494b** library that is connected through TCP/IP to the workstation. The address of the Library Manager on the Enterprise Tape Library is **9.115.32.21**. The library uses the **jupiter** identifier for the host.

```
libmgrc9           9.115.46.15           telos        9.115.46.17
```

This stanza defines the **libmgrc9** High Availability library that is connected through TCP/IP to the workstation. The IP addresses of the dual Library Managers are **9.115.46.15** and **9.115.46.17**.

```
libmgrc7    9.115.32.21   9.115.32.22        mercury
```

This stanza defines **libmgrc7** with a dual LAN card connected through TCP/IP to the workstation. The first address of the Library Manager on the 3494 tape library is **9.115.32.21** and the second address is **9.115.32.22**. The library uses the **mercury** identifier for the host.

The following stanza defines the **libmgrc7** High Availability library with dual LAN cards connected through TCP/IP to the workstation. The IP addresses of the first Library Manager are **9.115.32.21** and **9.115.32.22**. The IP addresses of the second Library Manager are **9.115.26.13** and **9.115.26.14**. The library uses the **mercury** identifier for the host.

```
libmgrc7    9.115.32.21   9.115.32.22    mercury  9.115.26.13   9.115.26.14
```

Adding or deleting entries in the library

You can add or delete entries in **/etc/ibmatl.conf** at any time. However, changes do not take effect until the daemon is started again. Use the UNIX **kill** command (kill -kill <pid>) to stop the **lmcpd** process, then enter the **/etc/lmcpd** command to start the daemon again.

Ensure that the library activity on all of the libraries is completed before the **lmcpd** is restarted.

Uninstallation procedure

Halt all library activity before the uninstallation procedure is started. Stop the **lmcpd** daemon if it is running. Enter the following command to uninstall the library support from your workstation.

```
/usr/sbin/pkgrm lmcpd
```

3494 Enterprise tape library attachment test

The following procedure tests the attachment of a 3494 Enterprise tape library to a Solaris system. The procedure assumes that your device is defined in **/etc/ibmatl.conf** as **L3494**.

1. Enter a shell prompt.
2. Enter mtlib -l L3494 -qI
3. Enter mtlib -l L3494 -qL

Problem determination

A set of tools is provided with the software to determine whether the **lmcpd** is functioning correctly.

Error logging

The **lmcpd** uses the **syslog** facility to log the errors. Errors are logged according to the **/etc/syslog.conf** file. The **lmcpd** uses the daemon facility for logging errors. Only errors are logged with this facility. For information about using **syslog**, refer to your system administration manuals.

Daemon trace facility

The following trace facility is available for the **lmcpd**.

```
daemon:trcatl -[ald]
```

Arguments:

```
-a               (trace all libraries defined in /etc/ibmatl.conf)
-l <name>        (name of library)
-d               (delete all log files; requires root authority)
```

Examples:

```
trcatl -a >/tmp/trace-out
trcatl -l libmgrc7
```

Note: The **-a** argument takes precedence over the **-l** argument.

Windows

The software consists of a tape library service that communicates directly with the Library Manager of the 3494 Enterprise Tape Library through LAN. A utility program also provides a command prompt interface

to the service, and a static library and DLL that can be used to provide a communication interface with the service.

A typical environment for the Windows Automated Tape Library Service is a workstation that runs the Microsoft Windows operating system. It acts as a data server on a network with SCSI tape devices that provide backup or restore and data server functions.

The IBM Automated Tape Library service is provided in the installation package. This service is installed with STARTUP=AUTOMATIC, which means that it is started when the Microsoft Windows operating system is started. An application program might access those functions through API calls. The interface is described in the *IBM Tape Device Drivers: Programming Reference*. The subroutines in this module communicate with the Enterprise Library Manager to run the various library operations.

The service communicates with the Library Manager through TCP/IP. The **c:\winnt\ibmatl.conf** configuration file is used to define the type of attachment for each library. Refer to "Defining the symbolic name to the service" on page 290 for information.

Data flow

The software described in this chapter covers the library driver. The interface between the application and the library driver is described in the *IBM Tape Device Drivers: Programming Reference*.Figure 71 on page 287 illustrates the data flow.
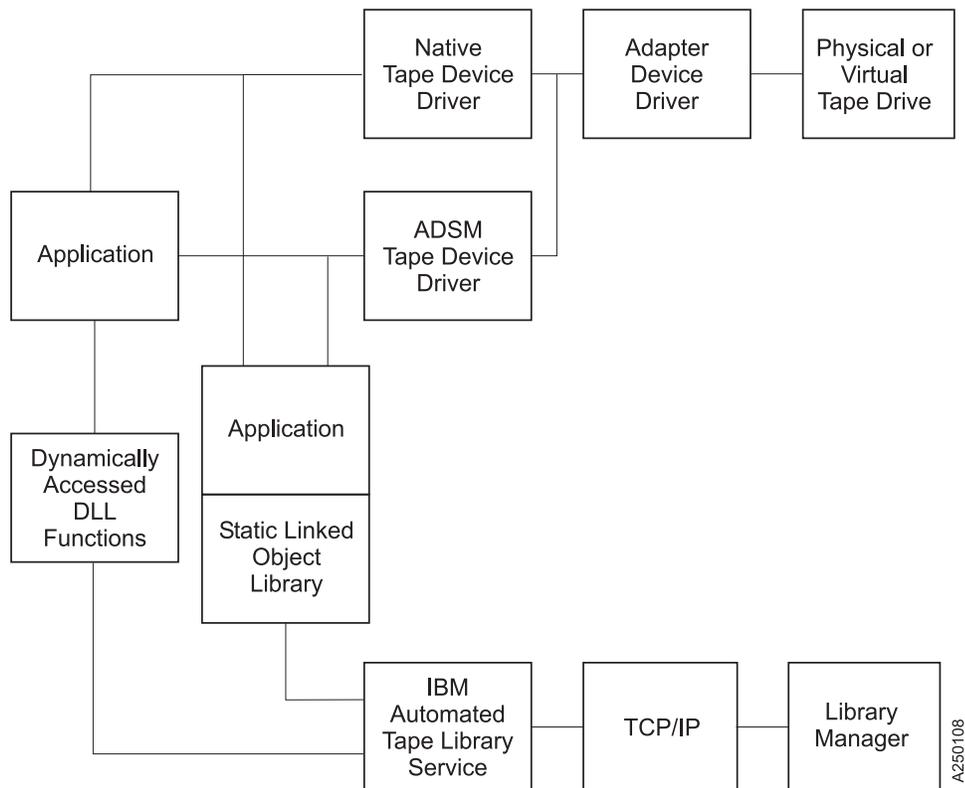
Figure 71. Data flow for Windows 3494 Enterprise tape library driver

Product requirements

The following hardware and software components are required and supported by IBM.

Hardware requirements

The following hardware is required for the library driver:

• 3494 Enterprise Tape Library with Enterprise Tape System 3590 and 3592 drives
• IBM TS1120 Tape Drive

- IBM Virtualization Engine TS7510
- IBM Virtual Tape Server (Models B10, B18, and B20)

The following options are required for operation of the Enterprise Library Manager:

- Token-Ring or Ethernet adapter card in an Intel-compatible workstation that runs Microsoft Windows and attached to the 3494 Enterprise Tape Library
- LAN cable

Software requirements

Microsoft Windows is required for the library driver: For information, refer to Chapter 6, "Windows Tape and Medium Changer device driver," on page 109.

To obtain the most current service and documentation for this software, refer to Appendix A, "Accessing documentation and software online," on page 293.

Installation instructions

The IBM tape library service for Microsoft Windows is installed by starting the installation binary. This binary has the format **ibmatl.x.x.x.x.x86.exe** for 32-bit Windows 200*x* that runs on *x*86, **ibmatl.x.x.x.x.i64.exe** for 64-bit Windows 2003 that runs on IA64, and **ibmatl.x.x.x.x.x64.exe** for 64-bit Windows Server 2003 and Windows Server 2008 that runs on AMD64 and EM64T.

Installation procedure

Use the following procedure to install the IBM Automated Tape Library Service or to upgrade the software level of your service on your workstation.

Follow these steps to run the installation of the service and its associated software:

1. Verify that the prerequisites are satisfied. Refer to "Product requirements" on page 287.
2. Ensure that the workstation is on the LAN.
3. Log on as Administrator.
4. If the IBM Automated Tape Library Service is installed, ensure that all programs and services that use the service are stopped. Then, remove it from the system.
5. Ensure that the IBM Automated Tape Library Service is not running.

   - On Windows NT

     a. Click **Start**.

     b. Move to **Settings**, then click **Control Panel**.

     c. Double-click the **Services** icon.

   - On Windows 2000 and 2003

     a. Click **Start**.

     b. Move to **Settings**, then click **Control Panel**.

     c. Double-click the **Services** icon.

   - On Windows 2008

     a. Click **Start**.

     b. Double-click the **Administrative Tools** icon.

     c. Double-click the **Services** icon.

   The **Services** window opens. Scroll through the entries until you find **IBM Automated Tape Library**. If you do not find the entry for **IBM Automated Tape Library**, the service is not installed; click **Close**.

If there is an entry and the status is blank, the service is not running; click **Close**. If the status is **Started**, click **IBM Automated Tape Library**, then click **Stop**.

- Wait for the service to stop and the **Status** to be set to blank, then click **Close**.
- On 32-bit Windows 200x, wait for the service to stop and the **Service status** to be set to **Stopped**, then close both windows.
- On 64-bit Windows, the service is stopped and removed automatically during the uninstallation.

6. Obtain **ibmatl** driver from the IBM storage FTP server in binary.

7. Locate and start **ibmatl** driver.

8. You see some windows displayed that indicates the image is unpacked and read and the installation program is setting up. After these messages are displayed, the screen stops on a window called **Welcome to the IBM Automated Tape Library Setup Program**. Follow the instructions on the window, then select **Next**.

9. The **Software License Agreement** window opens. Read the contents, then click **Yes** if you accept the terms. If you do not accept the terms, the installation script exits.

10. The **Choose Destination Location** window opens. You can accept the default destination folder by selecting **Next >**, or you can select **Browse...** and select another destination folder by following the prompts in the subsequent dialog. If you do not select the default destination folder, you must record your destination folder for future reference. After you select the folder, click **Next >**.

11. The **Setup Complete** window opens. You can check the **Yes, I want to view the Read Me file** prompt to read the file, then click **Finish**, or click **Finish**. The **Read Me** file is stored in the destination file that you indicated in step 10.

12. After you click **Finish**, if you did not select to view the **Read Me** file, the installation dialog exits. If you chose to view the **Read Me**, it is displayed. After you read it, exit the Notepad application. An informational message is displayed, indicating that the setup is complete. Click **OK** to exit the installation dialog.

13. Verify that you can use the **ping** utility successfully for any tape library you want to access from your workstation.

14. Update the **c:\winnt\ibmatl.conf** file, if necessary, with entries for each tape library you want to access from your workstation. Refer to "Defining the symbolic name to the service" on page 290 for details.

15. Start the service in one of the following ways:

- For Windows NT, start the service by restarting the system or by using the **Services** option in the **Control Panel** window.
- On Windows 2000 and 2003, start the service by using the **Services** icon, which is on the **Administrative Tools** icon in the **Control Panel** window.
- On Windows 2008, start the service by using the **Services** icon, which is on the **Administrative Tools** icon.

Note: When a firewall is enabled on Windows, you must allow the **lmcpd** program to access the network. Do not block the network IP port of 3494, which is used for communication between the 3494 library and **lmcpd**.

For example, to allow **lmcpd.exe** access to the network on Windows 2008 servers, click the **Windows Firewall** icon in the **Control Panel** window. Next, click the button to allow a program or an exception, and then click **Add Program**. Select your browser and then select **lmcpd.exe** in **/Windows/system32** for an x86 system or **/Windows/SysWOW64** for i64 or x64 systems.

Connecting the 3494 Enterprise tape library

Use a LAN connection (either Ethernet or Token-Ring) through TCP/IP to connect the workstation to the 3494 Enterprise tape library. The connection must be in place before the service is started to ensure correct initialization of the service.

Ensure that your machine has access to the Library Manager on the Tape Library. Use the **ping** utility to verify that you have network connectivity to the Library Manager. Consult your network administrator if you need help with this task.

Identify the host name of your workstation to the Enterprise Library Manager. Follow the instructions in the *IBM Enterprise Automated Tape Library Operator Guide,* in the **Add LAN Host** section.

Defining the symbolic name to the service

After the software is installed and the tape libraries are connected to the system, the **c:\winnt \ibmatl.conf** file must be edited to define the tape libraries to the service. The format of the file is

```
Symbolic name      Connection type      Identifier      Alternate LAN Connection
```

`Symbolic name` identifies each tape library. The symbolic names must be unique across all libraries that are defined in the **c:\winnt\ibmatl.conf** file.

`Connection type` is the IP address of the Library Manager. If the Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first IP address.

`Identifier` specifies a name by which the Library Manager identifies the host machine. This identifier has a maximum length of 8 characters. The host name of the workstation is usually the best name to use (although it is not necessary). This parameter identifies only a particular host to the Enterprise Library Manager.

The following stanza defines the **3494b** library that is connected through TCP/IP to the workstation. The address of the Library Manager on the 3494 tape library is **9.115.32.21**. The library uses the **jupiter** identifier for the host.

```
3494b              9.115.32.21              jupiter
```

The **Alternate LAN Connection** parameter specifies an alternate IP address for an Enterprise High Availability LAN configuration. If the High Availability Library has a dual LAN card that is installed, the second IP address of the dual LAN card must be entered after the first alternate LAN connection IP address.

The following stanza defines the **libmgrc9** High Availability library that is connected through TCP/IP to the workstation. The IP addresses of the dual Library Managers are **9.115.46.15** and **9.115.46.17**.

```
libmgrc9           9.115.46.15           telos           9.115.46.17
```

The following stanza defines **libmgrc7** with a dual LAN card connected through TCP/IP to the workstation. The first address of the Library Manager on the 3494 tape library is **9.115.32.21** and the second address is **9.115.32.22**. The library uses the **mercury** identifier for the host.

```
libmgrc7     9.115.32.21   9.115.32.22     mercury
```

The following stanza defines the **libmgrc7** High Availability library with dual LAN cards connected through TCP/IP to the workstation. The IP addresses of the first Library Manager are **9.115.32.21** and **9.115.32.22**. The IP addresses of the second Library Manager are **9.115.26.13** and **9.115.26.14**. The library uses the **mercury** identifier for the host.

```
libmgrc7     9.115.32.21   9.115.32.22     mercury   9.115.26.13   9.115.26.14
```

Adding or deleting libraries to the service

You can add or delete entries in **c:\winnt\ibmatl.conf** at any time. However, changes do not take effect until the tape service starts again.

On Windows NT, stop and start the service by using the **Services** option in the **Control Panel** window.

On Windows 200x, stop and start the service by using the **Services** icon, which is on the **Administrative Tools** icon in the **Control Panel** window.

Ensure that the library activity on all of the libraries is completed before the service is started again.

Uninstallation procedure

Use the following procedure to remove the IBM Automated Tape Library Service permanently from your workstation.

Note: If you are upgrading the software level of your service, follow the steps in .

Follow these steps to uninstall the service and its associated software:

1. Log on as Administrator.
2. Back up the **c:\winnt\ibmatl.conf** file if you want to keep a copy of this file because the uninstall procedure erases the file.
3. Ensure that all programs and services that use the IBM Automated Tape Library Service are stopped.
4. Ensure that the IBM Automated Tape Library Service is not running. Click **Start** > **Settings** > **Control Panel**.
   - Double-click the **Services** icon.
   - On Windows 200x, double-click the **Administrative Tools** icon, then double-click the **Services** icon.

   The **Services** window opens. Scroll through the entries until you find **IBM Automated Tape Library**. If the status is blank, the service is not running; click **Close**. If the status is **Started**, click **IBM Automated Tape Library**, then click **Stop**.
   - Wait for the service to stop and the **Status** to be set to blank, then click **Close**.
   - On 32-bit Windows 200x, wait for the service to stop and the **Service status** to be set to **Stopped**, then close both windows.
   - On 64-bit Windows, the service is stopped and removed automatically during the uninstallation.
5. Open a **Command Prompt** window, enter `lmcpd -remove`, press **Enter**, then wait for the command to complete.

   Note: If you forget this step, the next time that the system is started, Microsoft Windows NT tries (unsuccessfully) to start the service again. To resolve this situation, you must reinstall the service, then uninstall it.
6. Double-click **Add/Remove Programs** in Windows NT/200x or **Programs and Features** on Windows 2008 in the **Control Panel** window.
7. Scroll to and select **IBM Automated Tape Library**.
8. For Windows 200x, click **Change/Remove**.
9. A **Confirm File Deletion** window opens. Click **Yes**.
10. After various dialogs run, a **Remove Programs from Your Computer** window opens, which indicates the components that were removed successfully. Click **OK** to exit the dialog.
11. For Windows 2000 and 2003, close the **Add/Remove Programs Properties** window.

    For Windows 2008, close the **Programs and Features** window.

3494 Enterprise tape library attachment test

The following procedure tests the attachment of a 3494 Enterprise tape library to a Windows system. The procedure assumes that your device is defined in **c:\winnt\ibmatl.conf** as **L3494**.

1. Open a Windows command shell window.
2. Enter `mtlib -l L3494 -qI`

3. Enter `mtlib -l L3494 -qL`

Problem determination

A tracing tool is provided with the software to determine whether **ibmatl** is functioning correctly.

Daemon trace facility

The following trace facility is available for the **ibmatl** service.

```
trcatl -h
usage: trcatl [-ald]


   [-l  <name>]              name of library
   [-a]                     all libraries defined in c:\WINNT\ibmatl.conf
   [-d]                     delete all logfiles in c:\WINNT\
```

Note:

1. Run **trcatl** in the **Command Prompt** window.

2. The **-a** parameter takes precedence over the **-l** parameter.

3. The **trace.out** is located under the directory where the **trcatl** runs.

Examples:

```
        trcatl -l libmgrc7
        trcatl -a > trace.out
```

Appendix A. Accessing documentation and software online

IBM maintains the latest levels of System Storage tape drive and library device drivers and documentation on the Internet. Fix Central is a portal where you can download the latest version of drivers for most of the IBM tape products. In this download area, you find menus that can guide you to find what you need.

To access to tape Device Drivers or software downloads, click http://www-933.ibm.com/support/fixcentral/?productGroup0=System%20Storage&productGroup1=ibm/Storage_Tape&productGroup2=Tape%20drivers%20and%20software&productGroup3=ibm/Storage_Tape/Tape%20device%20drivers. Choose your platform, then click **Continue**. Alternately, you can follow these steps.

1. Access the Fix Central URL at http://www.ibm.com/support/fixcentral.
2. In the **Product Group** menu, select **System Storage**.
3. From the **System Storage** menu, select **Tape systems**.
4. In the **Tape systems** menu, select **Tape drivers and software**.
5. In the **Select from Tape drivers and software** menu, select **Tape device drivers**. You are also able to get tools such as ITDT.
6. The **Platform** menu displays. Select the platform that you are looking for, then click **Continue** to view what is available for the selected platform.
7. In the next screen, there is a list of the latest Tape device drivers or Tape Diagnostic tools versions. Select the package that you need, then click **Continue**.

   Note:

   - The latest driver has the highest number extension. Numeric sequence numbers are in each level of the device and library driver. So, for example, for AIX the number is Atape.11.7.5.0.bin. As newer levels of a driver are released, a higher numeric sequence is assigned. When a driver is downloaded, ITDT also appears as a recommended download if you selected the option of co-requisites and prerequisite.
   - As of January 31, 2012, each IBM client that accesses Fix Central (whether through their employees or other authorized representatives) is required to have an individual IBM ID to download fixes (some exemptions might apply). The registration is quick and simple and provides users with a customized experience to better serve their needs.

8. After you click **Continue**, you can choose the way that you want to download the fix or fixes. You can either use your browser (HTTP), the Download Director (http://www6.software.ibm.com/dldirector/doc/DDfaq_en.html#Q_A1), or bulk FTP option. The bulk FTP option is a web service where you can download a package with the FTP command or other download commands like WGET.

   Note:

   - To use the Download Director, ensure that the Java Runtime Environment is installed on your computer. For information, see http://www6.software.ibm.com/dldirector/doc/DDfaq_en.html. Leave the check box for prerequisites and co-requisites selected. Click **Continue**.
   - When you select the download option before **Continue** is pressed, you can change the way that you want to download the fix or fixes from the **Change download options** link at the top of the page.

9. Sign in, then click **Submit**.
10. Click **I agree** on the **Terms and Conditions** screen to continue.
11. A list of files and downloadable files displays, including links to Documentation, Programming guides, User guides, and readme files.

    Note: Some plain text files might require you to right-click, then select **Save Link As...** to download the file.

Table 56 on page 294 documents each driver by name and description.

Table 56. Driver descriptions

Driver	Description
`Atape.n.n.n.n.bin`	AIX Device Driver (Atape)
`.../atdd.n.n.n.n.bin`	HP-UX Device Driver
`/lin_tape_source-lin_taped/lin_tape-x.x.x.x-x.src.rpm.bin`	Linux Device Driver (lin_tape) source code
`/lin_tape_source-lin_taped/lin_taped-x.x.x-`*dist.arch*`.rpm.bin`	Linux lin_taped daemon program
`/IBMtape.n.n.n.n.bin`	Solaris Device Driver (IBMtape)
`/IBMTape.arch_wXX_nnnn.zip`	Windows Server 20XX Driver on arch (x86, x64) where XX denotes the version (such as, 2008, 2012)

Note:

1. Valid for Windows 2008 and Windows 2008 r2

2. **dist** indicates a Linux distribution. **arch** indicates a machine architecture (for example, i386, ia64, s390).

3. The *n.n.n.* or *n.n.n.n* strings are replaced with digits to reflect the version of each driver.

- For details on supported tape attachment, refer to the **System Storage Interoperation Center** website - http://www.ibm.com/systems/support/storage/config/ssic/.

- Information concerning supported Fibre Channel host bus adapters (HBAs) and associated HBA device drivers, firmware, and BIOS levels can be obtained from the **System Storage Interoperation Center** website - http://www.ibm.com/systems/support/storage/config/ssic/.

- The**IBM_Tape_Driver_IUG.pdf** file contains the current version of the *IBM Tape Device Drivers: Installation and User's Guide*, which can be found here: http://www-01.ibm.com/support/docview.wss?rs=577&iud=ssgIS7002972. You can also use the links that are located under **Related Information** to get quick access to the download section for the tape device drivers.

- The **IBM_Tape_Driver_PROGREF.pdf** file contains the current version of the *IBM Tape Device Drivers: Programming Reference*, which can be found here: http://www-01.ibm.com/support/docview.wss?uid=ssg1S7003032.

- For the current information for the device driver you are using, consult the readme file (not files) included in the download of your device driver.

Use the links listed below for quick access to the download section for every tape Device Driver platform.

- **AIX**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **AIX**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=AIX&function=all.

- **HPUX**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **HPUX**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=HPUX&function=all.

- **Linux**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **Linux**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=Linux&function=all.

- **Solaris**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **Solaris**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=Solaris&function=all.

- **Windows**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **Windows**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=Windows&function=all.

- **Windows WHQL**. Path: **Storage Systems** > **Tape Systems** > **Tape device drivers and software** > **Tape device drivers** > **Windows WHQL**, or http://www-933.ibm.com/support/fixcentral/swg/selectFixes?parent=ibm~ST~Tapedevicedriversandsoftware&product=ibm/Storage_Tape/Tape+device+drivers&release=1.0&platform=Windows+WHQL&function=all.

Appendix B. Verifying correct attachment of your devices

Before you start to use your devices for production work with your applications, or if you encounter difficulties with your devices, you might want to verify that the hardware, connections, and device drivers are working together properly. Before you can do this verification, you must do the following procedure -

1. Install your hardware as indicated in the appropriate hardware manuals.
2. Power On your hardware and verify that the hardware is functioning properly by running commands according to the product documentation. See "IBM Tape Product Publications" on page xiii.
3. Attach your hardware to the host system as indicated in the appropriate hardware manuals and as indicated in the appropriate chapters from this manual.
4. Start your operating system as indicated in the appropriate chapters from this manual.
5. Log in to the operating system as Administrator.
6. If device drivers are used by your device other than the ones documented in this manual, disable the other device drivers, and install or enable the drivers that are documented in this manual.
7. Start ITDT (for instructions see "Starting ITDT - Standard Edition" on page 128).
8. Scan for devices. Any devices that show up are properly attached.

Platform-specific help

There is a problem determination section for each platform.

- AIX: "Problem determination" on page 31
- HP-UX: "Problem determination" on page 241
- Linux: "Problem determination" on page 63
- Solaris: "Problem determination" on page 101
- Windows: "Problem determination" on page 118

IBM technical support

If the problem persists after these procedures are followed, it is possible that an unexpected condition occurred in the driver's environment. In this case, contact your IBM service representative (1-800-IBM-SERV) and provide the following information to help IBM re-create and resolve the problem:

1. Machine type and model of your IBM tape product
2. Specific driver version
3. Description of the problem
4. System configuration
5. Operation that was running at the time the problem was encountered

Appendix C. Managing the microcode on the IBM tape drive

Microcode is computer software that is stored in nonvolatile storage on your tape device or library hardware. It controls the operation of your hardware. When your tape device or library hardware was manufactured, a microcode load was installed and shipped with your device.

If you are having trouble with your hardware, IBM service personnel ask what level of microcode you have on your hardware. If they believe that you need a new level of microcode, they might instruct you to install a newer level of microcode on your hardware. They can provide you with updated microcode.

You can query the current level of microcode by issuing commands on the front panel of your hardware. Consult the appropriate hardware reference manual for specific instructions on querying your microcode level.

If your device is connected to a host system that has device or library support, you can also query the last 4 digits of the current level of microcode with software. Refer to Chapter 7, "IBM Tape Diagnostic Tool (ITDT)," on page 123. The unit must be powered On, configured properly, and ready. For information, refer to the appropriate chapter in this document (based on the operating system/platform) for details on how to have the device ready.

The following instructions are a guide to install another version of microcode on a tape drive.

1. Ensure that the tape drive is connected to a host system and that the tape device driver is powered-On and configured properly with no tape cartridge in the drive. Follow the instructions in Appendix B, "Verifying correct attachment of your devices," on page 297 to ensure that the drive is configured properly and ready.

2. Open ITDT and follow the instructions for downloading microcode. These instructions are in both the SE and the GE versions. In SE, it is available in all sections; scan menu under Firmware update, the tape utility (71) section, and the scripting (**ucode**) command.

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