

# HP LTO Ultrium tape drives

## LTO 4 FC, SCSI and SAS drives

### UNIX, Linux and OpenVMS configuration guide

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## Revision history

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This document is frequently revised and updated. To find out if there is a later version, please ask your HP OEM Representative.

HP LTO Ultrium 4 drives UNIX, Linux and OpenVMS configuration guide

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## About this guide

This volume provides basic information on configuring the following drive with various operating systems:

- HP LTO Ultrium 4 FC drives
- HP LTO Ultrium 4 SCSI drives
- HP LTO Ultrium 4 SAS drives

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 **NOTE:** This manual contains information on connecting to various operating systems. The information is given in good faith, but since the operating systems and any upgrades that are made to them are outside Hewlett-Packard's control, HP cannot guarantee that the details are correct. Please consult the operating system documentation in conjunction with this manual.

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## Related documents

The following documents provide additional information:

See [http://www.t10.org/t10\\_main.htm](http://www.t10.org/t10_main.htm) for INCITS SCSI Primary Commands—3 (SPC-3) and other specifications

Copies of documents of other standards bodies can be obtained from:

*INCITS* 11 West 42nd Street  
New York,  
NY 10036-8002  
USA

*ISO* CP 56  
CH-1211 Geneva 20  
Switzerland

*ECMA* 114 Rue du Rhône  
CH-1204 Geneva  
Switzerland

Tel: +41 22 849 6000

Web URL: <http://www.ecma.ch>

*Global Engineering Documents* 2805 McGaw  
Irvine, CA 92714  
USA

Tel: 800 854 7179 or 714 261 1455



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# 1 Introduction

## Purpose of this manual

This manual provides basic information on configuring the drives with various operating systems. See the top-level release notes that accompany the drive for expected functionality and features.

LTO Ultrium drives are supported on the following platforms:

- HP (HP-UX) servers and workstations ([Chapter 2](#))
- HP (OpenVMS) servers and workstations ([Chapter 3](#))
- HP (Tru64 5.1x) servers and workstations ([Chapter 4](#))
- IBM (AIX) servers and workstations ([Chapter 6](#))
- Linux (kernel 2.6.x) servers and workstations ([Chapter 5](#))
- Sun (Solaris 8, 9, 10) servers and workstations ([Chapter 7](#))

For platforms not mentioned here, contact HP because there may be new connectivity details available that arrived after the release notes were published.

See [Chapter 8 on page 35](#) for details of how to verify the installation.

## LTO Ultrium drives in a library

Although LTO Ultrium drives may also be used in a library, instructions about installing device drivers for automatic robotics are not included in this manual.

## SAS drives

SAS drives are only supported on Redhat and SLES Linux.

## Backup applications

For optimum performance it is important to use a backup application that supports the drive's features within your system's configuration.

For details of which backup applications are supported with your tape drive and system, visit the HP Tape Compatibility website:

<http://www.hp.com/products1/storage/compatibility/tapebackup/index.html>

Follow the "Software compatibility" link then click a tick in the appropriate matrix to drill down into detailed application support information.

See the *Getting Started Guide* for more information about usage models.





## 2 HP (HP-UX) servers and workstations

This chapter covers:

- HP servers and workstations: HP-UX 11i v1 (11.11), 11i v2 (11.23)
- HP servers: HP-UX 11i v3 (11.31)

Before you install your tape drive, log on to the HP web site, [www.hp.com](http://www.hp.com), and download the latest hardware enablement (HWE) patch bundle for your operating system. This ensures that you will have the correct device driver for your tape drive.

System Administration Management (SAM) tools have evolved with ongoing HP-UX version releases. As a result, the procedures for setting up with different HP-UX versions differ. They are described separately in this chapter.

### HP-UX11i v3 and agile addressing

HP-UX11i v3 introduces *agile addressing* of devices. Agile addressing uses a different format of the device special file (dsf) to represent the tape drive—known as a *persistent dsf*. However HP-UX11i v3 retains support for the legacy dsf format as used in HP-UX11i v1 and 11i v2.

For more information about HP-UX releases including HP-UX11i v3 please refer to [www.docs.hp.com](http://www.docs.hp.com).

## Determining a suitable SCSI ID

The tape drive SCSI ID setting must be unique for the SCSI bus to which the drive is attached. In many cases the drive will be the only device on a SCSI bus<sup>1</sup> in which case the default SCSI ID setting of 3 is suitable. See the tape drive *User Guide* for details of how to alter the SCSI ID setting physically (usually accessible at the rear panel of the drive).

Scan the system to list the existing devices attached. From a shell window (hpterm/xterm), execute `ioscan` as follows:

### For HP-UX 11i v1, 11i v2 and 11i v3 (legacy format)

Enter the command:


```
% /sbin/ioscan -f
```

The output should look similar to the following (which shows SCSI drives):

Class	I	H/W Path	Driver	S/W State	H/W Type	Description
root	0		root	CLAIMED	BUS_NEXUS	
ioa	0	0	sba	CLAIMED	BUS_NEXUS	System Bus Adapter (880)
ba	0	0/0	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
OO	0	0/0/1/0	UsbOhci	CLAIMED	INTERFACE	PCI SerialBus (10330035)
OO	1	0/0/1/1	UsbOhci	CLAIMED	INTERFACE	PCI SerialBus (10330035)
OO	2	0/0/1/2	UsbEhci	CLAIMED	INTERFACE	PCI SerialBus (103300e0)
sideba	0	0/0/2/0	side_multi	CLAIMED	INTERFACE	CMD IDE controller
ext_bus	0	0/0/2/0.0	side	CLAIMED	INTERFACE	IDE Primary Channel
target	2	0/0/2/0.0.0	tgt	CLAIMED	DEVICE	
disk	1	0/0/2/0.0.0.0	sdisk	CLAIMED	DEVICE	TEAC DV-28E-N

1. Note that HP does not support disk drives and tape drives sharing the same SCSI bus.

ext_bus	1	0/0/2/0.1	side	CLAIMED	INTERFACE	IDE Secondary Channel
ba	1	0/1	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
ext_bus	2	0/1/1/0	c8xx	CLAIMED	INTERFACE	SCSI C1010 Ultra160 Wide LVD
target	0	0/1/1/0.0	tgt	CLAIMED	DEVICE	
disk	0	0/1/1/0.0.0	sdisk	CLAIMED	DEVICE	HP 73.4GST373454LC
ext_bus	3	0/1/1/1	c8xx	CLAIMED	INTERFACE	SCSI C1010 Ultra160 Wide LVD
lan	0	0/1/2/0	igelan	CLAIMED	INTERFACE	HP PCI 1000Base-T Core
ba	2	0/2	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
ext_bus	4	0/2/1/0	mpt	CLAIMED	INTERFACE	SCSI Ultra320 A6961-60011
ext_bus	5	0/2/1/1	mpt	CLAIMED	INTERFACE	SCSI Ultra320 A6961-60011
target	1	0/2/1/1.3	tgt	CLAIMED	DEVICE	
tape	1	0/2/1/1.3.0	stape	CLAIMED	DEVICE	HP Ultrium 4-SCSI
ba	3	0/3	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
ext_bus	6	0/3/1/0	c8xx	CLAIMED	INTERFACE	SCSI C1010 Ultra160 Wide LVD
A6829-60001						
ext_bus	7	0/3/1/1	c8xx	CLAIMED	INTERFACE	SCSI C1010 Ultra160 Wide LVD
A6829-60001						
ba	4	0/4	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
ba	5	0/6	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
ba	6	0/7	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
tty	0	0/7/1/0	asio0	CLAIMED	INTERFACE	PCI SimpleComm (103c1290)
tty	1	0/7/1/1	asio0	CLAIMED	INTERFACE	PCI Serial (103c1048)
unknown	-1	0/7/2/0		UNCLAIMED	UNKNOWN	PCI Display (10025159)
memory	0	8	memory	CLAIMED	MEMORY	Memory
ipmi	0	16	ipmi	CLAIMED	INTERFACE	IPMI Controller
processor	0	128	processor	CLAIMED	PROCESSOR	Processor
processor	1	129	processor	CLAIMED	PROCESSOR	Processor

 **NOTE:** If you are installing a SCSI drive onto a Storage Area Network (SAN), the fibre channel/SCSI router will also appear in the list of attached devices.

For a particular SCSI device in the `ioscan` listing, the SCSI bus ID and the drive's SCSI ID and LUN ID can be decoded from the H/W path (hardware path)/ For example:

Class	I	H/W Path	Driver	S/W State	H/W Type	Description
tape	1	2/0/1.5.0	stape	CLAIMED	DEVICE	HP Ultrium 2-SCSI

The H/W path for this tape drive is "2/0/1.5.0".

- The SCSI bus ID is "2/0/1" (including all the numbers separated by "/").

From the remaining ".5.0" portion:

- Tape drive SCSI ID = 5
- Tape drive SCSI LUN = 0

Fibre Channel drives have a slightly different format in `ioscan` output, similar to the following segment:

Class	I	H/W Path	Driver	S/W State	H/W Type	Description
=====						
ba	4	0/4	lba	CLAIMED	BUS_NEXUS	Local PCI-X Bus Adapter (783)
fc	2	0/4/1/0	fcd	CLAIMED	INTERFACE	HP AB378-60001 4Gb Single Port
PCI/PCI-X Fibre Channel Adapter (FC Port 1)						
fcp	1	0/4/1/0.84	fcd_fcp	CLAIMED	INTERFACE	FCP Domain
ext_bus	6	0/4/1/0.84.3.255.0	fcd_vbus	CLAIMED	INTERFACE	FCP Device Interface
target	3	0/4/1/0.84.3.255.0.0	tgt	CLAIMED	DEVICE	
tape	2	0/4/1/0.84.3.255.0.0.0	stape	CLAIMED	DEVICE	HP Ultrium 3-SCSI
fcp	0	0/4/1/0.180	fcd_fcp	CLAIMED	INTERFACE	FCP Domain
ext_bus	10	0/4/1/0.180.2.255.0	fcd_vbus	CLAIMED	INTERFACE	FCP Device Interface
target	7	0/4/1/0.180.2.255.0.0	tgt	CLAIMED	DEVICE	
tape	9	0/4/1/0.180.2.255.0.0.0	stape	CLAIMED	DEVICE	HP Ultrium 4-SCSI

For 11i v3 (Agile I/O tree view)

Enter the command:

```
% ioscan -m lun
```

The output should look similar to the following<sup>1</sup> (SCSI interface drives are shown in this example)

Class	I	Lun	H/W Path	Driver	S/W State	H/W Type	Health	Description
disk	2	64000/0xfa00/0x0	0/1/1/0.0x0.0x0	esdisk	CLAIMED	DEVICE	online	HP 73.4GST373454LC
			/dev/disk/disk2	/dev/rdisk/disk2				
disk	3	64000/0xfa00/0x3	0/0/2/0.0x0.0x0	esdisk	CLAIMED	DEVICE	online	TEAC DV-28E-N
			/dev/disk/disk3	/dev/rdisk/disk3				
tape	5	64000/0xfa00/0xa	0/2/1/1.0x5.0x0	estape	CLAIMED	DEVICE	online	HP DLT VS160
			/dev/rtape/tape5_BEST	/dev/rtape/tape5_BESTb				/dev/rtape/tape5_BESTn
			/dev/rtape/tape5_BESTnb					
tape	9	64000/0xfa00/0x12	0/1/1/1.0x2.0x0	estape	CLAIMED	DEVICE	online	HP C5683A
			/dev/rtape/tape9_BEST	/dev/rtape/tape9_BESTb				/dev/rtape/tape9_BESTn
			/dev/rtape/tape9_BESTnb					
tape	0	64000/0xfa00/0x16	0/3/1/1.0x3.0x0	estape	CLAIMED	DEVICE	online	HP Ultrium 2-SCSI
			/dev/rtape/tape0_BEST	/dev/rtape/tape0_BESTb				/dev/rtape/tape0_BESTn
			/dev/rtape/tape0_BESTnb					
tape	12	64000/0xfa00/0x1a	0/2/1/0.0x3.0x0	estape	CLAIMED	DEVICE	online	HP SDLT600
			/dev/rtape/tape12_BEST	/dev/rtape/tape12_BESTb				/dev/rtape/tape12_BESTn
			/dev/rtape/tape12_BESTnb					

For a particular SCSI device, you can decode the SCSI bus ID and the drive’s SCSI ID and LUN ID from the lunpath hardware path. For example:

Class	I	Lun	H/W Path	Driver	S/W State	H/W Type	Health	Description
tape	0	64000/0xfa00/0x16	0/3/1/1.0x3.0x0	estape	CLAIMED	DEVICE	online	HP Ultrium 4-SCSI

The lunpath hardware path for the above tape drive is “0/3/1/1.0x3.0x0”.

- SCSI bus ID is “0/3/1/1” (including all the numbers separated by “/”).

From the remaining “0x3.0x0” portion:

- Tape drive SCSI ID = 3 (decimal value from hexadecimal 0x3)
- Tape drive SCSI LUN = 0 (decimal value from hexadecimal 0x0)

Fibre Channel drives have a slightly different format in `ioscan` output, similar to the following segment:

Class	I	Lun	H/W Path	Driver	S/W State	H/W Type	Health	Description
tape	10	64000/0xfa00/0x14	0/4/1/0.0x50060b0000b7f3c8.0x0	estape	CLAIMED	DEVICE	online	HP Ultrium 4-SCSI
			/dev/rtape/tape10_BEST	/dev/rtape/tape10_BESTb				/dev/rtape/tape10_BESTn
			/dev/rtape/tape10_BESTnb					

For a given FC device the FC bus ID, the World Wide Name (WWN) and the LUN ID can be decoded from the Lun H/W Path. For example:

1. Note that device files (such as `/dev/rtape/tape9_BEST`) may or may not be in place initially.

The lunpath hardware path for the above tape drive is  
"0/4/1/0.0x50060b0000b7f3c8.0x0".

- The FC bus ID is "0/4/1/0" (including all the numbers separated by "/").

From the remaining "0x50060b0000b7f3c8.0x0" portion:

- Tape drive WWN (hexadecimal) = 0x50060b0000b7f3c8
- Tape drive SCSI LUN = 0x0 (hexadecimal SCSI-3 64-bit LUN identifier)

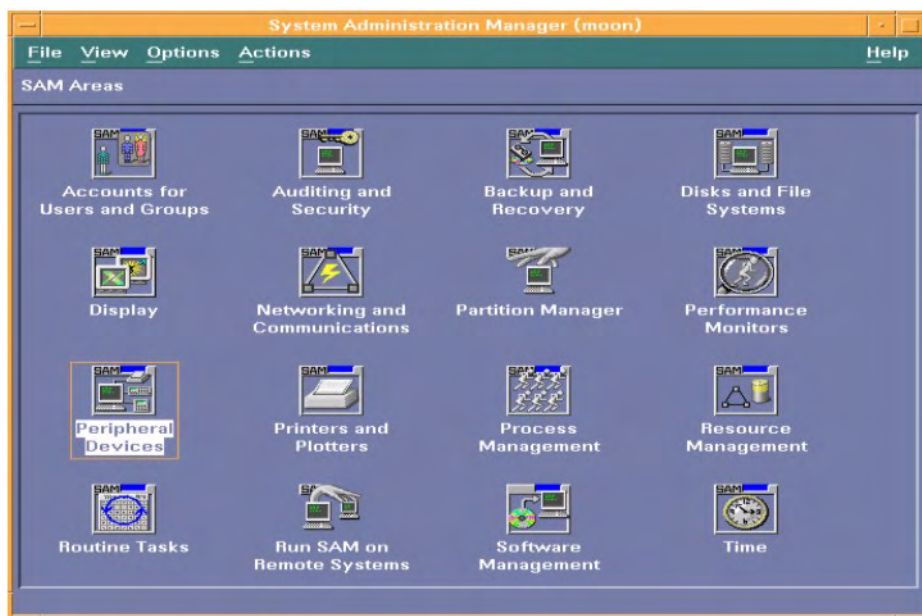
## Adding stape and schgr (autoloader driver) to the kernel

For HP-UX 11i v1, 11i v2

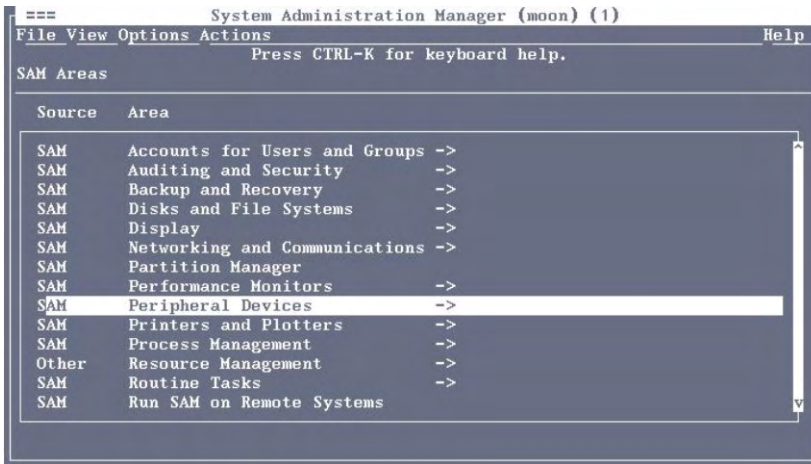
If your tape drive or autoloader does not appear in `ioscan` listing or is listed with H/W Type "UNKNOWN" you may need to install the appropriate drivers.

Use the 'sam' utility. Sam runs as a mouse driven GUI (Figure 1) on a system with full graphics capability, or as a console text-based interface (Figure 2). If you use the text-based interface, use the Tab and arrow keys to navigate, and the Return key to select.

**Figure 1** SAM GUI



**Figure 2** SAM text-based interface



### For HP-UX 11i v1 (11.11)

1. Enter `sam` at the command line.  

```
% sam
```
2. Select the following:  

```
Kernel Configuration
Drivers
```
3. Highlight the `stape` driver. If the driver has not been added to the kernel, both Current State and Pending State will read "Out".
4. Select the following:  

```
Actions
Add Driver to Kernel
```

The Pending State will now read "In".
5. To add the new driver to the kernel, select:  

```
Actions
Create a New Kernel
```

The `stape` driver is added to the kernel.
6. If you are going to attach an autoloader, use a similar procedure to change `schgr` to "static".
7. Reboot the system.

### For HP-UX 11i v2 (11.23)

1. Enter `sam` at the command line.  

```
% sam
```
2. Select the following:  

```
Kernel Configuration
Kernel Configuration (character mode)
Modules
```

3. Highlight the `stape` driver. If the driver has not been added to the kernel, both Current State and Planned State will read “unused”.
4. Type “m” to modify the stape driver and “s” to set it to “static”. The Planned State will now read “static”.
5. The `stape` driver is now added to the kernel.
6. If you are going to attach an autoloader, use a similar procedure to change `schgr` to “static”.
7. Reboot the system.

### For HP-UX 11i v3 (11.31)

1. Start up the SMH web-based interface.

```
% smh -w
```

This will attempt to launch a web browser. Mozilla browser<sup>1</sup> is the default when HP-UX 11i v3 is installed.

2. From the SMH Tools page (see [Figure 3](#)), select Modules from the Kernel Configuration section.

**Figure 3** SMH web-based interface (HP-UX11i v3)



3. In the Search box on the Kernel Configuration page, type `stape` and execute the search. The search results list will include both `estape` and `stape` modules. If either of these modules is not installed both Current State and Next Boot State will be shown as “unused”. A state of “static” indicates that the module is installed.

1. If Mozilla is being invoked for the first time you may be asked to agree to license terms for the software.

4. Select the `estape` module<sup>1</sup> radio button. Its details will appear in a panel below the modules list. From the right hand panel on the web page, click the **Modify Module** link.
5. On the Modify Kernel Module: `estape` page, for **Next Boot State**, select the “static” radio button. Check the box entitled **Backup** to create a backup copy of the existing kernel (see [Figure 4](#)).

**Figure 4** Adding `estape` driver to the kernel

Modify Kernel Module : `estape`

Module Name	<code>estape</code>
Description	SCSI Tape Driver for Enhanced SCSI Stack
Version	1.0
Current State	unused
Current Cause	explicit
Capabilities	static unused
Dynamic	no
Dependencies	module <code>esct:0.0.0</code> , module <code>stape:0.0.0</code> , interface <code>HPUX_11_31_PERF:1.0</code>

Enter your changes and click on the Modify button. For more information on `lcmodule` refer to [lcmodule manpage](#).

Next Boot State ☒ static ☐ unused

Backup ☒ back up the current configuration before applying change

Reason for Change

Modify Preview Cancel Help

Command Preview:  
To see the command(s) that will be run, input the required information and press the [Preview] button.

6. If you wish, type in a Reason for Change, such as “Initial `estape` installation May 1st 2007” and then select the **Modify** tab.
7. Click the **OK** button at the Operation Successful page. Both `estape` and `stape` drivers will now be shown with **Next Boot State** as “static”.
8. For autoloaders, use a similar procedure to prepare the `eschgr` (with `schgr`) module.
9. From the right-hand panel on the Kernel Configuration page, click **View Pending Changes and reboot** and proceed to reboot the system as directed.
10. Following the reboot, re-run SMH and search again for the driver as in step 3 above. **Current State** and **Next Boot State** should both be listed as “static”.

## Add device files

For HP-UX 11i v1, 11i v2

Use the `sam` utility to create device files. `sam` runs as a mouse driven GUI (see [Figure 1](#) on page 10) on a system with full graphics capability, or as a console text-based interface (see [Figure 2](#) on page 11). If you use the text-based interface, use the Tab and arrow keys to navigate, and the Return key to select.

1. Enter `sam` at the command line:  
% `sam`
2. Select the following:

1. The `estape` and `stape` modules are linked, so it is sufficient to select the `estape` module alone for installation.

## Peripheral Devices

### Tape Drives

`sam` will then scan the system for any tape drives connected.

For example, when an HP LTO Ultrium 4 drive is found, it will be displayed as something like:

Hardware Path	Driver	Description
8/0/2/0.3.0	stape	HP Ultrium 4-SCSI

3. Highlight the drive and select the following from the tool bar:

Actions

Create Device Files

Create Default Device Files

This will create default device files for the drive. To view the device files that have been created, select:

Actions

Create Device Files

Show Device Files

4. When you have exited `sam`, run `ioscan` to see the tape drive:

```
%/sbin/ioscan -fnC tape
```

All default device files displayed have compression enabled.

---

**NOTE:** HP recommends the 'Berkeley' device files for most applications:

`cXtYdZBESTnb` = Berkeley, no rewind, best available density

`cXtYdZBESTb` = Berkeley, with rewind, best available density

where:

X = card number

Y = target number (drive SCSI ID)

Z = LUN number

---

### For HP-UX 11i v3 (HP-UX 11.31)

1. Start up the SMH web-based interface:

```
% smh -w
```

This will attempt to launch a web browser. Mozilla browser<sup>1</sup> is the default when HP-UX 11i v3 is installed.

2. From the SMH Tools page (see [Figure 3](#) on page 12), select Manage Peripheral Devices from the Peripheral Devices section.

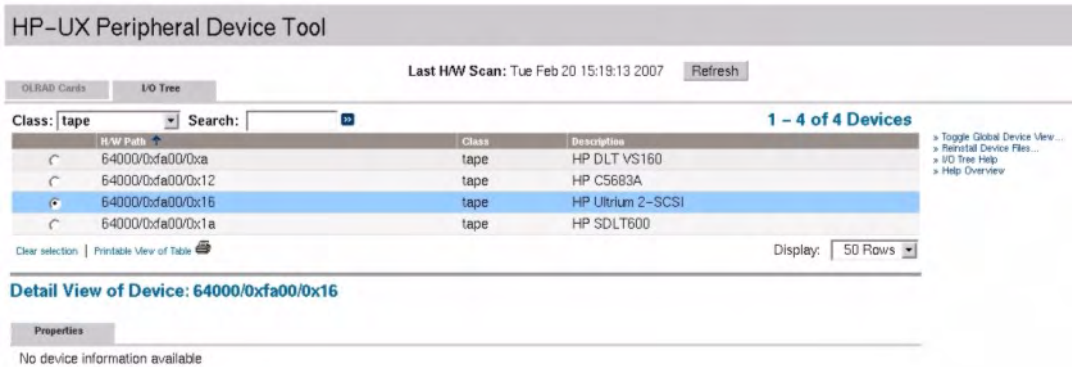
---

1. If Mozilla is being invoked for the first time you may be asked to agree to license terms for the software.



3. Select `tape` from the **Class** drop down box on the HP-UX Peripheral Device Tool page. Select the tape device (radio button) requiring device files from the resulting list. If device files are not already present this will be indicated under the Properties header (see [Figure 5](#))<sup>1</sup>.

**Figure 5** Selecting a tape device to create its device files (Agile View)



4. From the right-hand panel on the HP-UX Peripheral Device Tool page, click on **Reinstall Device Files**. At the next page, click the **Reinstall** button. When the browser returns to the HP-UX Peripheral Device Tool page, click the **Refresh** button one or more times until the list of device files appears under the Properties header.

## What next?

Once device files have been created, you should confirm that your new tape drive is working properly. [Chapter 8 on page 35](#) provides instructions on backing up and restoring a sample file to test your installation.

1. Depending on how SMH was last used the HP-UX Peripheral Device Tool page will display either the *Agile View* or the *Legacy View* as described at the beginning of this chapter (page 7). To switch between these views use the *Toggle Global Device View* link on the right hand side of the HP-UX Peripheral Device Tool page. In this chapter, the *Agile View* is assumed. The process is similar for the *Legacy View*.



# 3 HP (OpenVMS) servers and workstations

**NOTE:** Only SCSI drives are supported on Alpha Server systems.

## Determining attached devices

After connecting the tape drive to your system, boot OpenVMS and check for the presence of the new tape device. Execute the following commands.

**\$ sho dev mk**

Device Name	Device Status	Error Count	Volume Label	Free Blocks	Trans Count	Mnt Cnt
MKD300:	Online	0				

↑ *use this value in the next command line*

**\$ sho dev MKD300/full**

Magtape SIT058\$MKD300:, device type HP Ultrium 4-SCSI, is online, file-oriented device, available to cluster, error logging is enabled, controller supports compaction (compaction disabled), device supports fastskip (per\_io).

Error count	0	Operations completed	0
Owner process	" "	Owner UIC	[SYSTEM]
Owner process ID	00000000	Dev Prot	S:RWPL,O:RWPL,G:R,W
Reference count	0	Default buffer size	2048
Density	default	Format	Normal-11


Volume status: no-unload on dismount, beginning-of-tape, odd parity.

## What next?

You are now ready to begin using your tape drive. Please consult your OpenVMS system documentation for details.



# 4 HP (Tru64 5.1x) servers and workstations

 **NOTE:** Only SCSI drives are supported on Alpha Server systems.

## Determining attached devices

After connecting the tape drive to your system, boot TRU64 and check for the presence of the new tape device. Execute the following commands

```
# hwmgr -scan scsi
hwmgr: Scan request successfully initiated

# hwmgr -v d
HWID: Device Name           Mfg      Model          Location
-----
  4: /dev/dmapi/dmapi
  5: /dev/scp_scsi
  6: /dev/kevm
149: /dev/disk/dsk0c         COMPAQ    BD03685A24     bus-2-targ-0-lun-0
150: /dev/disk/dsk1c         COMPAQ    BD03664553     bus-2-targ-1-lun-0
151: /dev/disk/cdrom0c       TEAC      CD-W216E       bus-3-targ-0-lun-0
152: /dev/random
153: /dev/urandom
237: /dev/ntape/tape0        HP        Ultrium 4-SCSI bus-1-targ-3-lun-0
```

## What next?

Once device files have been created, you should confirm that your new tape drive is working properly. Please consult your Tru64 operating system documentation and [Chapter 8 on page 35](#) for instructions on testing your installation.



---

## 5 Linux (kernel 2.6.x) servers and workstations

### Determining the SCSI ID

Look at the output of `dmesg` to find out what SCSI channel number is used for each connection.

To find out the SCSI IDs in use on each channel, type:

```
cat /proc/scsi/scsi
```

This will produce output similar to the following for each device:

```
Attached Devices
Host: SCSI0 Channel: 00 Id:00 Lun:00
Vendor: HP Model -----
Type: Direct-Access ANSI SCSI Revision 02
```

Look at the ID information to establish which IDs are in use.

### Configuring on Linux systems

No changes are needed to support LTO Ultrium on Linux platforms, however you should ensure that you have the relevant drivers loaded.

To see the device drivers loaded currently, execute `lsmod`. This will give output similar to:

Module	Size	Used by
sgm	4376	1
ide-scsi	7200	0
lockd	30792	1
sunrpc	53316	1
st	24656	0
sym53c8xx	52096	1
aic7xxx	136184	2


The lines of interest here are:

<code>st</code>	The tape driver. Its presence shows that the tape driver is loaded.
<code>sym53c8xx</code>	The SCSI chipset driver for the LSI Logic family of HBAs (amongst others).
<code>aic7xxx</code>	The SCSI chipset driver for the Adaptec 7xxx chipset family (such as Adaptec 29160LP).

Latest SCSI controller drivers for Linux are available from the manufacturer's web site.

In order to communicate with a tape device, the operating system needs to have drivers for the tape and the underlying transport mechanism (the host bus adaptor) loaded. Ensure that both are available as either loadable modules (for example, usable with `insmod` and visible with `lsmod`) or are statically built into your kernel.

---

 **NOTE:** To add drivers to the statically built kernel you need the Linux source code available on disk and knowledge of how to use the kernel building tools that ship with various Linux distributions. This should not be attempted by novice users.

---

In order to determine if the drive has been detected by the tape driver at module load time, execute:

```
dmesg | grep "st"
```

This should find a number of lines. One should look like:

```
Detected SCSI tape st0 at scsi1, channel 0, id 5, lun 0
```

To load the tape driver module if it is not loaded as above, execute:

```
insmod st
```

to load it. This should happen naturally if your system is rebooted after attaching the drive.

When the `ST` driver module has been added, a list of tape device files will be created automatically. They reside in the `/dev/` directory and have the syntax:

```
/dev/stp or dev/nstp
```

where:

p Instance number of the device file (0 if only one drive is connected to the system)

n Indicates this is a no-rewind driver

To enable large transfers under Linux (>64 KB per write), edit the file `/usr/src/linux/drivers/scsi/st_options.h` and change the definition of `ST_BUFFER_BLOCKS`.

If you want requests to space to end of data (EOD) to be faster, you should also enable `ST_FAST_MTEOM` in the same file. After changing this file, rebuild the modules and install the new binary. At the very least, this requires:

```
make modules
make modules_install
```

from the `/usr/src/linux` directory. See your kernel documentation.

## Using the seek and tell features of `mt`

To use the seek and tell features of `mt`, you must tell the `st` driver that HP LTO Ultrium drives use logical block addressing:

```
mt -f <device file> stsetoptions scsi2logical
```

where `/dev/stp` is the device file.

Note however that this information is not preserved across reboots, so you need to execute this command each time the system comes up. The `stinit` utility offers a convenient way of handling this; see the relevant `man` page for more information. If you use this approach, set the manufacturer parameter to `HP` and the model to `"Ultrium 4-SCSI"`.



## What next?

Once device files have been created, you should confirm that your new tape drive is working properly. [Chapter 8 on page 35](#) provides instructions on backing up and restoring a sample file to test your installation.



## 6 IBM (AIX) servers and workstations

### Determining the SCSI ID

Before you configure your system to support LTO Ultrium drives, determine which SCSI ID to use. IDs must be unique for each device attached to the SCSI bus. To list existing devices, use the following:

```
% lsdev -C |grep SCSI
```

This produces output similar to:

```
scsi0 Available 00-00-0S Standard SCSI I/O Controller
hdisk0 Available 10-60-00-0,0 16 Bit LVD SCSI Disk Drive
rmt1 Defined 00-00-0S-2,0 Other SCSI Tape Drive
```

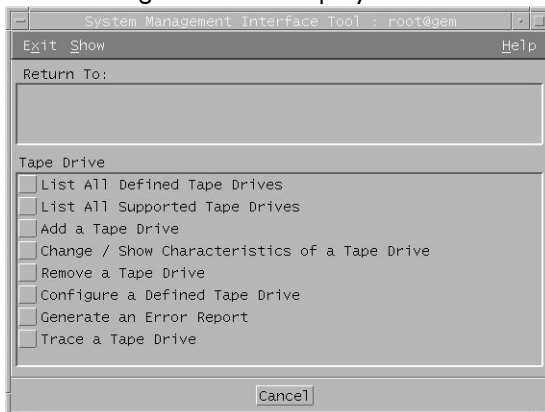
The SCSI ID is in the series 00-00-0S-X, 0, where X is the SCSI ID. Review the list of existing SCSI IDs and choose an available ID to assign to the new tape drive.

### Configuring the device files

To install an HP LTO Ultrium drive on an IBM workstation, create the appropriate device files for the drive. To change to variable block mode, use the following procedure:

If you are using a graphics terminal running X-Windows

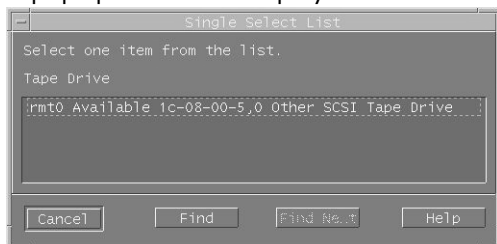
1. At a Windows terminal, type:  
`smit tape`
2. The following window is displayed:



If no device has been configured at this address before, select “add a tape drive” to set up the address.

Otherwise, select “change/show characteristics of a tape drive”

3. A pop-up window is displayed:



Select "ost" or "Other SCSI tape drive" as the tape drive you wish to change. If no device has been configured at this address before, choose connection addresses as appropriate.

4. The following details are displayed:

Tape Drive	rmt0	
Tape Drive type	ost	
Tape Drive interface	scsi	
Description	Other SCSI Tape Driv	
Status	Available	
Location	1c-08-00-5,0	
Parent adapter	scsi4	
Connection address	5,0	
BLOCK size (0=variable length)(Num.)	512	List
Use DEVICE BUFFERS during writes	yes	List ▲ ▼
RETURN error on tape change or reset	no	List ▲ ▼
Use EXTENDED file marks	yes	List ▲ ▼
RESERVE/RELEASE support	no	List ▲ ▼
BLOCK SIZE for variable length support(Num.)	0	List
DENSITY setting #1(Num.)	0	List
DENSITY setting #2(Num.)	0	List
Set delay after a FAILED command(Num.)	45	List
Set maximum delay for the READ/WRITE command(Num.)	144	List
Maximum LUN inquired on device	31	List

OK Command Reset Cancel ?

Check the following values and change them if necessary:

- BLOCK Size = 0
- Use EXTENDED file marks = "no"
- RESERVE/RELEASE support = "yes"
- Set maximum delay for the READ/WRITE command = 1200

Click on the "DO" button to apply the changes.

## If you are using a non-graphics terminal

1. At the command line type:  
`% smit -C tape`
2. The following is displayed:

```
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 an Error Report
Trace a Tape Drive
```

If no device has been configured at this address before, select “add a tape drive” to set up the address.

Otherwise, select “change/show characteristics of a tape drive”

3. A pop-up window is displayed:

```
Tape Drive
Move cursor to desired item and press Enter.

rmt0 Available 1c-08-00-5,0 Other SCSI Tape Drive

F1=Help      F2=Refresh    F3=Cancel
F8=Image     F10=Exit      Enter=Do
/=Find       n=Find Next
```

Select “ost” or “Other SCSI tape drive” as the tape drive you wish to change.

If no device has been configured at this address before, choose connection addresses as appropriate.

4. The following details are displayed:

```
Change/Show Characteristics of a Tape Drive

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[MORE...5]                                [Entry Fields]
Location                                1c-08-00-5,0
Parent adapter                          scsi4
Connection address                      5,0
BLOCK size (0=variable length)         [512]      +-
Use DEVICE BUFFERS during writes       yes        +
RETURN error on tape change or reset   no         +
Use EXTENDED file marks                yes        +
RESERVE/RELEASE support                 no         +
BLOCK SIZE for variable length support [0]        +-
DENSITY setting #1                     [0]        +-
DENSITY setting #2                     [0]        +-
Set delay after a FAILED command        [45]       +-
Set maximum delay for the READ/WRITE command [144]     +-
Maximum LUN inquired on device          [0]        +

[BOTTOM]

F1=Help      F2=Refresh    F3=Cancel    F4=List
F6=Reset     F6=Command   F7=Edit      F8=Image
F9=Shell     F10=Exit     Enter=Do
```

Check the following values and change them if necessary:

- BLOCK Size = 0
- Use EXTENDED file marks = “no”
- RESERVE/RELEASE support = “yes”
- Set maximum delay for the READ/WRITE command = 1200

Click on the “DO” button to apply the changes.

HP LTO Ultrium drives will work with `tar`, `cpio`, `backup`, `restore` and `dd`.

Once device files have been created, you should confirm that your new tape drive is working properly. [Chapter 8 on page 35](#) provides instructions on backing up and restoring a sample file to test your installation.

## Device filenames under AIX

Use device filenames as listed below for the combination of Rewind on Close, Retension on Open, and Compression that you want:

Filename	Rewind on Close	Retension on Open	Compression
<code>/dev/rmt<math>n</math></code>	Yes	No	enabled
<code>/dev/rmt<math>n</math>.1</code>	No	No	enabled
<code>/dev/rmt<math>n</math>.2</code>	Yes	Yes	enabled
<code>/dev/rmt<math>n</math>.3</code>	No	Yes	enabled
<code>/dev/rmt<math>n</math>.4</code>	Yes	No	disabled
<code>/dev/rmt<math>n</math>.5</code>	No	No	disabled
<code>/dev/rmt<math>n</math>.6</code>	Yes	Yes	disabled
<code>/dev/rmt<math>n</math>.7</code>	No	Yes	disabled

The  $n$  in the filename is the instance number assigned to the drive by the operating system, where 0 is the first device, 1 is the second and so on.

- Rewind on Close** Normally, the drive repositions the tape to BOT (Beginning of Tape) when the device file is closed. Using the no rewind option is useful when creating and reading tapes that contain multiple files.
- Retension on Open** Retensioning consists of winding to EOT (End of Tape) and then rewinding to BOT, in order to reduce errors. If this option is selected, the tape is positioned at BOT as part of the open process.
- Compression** Compression can be disabled or enabled.

---

## 7 Sun (Solaris 8, 9, 10) servers and workstations

### Fibre Channel drives

Before configuring your system to support an HP LTO Ultrium drive, ensure that the drive is visible to the Sun system HBA by correctly zoning the fabric switch (if one is being used).

#### Configuring the device files

Before configuring FC-attached drives, ensure the operating system is updated with the latest recommended patches. On Solaris 8 and 9 you also need to install the Sun/StorageTek StorEdge SAN Foundation software from [www.sun.com/download](http://www.sun.com/download) (select the Storage Management link, then StorageTek SAN x.x).

When SAN configuration is complete, verify that the drive is visible to the HBA by typing:

```
% cfgadm -al
```

This should produce an output similar to:

```
...  
c3::50060b000xxxxxxx      tape      connected      configured      unknown  
...
```

This indicates that the drive is configured and the device files built. In this example `c3::50060b000xxxxxxx` is the attachment point identifier with `50060b000xxxxxxx` being the WWN of the drive port attached to the SAN and visible to the HBA.

If you do *not* see anything similar to the example above, recheck the SAN connections and the zoning configuration to ensure that the HBA and drive ports are visible to each other.

If the tape device shows as `unconfigured`, type the following:

```
% cfgadm -c configure c3::50060b000xxxxxxx
```

This will build the necessary device file in the `/dev/rmt` directory.

To verify the particular devices associated with a specific WWN then use the following command.

```
% ls -al /dev/rmt | grep 50060b000xxxxxxx
```

Replace `50060b000xxxxxxx` with the appropriate WWN for the drive.

### SCSI drives

#### Determining the SCSI ID

Before you configure your system to support an HP LTO Ultrium drive, determine which SCSI ID to use. IDs must be unique for each device on attached to the SCSI bus.

1. Use the `modinfo` command to identify SCSI controller drivers installed on the system:

```
# modinfo | grep "HBA Driver"
```

This produces output similar to the following:

```
106 780a0000 102b3 50 1 glm (GLM SCSI HBA Driver)
110 780b4000 1272c 228 1 qus (isp10160 HBA Driver)
```

For the adapter to which the new tape drive is attached, you need to determine what SCSI IDs are already used.

## 2. Determine the SCSI IDs of existing devices attached to the SCSI controller:

For all adapters:

```
# dmesg | egrep ".*xxx.*target" | sort | uniq
```

where `xxx` = the type of adapter (`esp`, `glm`, `fas`, `qus` or `isp`), as appropriate.

For example, for an ESP-based adapter:

```
# dmesg | egrep ".*esp.*target" | sort | uniq
```

This produces a list similar to:

```
sd0 at esp0: target 0 lun 0 sd6 at esp0: target 6 lun 0
```

This indicates that SCSI IDs 0 and 6 are used for existing devices. SCSI ID 7 is generally used for the adapter itself. Here, you would choose a SCSI ID from 1 to 5 for the new tape drive.

## Configuring the device files

Determine the device file by typing:

```
# ls -l /dev/rmt/*m | grep "st@X"
```

where `X` is the SCSI ID. Identify the line for the tape drive. For example, if the drive was at SCSI ID 2, look for the line containing `"st@2,0"`. This might be as follows (but on a single line):

```
lrwxrwxrwx 1 root root 63 Mar 1 00:00 /dev/rmt/0m
../../../../devices/sbus@1f,0/espdma@e,8400000/esp@e, 8800000/st@2,0:m
```

Here you could use `/dev/rmt/0m` (shown underlined above) as the device file.

For optimal performance, ensure that you have the following minimum patch number:

	Minimum patch <sup>a</sup>
Solaris 8	108725-13
Solaris 9	Generic_122300-03
Solaris 10	Generic_118822-30

a. Patch levels are liable to change every 6 months or so, so these "minimum" levels may quickly become out-of-date.

Upgrading to the minimum patch level will ensure that the necessary support for officially supported drives is included in the driver. You can view your existing patch level using the command `"uname -a"`. To access Solaris patch upgrades, you need to set up an Online Account with Sun. For additional information on changes to Solaris 8, 9 and 10 Software Update access, see SunSolve InfoDoc #83061 at

<http://sunsolve.sun.com/search/document.do?assetkey=1-9-83061-1>



If for some reason you cannot upgrade to the minimum patch level, you can make the following file modifications to enhance performance:

1. In the file `/kernel/drv/st.conf`, after these lines:

```
#####  
# Copyright (c) 1992, by Sun Microsystems, Inc.  
#ident "@(#)st.conf 1.6 93/05/03 SMI"
```

add the following depending on which version of operating system you are installing (there are 6 significant spaces between HP and Ultrium in line 2):

for Solaris 8 without st patch:

```
tape-config-list =  
"HP      Ultrium 4", "HP Ultrium LTO 4", "HP_LTO_GEN_4";  
HP_LTO_GEN_4 = 1, 0x36, 0, 0xd639, 4, 0x00, 0x42, 0x44, 0x46, 3;  
name="st" class="scsi" target=X lun=0;
```

where X is the SCSI target address of the device you have attached.

for Solaris 9 and 10 (and 8 with st patch):

```
tape-config-list =  
"HP      Ultrium 4", "HP Ultrium LTO 4", "HP_LTO_GEN_4";  
HP_LTO_GEN_4 = 2, 0x3B, 0, 0x18659, 4, 0x00, 0x42, 0x44, 0x46, 3, 60, 1200,  
600, 1200, 600, 600, 18000;  
name="st" class="scsi" target=X lun=0;
```

where X is the SCSI target address of the device you have attached.

See “HP-data values” on page 32 below for the values of the parameters in these lines.

2. If you are replacing an existing tape device on the same SCSI ID, remove the contents of the `/dev/rmt` directory as follows:

```
# cd /dev/rmt  
# rm *
```

3. Instead of rebooting the device, follow these steps.

- a. Find the kernel module ID:

```
# modinfo | grep "st ("  
96 60dcc000 cdb0 33 1 st (SCSI Sequential Access Driver)
```

In this example the ID is 96.

- b. Unload the kernel module:

```
# modunload -i 96
```

- c. Load the kernel module back in:

```
# modload -p drv/st
```

- d. Rebuild the device paths:

```
devfsadm -C  
devfsadm -i st
```

For further details, see “How do you load *st.conf* changes without rebooting,” SunSolve document 18010, on

<http://sunsolve.sun.com/search/document.do?assetkey=1-9-18010-1&searchclause=18010>

This link is valid for registered SunSolve users with a valid Sun Service Plan.

4. You should now be able to use the drive.
- Use `/dev/rmt/Xcb` if you require a compression rewind device file, where *X* is the relevant device address.
  - Use `/dev/rmt/Xcbn` when you require a compression non-rewind device.

Once the device files have been created, you should confirm that your new tape drive is working properly. [Chapter 8 on page 35](#) provides instructions on backing up and restoring a sample file to test your installation.

## HP-data values

The values for `HP_LTO_GEN_n` and `name`, which provide normal LTO mode, have the following meanings:

The syntax for `HP_LTO_GEN_n` on Solaris 8/9/10 is:

```
<drive type> = <version>, <type>, <bsize>, <options>,  
               <no. of densities>, <density 0>, <density 1>,  
               <density 2>,<density 3>, <default density>,  
               <non-motion timeout>, <read/write timeout>,  
               <rewind timeout>, <space timeout>, <load timeout>,  
               <unload timeout>, <erase timeout>
```

where:

Parameter	Value	Meaning														
<version>	1 or 2	Indicates the format of the following parameters.														
<type>	0x36 or 0x3B	The value for an LTO Ultrium drive in /usr/include/sys/mtio.h. For Solaris 8, 0x36 indicates a type of MT_ISOTHER. Later versions of Solaris support the value 0x3B which indicates a type of MT_LTO.														
<bsize>	0	Indicates variable block size.														
<options>	0xd639 or 0x18659	<div>This value is derived from constants provided in /usr/include/sys/scsi/targets/stddef.h. The value determines which operations the driver can perform with the attached device by using a unique value for each feature and then adding them together to form the options value. Supported features will vary with OS revision, and may include the following:</div> <table><tr><td>0x001</td><td>Device supports variable length records.</td></tr><tr><td>0x008</td><td>Device can backspace over files (as in the 'mt bsf' option).</td></tr><tr><td>0x010</td><td>Device supports backspace record (as in 'mt bsr').</td></tr><tr><td>0x020</td><td>Device requires a long time-out period for erase functions.</td></tr><tr><td>0x040</td><td>Device will automatically determine the tape density.</td></tr><tr><td>0x0200</td><td>Device knows when end of data has been reached.</td></tr><tr><td>0x0400</td><td>Device driver is unloadable.</td></tr></table>	0x001	Device supports variable length records.	0x008	Device can backspace over files (as in the 'mt bsf' option).	0x010	Device supports backspace record (as in 'mt bsr').	0x020	Device requires a long time-out period for erase functions.	0x040	Device will automatically determine the tape density.	0x0200	Device knows when end of data has been reached.	0x0400	Device driver is unloadable.
0x001	Device supports variable length records.															
0x008	Device can backspace over files (as in the 'mt bsf' option).															
0x010	Device supports backspace record (as in 'mt bsr').															
0x020	Device requires a long time-out period for erase functions.															
0x040	Device will automatically determine the tape density.															
0x0200	Device knows when end of data has been reached.															
0x0400	Device driver is unloadable.															

Parameter	Value	Meaning
		<p>0x1000 Time-outs five times longer than normal.</p> <p>0x4000 Driver buffers write requests and pre-acknowledges success to application.</p> <p>0x8000 Variable record size not limited to 64 KB.</p> <p>0x10000 Device determines which of the two mode pages the device supports for selecting or deselecting compression.</p> <p>So 0xd639 indicates variable record length, bsf and bsr enabled, long timeouts for erase, EOD recognition, Unloadable device driver, 5 x longer timeouts, buffer writes and pre-acknowledge success, variable records not limited to 64 KB, auto-density over-ride and MODE SELECT compression.</p> <p>Similarly, 0x018659 indicates variable record length, bsf and bsr enabled, automatic density determination, EOD recognition, unloadable device driver, variable records not limited to 64 KB, and device selection of mode pages for controlling compression.</p>
<no. of densities>	4	There are four densities following in the parameter list.
<density n>	0x00	Creates a device file with compression disabled.
<density 3>	0x46	The density code for data compression enabled by default.
<default density>	3	Density 3 (0x46) is the default for Generation 4 drives.
<X timeout>		All timeouts are in seconds

Values for the parameters for `name` are as follows:

Parameter	Value	Meaning
target	X	X specifies the SCSI ID (target) of the device.
lun	0	Specifies the LUN for the device.



---

## 8 Verifying the installation

### Verifying the installation of the drive (UNIX)

As part of the installation process, you will have installed the appropriate device driver for your UNIX system, and created device files to communicate with the tape drive.

This section describes how you can verify the installation has been performed correctly.

In outline, the procedure is as follows:

1. Check the tape drive responds to a rewind command.
2. Write test data to a tape.
3. Read the test data from the tape.
4. Compare the data read from the tape with the original data on disk.

#### To verify the installation:

1. Test the SCSI connection to the tape drive by performing a rewind:

- a. If there is a tape cartridge already in the drive, remove it.
- b. Insert a new tape cartridge.

- c. Rewind the tape using the command line:

```
% mt -f <device file> rewind
```

For example, on HP-UX 11i v1 or 11i v2

```
% mt -f /dev/rmt/c4t3d0BESTnb
```

For example, on HP-UX 11i v3 (using a persistent device file):

```
% mt -f /dev/rtape/tape0_BESTnb rewind
```

If the command completes successfully, there will be no feedback. If it fails, you will see an error message on the console. There may be a reservation by another host, or a zone change, or the hardware installation may be faulty. Check the troubleshooting section of the *User's Guide* for help in identifying the problem.

2. Write a sample file to tape, using 'tar':

```
% cd /
```

```
% tar cvf <device file> <file>
```

The options to `tar` have the following meanings:


- |   |   |
|---|---|
| c | Create a new archive (backup file) on the device. |
| v | Operate in verbose mode.                          |
| f | Specify the device file explicitly.               |

The arguments follow the `cvf` options in the command line. Their values depend on the operating system; suggested values are given in the appropriate operating system chapter. The arguments are as follows:

`<device file>` The name of the device file for the drive.  
*Example:* `/dev/rmt/c4t3d0BESTnb`

`<file>` The name of the file to archive, prefixed with `'.'` `'/'`.  
*Example:* `./stand/vmunix`

---

 **NOTE:** Make sure you prefix the file name with `'.'` when you back it up to tape. If you do not, the restore operation in step 3 will overwrite the original copy on disk.

---

**3. Read the file back from tape:**

```
% cd /tmp
% tar xvf <device file>
```

The `'x'` option to `tar` here means “extract from the archive”.

Use the same value for the `<device file>` argument as in step 2.

**4. Compare the original with this retrieved file:**

```
% cmp <original file> /tmp/<retrieved file>
```

This compares the files byte by byte. If they are the same, there should be no output, and this verifies that the installation is correct. The arguments are:

`<original file>` The name of the original file, prefixed with `'/'`.  
*Example:* `/stand/vmunix`

`<retrieved file>` The name of the file retrieved from the archive.  
*Example:* `stand/vmunix`

## Example

Suppose you are verifying the installation of an HP LTO Ultrium tape drive on an HP-UX 11.X system. The procedure would be as follows.:

**1. Use `ioscan` to obtain the tape drive device file options:**

```
%/sbin/ioscan -fnC tape
```

Identify the Berkeley ‘no-rewind’ option, for example: `/dev/rmt/c4t3d0BESTnb`

**2. Change directory to root:**

```
% cd /
```

**3. Back up `/stand/vmunix` to tape. For example:**

```
% tar cvf /dev/rmt/c4t3d0BESTnb ./stand/vmunix
```

Note the prefix of `'.'` to the filename.

**4. Change to the temporary directory:**

```
% cd /tmp
```

**5. Extract the file from the tape. For example:**

```
% tar xvf /dev/rmt/c4t3d0BESTnb
```

6. Compare the original with the restored version:

```
% cmp /stand/vmunix /tmp/stand/vmunix
```

Note that the original filename is *not* prefixed with ' '.





---

# Glossary

<b>AT&amp;T mode</b>	Berkeley and AT&T functional modes differ in “read-only” close functionality. In AT&T mode, a device close operation will cause the tape to be repositioned just after next filemark on the tape (the start of the next file).
<b>Berkeley mode</b>	Berkeley and AT&T functional modes differ in “read-only” close functionality. In Berkeley mode the tape position will remain unchanged by a device close operation.
<b>BOT</b>	<i>Beginning Of Tape</i> . The first point on the tape that can be accessed by the drive.
<b>buffered mode</b>	A mode of data transfer in write operations that facilitates tape streaming. It is selected by setting the Buffered Mode Field to 1 in the SCSI MODE SELECT Parameter List header.
<b>compression</b>	<p>A procedure in which data is transformed by the removal of redundant information in order to reduce the number of bits required to represent the data. This is basically done by representing strings of bytes with codewords.</p> <p>In LTO Ultrium drives, the data is compressed using the LTO-DC compression format which is based on ALDC (licensed from Stac/IBM) with two enhancements. One limits the increase in size of data that cannot be compressed that ALDC produces. The other is the use of embedded codewords.</p>
<b>data transfer phase</b>	<p>On a SCSI bus, devices put in requests to be able to transfer information. Once a device is granted its request, it and the target to which it wants to send information can transfer the data using one of three protocols (assuming both devices support them): asynchronous, synchronous, and wide.</p> <p>In asynchronous transfers, the target controls the flow of data. The initiator can only send data when the target has acknowledged receipt of the previous packet. All SCSI devices must support asynchronous transfer.</p> <p>In synchronous data transfer, the initiator and target work in synchronization, allowing transmission of a packet of data to start before acknowledgment of the previous transmission.</p> <p>In wide (16-bit) data transfer, two bytes are transferred at the same time instead of a single byte.</p> <p>HP LTO Ultrium drives support asynchronous, synchronous and narrow (8-bit) wide transfers.</p>

<b>Fibre Channel</b>	<p>Fibre Channel provides an inexpensive yet expandable means of quickly transferring data between workstations, mainframes, supercomputers, desktop computers, storage devices, displays and other peripherals. Although it is called Fibre Channel, its architecture represents neither a channel nor a real network topology. It allows for an active intelligent interconnection scheme, called a fabric, to connect devices. All a Fibre Channel port has to do is to manage a simple point-to-point connection between itself and the fabric.</p> <p>Several common ULPs (Upper Level Protocols) including IP and SCSI can run on Fibre Channel, merging high-speed I/O and network functionality in a single connectivity technology.</p>
<b>filemark</b>	<p>A mark written by the host to the tape that can be searched for, often using the drive's fast-search capability. It does not necessarily separate files. It is up to the host to assign a meaning to the mark.</p>
<b>immediate mode</b>	<p>A mode of responding to SCSI commands where the drive or other peripheral does not wait until the command has finished before returning status information back to the host. For writing filemarks, Immediate mode can significantly improve the performance of systems that do not set the Immediate bit when sending a SCSI WRITE FILEMARKS command. On the other hand, data is not flushed to tape in response to a filemark command.</p>
<b>infinite flush</b>	<p>By default, the buffer in the drive is flushed every 5 seconds. Infinite flush avoids frequent starting and stopping of the mechanism when using a very slow application. It also avoids losing capacity through the flushing of partly written groups. On the other hand, infinite flush means that data can remain in the buffer for very long periods of time, and could be lost in the event of a power failure.</p>
<b>LUN</b>	<p><i>Logical Unit Number.</i> A unique number by which a device is identified on the SCSI bus. A tape drive has a fixed LUN of 0. In an autoloader, the changer mechanism is LUN1.</p>
<b>SAN</b>	<p><i>Storage Area Network.</i> A dedicated, high-speed network that establishes a direct connection between storage elements and servers. The hardware that connects workstations and servers to storage devices in a SAN is referred to as a fabric. The SAN fabric enables any-server-to-any-storage device connectivity through the use of Fibre Channel switching technology.</p>
<b>sequential access</b>	<p>Sequential access devices store data sequentially in the order in which it is received. Tape devices are the most common sequential access devices. Devices such as disk drives are <i>direct access</i> devices, where data is stored in blocks, not necessarily sequentially. Direct access allows speedy retrieval, but is significantly more costly.</p>

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