

LTFS User's Guide

This manual is written for Quantum LTFS operators and administrators and introduces Quantum Linear Tape File System (LTFS) software and discusses its configuration and operation.

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Introduction

This guide provides information about Quantum Linear Tape File System (LTFS) Software. Quantum LTFS makes tape self-describing, file-based, and easy-to-use, and provides users with the ability to use standard file operations on tape media for accessing, managing and sharing files with an interface that behaves like a hard disk. In addition, Quantum LTFS provides the ability to share data across platforms, as you would with a USB drive or memory stick.

Features

Quantum LTFS includes the following features:

- Provides all you need to use LTO-5 or later media as a disk
- Based on open source software, subject to EULA terms and BSD requirements
- Precompiled application versions provided for supported platforms
- Full source code available (covered by the 3 Clause BSD license)
- Supported on Linux® and MAC OS®

Benefits

In addition to the wide range of benefits that Quantum LTO-5 or later tape drives have to offer, these drives with Linear Tape File System (LTFS) functionality also deliver:

- Faster access to data: When a tape is mounted, the files and directories stored on it appear on the desktop in the same way as a disk directory listing.
- Simple drag and drop: Quantum LTFS increases ease of use, simply drag and drop files to and from the tape.
- Compatibility across your environment: Tape media written using Quantum LTFS is self-describing so that data retrieval from tape is independent of any hardware or software platforms.
- Increased data mobility: Easily share content to increase data mobility; tapes written with Quantum LTFS application can be exchanged more easily between users working on different operating systems, using different software and in different locations.
- A single storage media standard: Unify organization-wide file sharing with Quantum LTO-5 or later tape drives. Tapes can move across libraries and vendors with the ease of video cassettes, while files on tape can be accessed using straightforward drag-and-drop.

Intended Usage

Quantum LTFS application presents the contents of the tape like a disk volume. However it is important to bear in mind that it is not a true disk, therefore there are some best practices to follow to ensure satisfactory performance and a good user experience.

Note: A best practice for all customers is to always have two copies of your data at all times.

- Quantum LTFS is designed to work best in a single-user environment, where just one user is copying files to or from the tape. Multiple users or processes trying to write and/or read at the same time will result in poor performance due to the sequential access nature of tape.
- For the same reasons, the tape drive should not be shared between different systems. A single tape drive should be connected to a single host bus adapter (HBA).
- The expected usage model is to transfer large files between systems, by mounting the tape on one system, writing the files, un-mounting, mounting on the second system, and reading the files. Treating the tape volume as a true random access device (for example frequently reading and updating individual files) will not perform as well as streamlining large files to/from tape.
- The Quantum LTFS application will work in conjunction with graphical file explorer programs such as Nautilus (on Linux) or Finder (on Mac OS X). However because these types of applications tend to try to pre-read files in the directory, using the graphical explorer window may lead to poor performance. Optimum performance will be enjoyed by using a terminal window and issuing shell commands to copy data, view directory contents, etc.
- The Quantum LTFS application utilizes a block size of 512 KB. Older Host Bus Adapters may not support that block size, which would prevent being able to create or mount an LTFS volume.
- Tape activity may continue for several minutes after un-mounting an LTFS volume. Do not attempt to remove the tape cartridge, power down the system or tape drive, or delete the folder where the LTFS volume is mounted, until all tape activity has finished. Check the front panel LEDs and wait for them to stop flashing. Attempting these actions before tape activity has finished may cause corruption of the tape format.
- Quantum LTO-5 or later tape drives are optimized for high speed data transfer. For best results, when copying data to or from an LTFS volume, utilize a device which can sustain a transfer rate of at least 50 MB/s.

Supported Configurations

Quantum LTFS supports:

- LTO-5 or later Tape Drives with SAS interfaces
- Red Hat 6.9 is only supported with LTFS 2.2.2
- Red Hat 7.3 or later are supported with both LTFS 2.2.2 and 2.4.0.2
- SUSE Linux Server 12 SP2 or later
- Mac OS X 10.12.2 (Sierra) or later

Note: See the Compatibility Matrix on www.quantum.com/LTFS for the latest details on supported operating system and hardware configurations.

Linux Installation and Configuration

When using Quantum LTFS with Quantum LTO-5 or later tape drives, the following components are required:

- A drive firmware revision that supports dual partitioning. Quantum LTFS will check and tell you if your tape drive firmware needs updating
- The software package that contains the “run-time” executable, this can be found at <http://www.quantum.com/LTFS>.
- The FUSE kernel module and shared libraries

Note: xTalk version 6.4.1.1 or later provides a new LTFS check test that determines whether or not dual partitioning and LTFS are supported.

Downloading and Installing Quantum LTFS

To download and install Quantum LTFS:

- 1 Before starting to install and use Quantum LTFS, you must ensure that the FUSE kernel module is present and loaded. To check whether FUSE is installed, the following commands may be used:

For RHEL:

- `$ rpm -qi fuse`
- `$ rpm -qi fuse-libs`

For SLES:

- `$ rpm -qi fuse`
- `$ rpm -qi libfuse2`

Note: If the module is not present on your system, you must first obtain and then install it.

For RHEL 5 Update 4 or later:

The required FUSE packages are fuse and fuse-libs, version 2.7 or later.

Note: If FUSE cannot be installed via an RPM package, the source code may be downloaded from the following location:
<http://fuse.sourceforge.net>

After FUSE has been installed, the following command may be used to check whether the module is loaded:

```
$ lsmod | grep fuse
```

If the module is not listed as currently loaded, you must load it before proceeding:

```
$ modprobe fuse
```

- 2 Determine whether you want to use precompiled utilities or build your own version of the Quantum LTFS application.

Note: Currently, Quantum only supports installations using the precompiled binaries.

- 3 To build from the source code, download and unpack the Quantum LTFS source archive:
`qtmltfs-x.x.x.tar.gz`

Then, follow the instructions in `./qtmltfs-x.x.x/doc/BUILDING.linux` or `qtmltfs-x.x.x/doc/BUILDING.linux`.

- 4 To use precompiled utilities, download the appropriate package for your operating system platform:

For RHEL:

```
rhelx-qtmltfs-x.x.x-x.x86_64.rpm (64-bit)
```

For SLES:

```
slesxxspx-qtmltfs-x.x.x-x.x86_64.rpm (64-bit)
```

Download the Quantum LTFS GPG key from the Quantum LTFS download page and import it with the following command:

```
$ rpm --import qtmltfs-public-GPG-key.asc
```

Install the Quantum LTFS package with the following command:

```
$ rpm -ivh package_name
```

For example:

```
$ rpm -ivh qtmltfs-1.2.0-1.x86_64.rpm
```

Note: The binary RPM checks for dependencies in the RPM database. If FUSE was installed by building from the source, the RPM database may not properly reflect that the dependencies have been installed, which will prevent LTFS from being installed. It is possible to work around this by utilizing the `--nodeps` option to disable dependency checking, when installing the RPM package.

Note: The SLES 11 version of `chkconfig` command is a little different from standard linux in that, after invoked with either `add` or `delete` service option it executes the `list` mode option of `chkconfig` to display the new runlevels 0 to 6 to the terminal.

The binary RPM will place links to executables in `/usr/local/bin/`
(`ltfs`, `mkltfs`, `ltfsck`)

and a number links to dynamic libraries in `/usr/local/lib/` (or `/usr/local/lib64`) and also in a new subdirectory `/usr/local/lib/ltfs/` (or `/usr/local/lib64/ltfs/`).

5 Quantum LTFS is now installed. See Using Quantum LTFS for the next steps.

To Uninstall LTFS

If at a later date you want to uninstall LTFS from your system, use the following command:

```
$ rpm -e qtmltfs
```

Mac OS X Installation and Configuration

When using Quantum LTFS with Quantum LTO-5 or later tape drives, the following components are required:

- A drive firmware revision that supports dual partitioning
- The software package that contains the “run-time” executable
- The ICU package (provided)

Note: Quantum LTFS will check and tell you if your tape drive firmware needs updating.

Downloading and Installing Quantum LTFS

To download and install Quantum LTFS with precompiled binaries:

- 1 Before starting to install and use LTFS, you must ensure FUSE for OS X is present and loaded.
It is recommended the most current version be used.

Note: Currently, Quantum only supports installations using the precompiled binaries.

- 2 To use precompiled utilities, download the file:
`qtmltfs-x.x.x.dmg`
- 3 Open the binary disk image by double clicking on it in a Finder window. The disk image contains the installation package, **LinearTapeFileSystem.pkg** as well as the following support file:
`ICUFramework-x.x.x.x.pkg`
- 4 Install the ICU package first by double-clicking on the file **ICUFramework-x.x.x.x.pkg** and following the instructions.
- 5 Now install the LTFS package by double-clicking on the file **LinearTapeFileSystem.pkg** and following the instructions.

Note: Packages will not install if all applicable licenses are not accepted.

- 6 Quantum LTFS is now installed.
See Using Quantum LTFS for the next steps.
- 7 GUI Updates:
 - a Install Quantum LTFS Manager package by double-clicking on the file **Quantum LTFS Manager.pkg** and follow the instructions
 - b Double-click Quantum LTFS Manager in the Applications Folder to begin.

To Uninstall LTFS

If at a later date you want to uninstall LTFS from your system, **delete** `/usr/local/bin/*ltfs*` and then delete the tree under `/Library/Frameworks/LTFS.framework`.

To also delete the ICU package, delete the tree under `/Library/Frameworks/ICU.framework`.

To remove Quantum LTFS Manager delete it from the `/Applications` and delete `/usr/local/lib/libLtfsApi.dylib`.

How to use LTFS - Linux

To use Quantum LTFS:

- 1 Ensure that `/usr/local/bin/` is in your command search path. For example:

```
$ export PATH="$PATH:/usr/local/bin"
```

- 2 Load a tape cartridge into the drive, and then format it in LTFS format:

```
$ mklfts -d /dev/sg0
```

Note: If the cartridge already has been formatted for LTFS, you need to use the force reformat option (-f) in some cases. Linux example:

```
- $ mklfts -d /dev/sg0 -f
```

mklfts Options

[Table 1](#) provides `mklfts` options.

Table 1 `mklfts` Options

mklfts Option	Explanation
<code>-d<name></code> OR <code>--device=<name></code>	Tape device (required). For Linux use the device name such as <code>/dev/sg0</code> .

mklfts Option	Explanation
-s<id> OR --tape-serial=<id>	Tape serial number (6 alphanumeric ASCII characters)
-n OR --volume-name=<name>	Tape volume name (empty by default)
-r<rule[/rule]> OR --rules=<rule[,rule]>	<p>Rules for choosing files to write to the index partition. The syntax of the rule argument is:</p> <ul style="list-style-type: none"> • size=1M • size=1M/name=pattern • size=1M/name=pattern1:pattern2:pattern3 <p>A file is written to the index partition if it is no larger than the given size AND matches at least one of the name patterns (if specified).</p> <ul style="list-style-type: none"> • The size argument accepts K, M and G suffixes. • Name patterns may contain the special characters '?' (match any single character) and '*' (match zero or more characters).
--no-override	Disallow mount-time data placement policy changes
-w OR --wipe	Restore the LTFS medium to an unpartitioned medium (format to a legacy scratch medium)
-f OR --force	Force reformat of existing LTFS volume (normally prevented)
-q OR --quiet	Suppress progress information and general messages
-t OR --trace	Enable function call tracing (only useful for debugging)
-h OR --help	This help.
-p OR --advanced-help	Full help including advanced options.
-g OR --interactive	Interactive Mode

3 Mount the formatted tape cartridge.

```
$ mkdir /mnt/ltfs
$ ltfs /mnt/ltfs
```

Note: Some operating systems require creating each folder or sub-folder in separate commands.

For example:

```
$ mkdir /mnt
$ cd /mnt
$ mkdir ltfs
$ cd ltfs
```

ltfs Options

Table 2 provides `ltfs` options.

Table 2 `ltfs` Options

ltfs Option	Explanation
<code>-o devname=<dev></code>	Tape device (required if not using the default device: <code>/dev/sg0</code> for Linux)
<code>-o work_directory=<dir></code>	LTFS work directory (default: <code>/tmp/ltfs/</code>)
<code>-o trace</code>	Enable function call tracing (only useful for debugging)
<code>-o eject</code>	Ejects the cartridge after an unmount command.
<code>-o sync_type=<type></code>	Specify sync type (default: <code>time@5</code>) <code><type></code> should be specified as follows: <ul style="list-style-type: none"> time@min: LTFS attempts to write an index each min minutes. <ul style="list-style-type: none"> Min should be the decimal number from 1 to 15372286728912 (default: <code>min=5</code>). Specifying an integer greater than 35791394 on 32-bit Linux systems will result in an error message and the value will not be accepted. Therefore, on 32-bit Linux systems the maximum value displayed for <code>sync_type</code> field is the maximum allowed integer, 35791394. close: LTFS attempts to write an index when a file is closed. unmount: LTFS attempts to write an index when the medium is unmounted.
<code>-o force_mount_no_eod</code>	Skips eod existence check when mounting (read only mount). Only use for a CM corrupted medium.
<code>-o rollback_mount=<gen></code>	Attempt to mount on previous index generation (read-only mount)
<code>-o release_device</code>	Clear device reservation (should be specific with <code>-o devname</code>). Note: This option can only release legacy reservation and will also unload the cartridge.
<code>-o symlink_type=<type></code>	Specific symbolic link type (default: <code>posix</code>) <code><type></code> should be specified with one of the following values: <ul style="list-style-type: none"> posix: LTFS behavior is the same as standard symbolic link live: LTFS replaces mount point path by current mount point
<code>-a</code>	Advanced help, including standard FUSE options
<code>-V OR --version</code>	Output version information and exit
<code>-h OR --help</code>	Display this help and exit

ltfs Option	Explanation
-o umask=M	Set file permissions (octal)
-o uid=N	Set file owner
-o gid=N	Set file group

4 Write files to the LTFS volume. For example:

```
$ cp -r /root /mnt/ltfs/
```

5 Unmount the tape cartridge. This flushes the data buffer of the file system to the tape cartridge, and prepare for eject.

```
$ umount /mnt/ltfs
```

or

```
$ fusermount -u /mnt/ltfs
```

Note: The **umount** (or **fusermount**) command will return immediately, but the drive may still be busy writing cached data to tape.

- Do not attempt to remove the tape cartridge, power down the system or tape drive, or delete the folder where the LTFS volume is mounted, until all tape activity has finished.

- Check the front panel LEDs and wait for them to stop flashing.

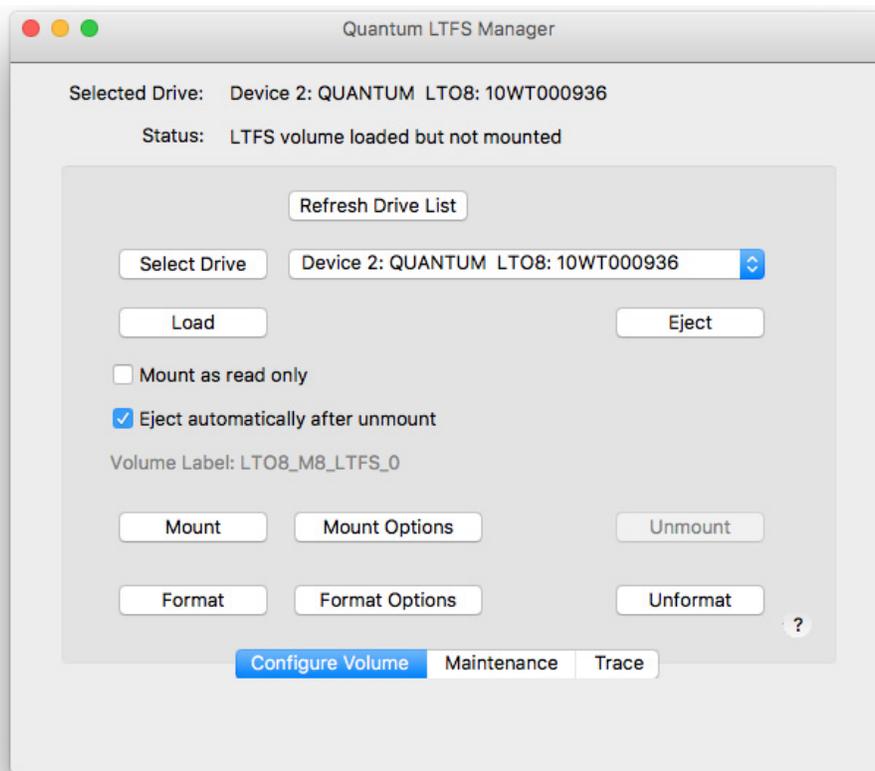
- Attempting these actions before tape activity has finished may cause corruption of the tape format.

How to Use LTFS - Mac GUI

To access the LTFS GUI on Mac OS:

- 1 Click Quantum LTFS Manager from the Applications folder or your desktop. The Configure Volume Screen displays.

Figure 1 Configure Volume Screen



The **Configure Volume Screen** should display the available Quantum tape drives. If there is no drive listed in the drop-down menu, click the **Refresh Drive List** button.

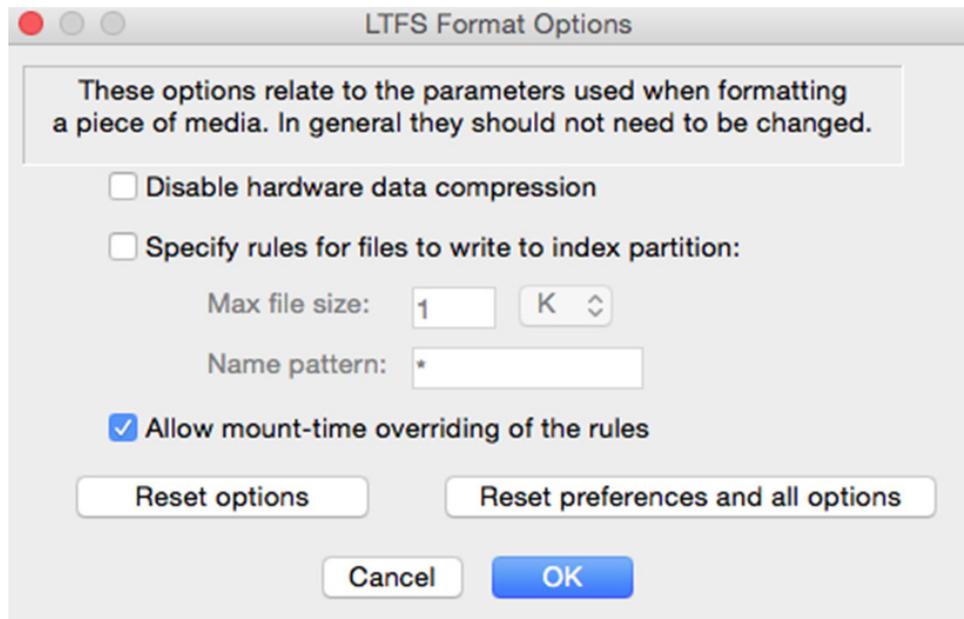
Note: If a tape drive still does not display after clicking the Refresh Drive List button, troubleshoot the drive itself.

2 Once the tape drive is listed, click the **Select Drive** button.

- Now you can prepare a tape for the first use. Before a cartridge can be used by LTFS, it must be loaded into the drive, named and prepared by formatting. Use the **Configure Volume Screen** to load a tape into the drive or eject a tape from the drive.
- **Volume Label: {volume label}** (LTO8_M8_LTFS_0 is an example of a volume label) is how the LTFS volume will appear, as a folder, in the OS file system. The optional volume label may be specified when formatting the volume (see [Step 3](#)) and the volume will be in the folder specified as the mount point in the mount options (see [Step 7](#)).
- The tape volume will normally be mounted for reading and writing; however sometimes you may wish to prevent further modifications to it. This can be done by sliding the tab on the tape cartridge itself prior to loading into the tape drive; or it can also be done in software by checking the **Mount as read only** box.

- The **Eject automatically after unmount** option controls what happens to the tape cartridge once the LTFS session is over and you unmount the volume. Checking the **Eject automatically after unmount** box will cause the cartridge to be ejected from the drive once the unmount is complete. If the checkbox is clear then the cartridge will be retained in the drive.
- 3 If you do not have a previously formatted LTFS volume, click **Format** to get the tape ready for use with LTFS.
 - You will be prompted to enter an optional volume label.
 - The volume name is used to as the name of the folder on the mount point.
 - If a volume name is not desired, leave the field blank and click OK.
 - If a volume name is not provided, you will be prompted for a folder name when mounting the volume.
 - Next you will be prompted for an optional serial number.
 - If a serial number is not desired, click **No**.
 - A message appears to remind you that formatting the cartridge permanently deletes any existing data.
 - 4 You can use **Format Options** to specify modifications of parameters pertaining to the way that an LTFS Volume is formatted.

Figure 2 Format Options



LTO tape drives have built-in lossless hardware data compression, which is enabled by default. If desired, you can format the cartridge in such a way that this compression will be disabled.

Normally all data files are written to the data partition of the cartridge, and the index partition contains only the index of the contents.

- It is possible to format the cartridge in such a way that small data files, or files whose name match a certain pattern, can be written to the index partition.
- In general this may lead to poorer performance, so unless you have a particular need; it is recommended that you leave this setting in its default (disabled) state.

A file is written to the index partition if it is no larger than the given size AND matches at least one of the name patterns (if specified).

- The size argument accepts K, M and G suffixes.
- Name patterns may contain the special characters '?' (match any single character) and '*' (match zero or more characters).
- Multiple patterns can be specified using colons (:)
pattern1:pattern2:pattern3:.

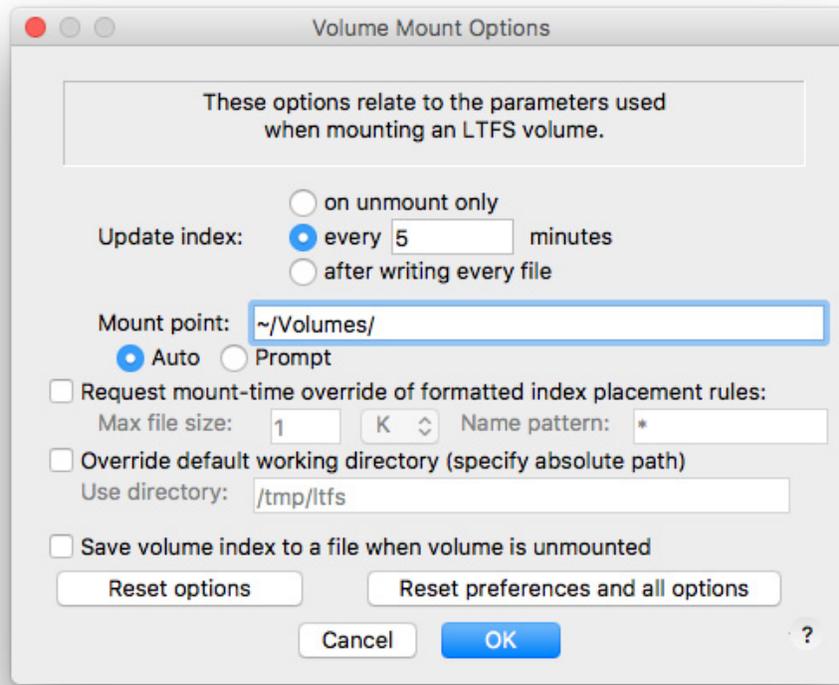
It is possible, when mounting an LTFS volume, to try to override the rules specified at format time for which files are written to the index partition. If you clear this checkbox, that will not be permitted and the volume will mount with the rules used during the format operation.

- 5 If at some future time you desire to free up an LTFS-formatted cartridge for some other use, click **Unformat** to erase a tape completely for use with other applications.

Caution: Using the **Format** and **Unformat** buttons completely erases all data from the tape.

- 6 After the formatted tape is loaded and ready, click the **Mount** button. This will make LTFS volume available to the system.
- 7 You can use **Mount Options** to specify modifications of parameters pertaining to the way that an LTFS volume is mounted into the OS.

Figure 3 Mount Options



The current LTFS code supports three different methods for updating the index, which is where all the file details are stored for the volume. By default a copy of the index is written every five minutes, which gives a reasonable balance between having confidence that a current index exists, and the (normally small) impact on performance and capacity caused by writing multiple copies of the index.

For best performance and capacity, you can select on unmount only; however the risk then is that power loss or a system crash before the volume is unmounted will cause all files written during that session to be lost.

For maximum confidence you can opt to write a copy of the index after every file has been written to tape; however this may have a serious impact on both performance and capacity, especially if the files being written are relatively small (say < 100MB).

The mount point is a directory where the LTFS volume will appear in the file system.

- The initial value is **~/Volumes** but can be set to any folder where you have write permission.
- If **Auto** is selected and a name was specified when the volume was formatted, the files will be available in the file system in <mount point>/<volume name>.
- If **Prompt** is selected or the volume does not have a name, you will be prompted each time the volume is mounted.
- The value entered in the **Mount point:** field will be used to initialize the prompt.

- If the volume is named, the files will be in <mount point>/<volume name>.
- If the volume is not named, the files will be in the folder entered.

Note: The folder does not have to be empty before mounting the volume; but, any file previously in the folder will be hidden until the volume is unmounted.

During normal operation, the LTFS system may need to use a directory for temporary or “working” files, and may also need a location for storing index contents when a volume is unmounted. To modify the directory used, select the **Override default working directory** checkbox and enter a valid directory name (for which you have write permission).

It may be useful to be able to access the volume index even when the volume is not mounted.

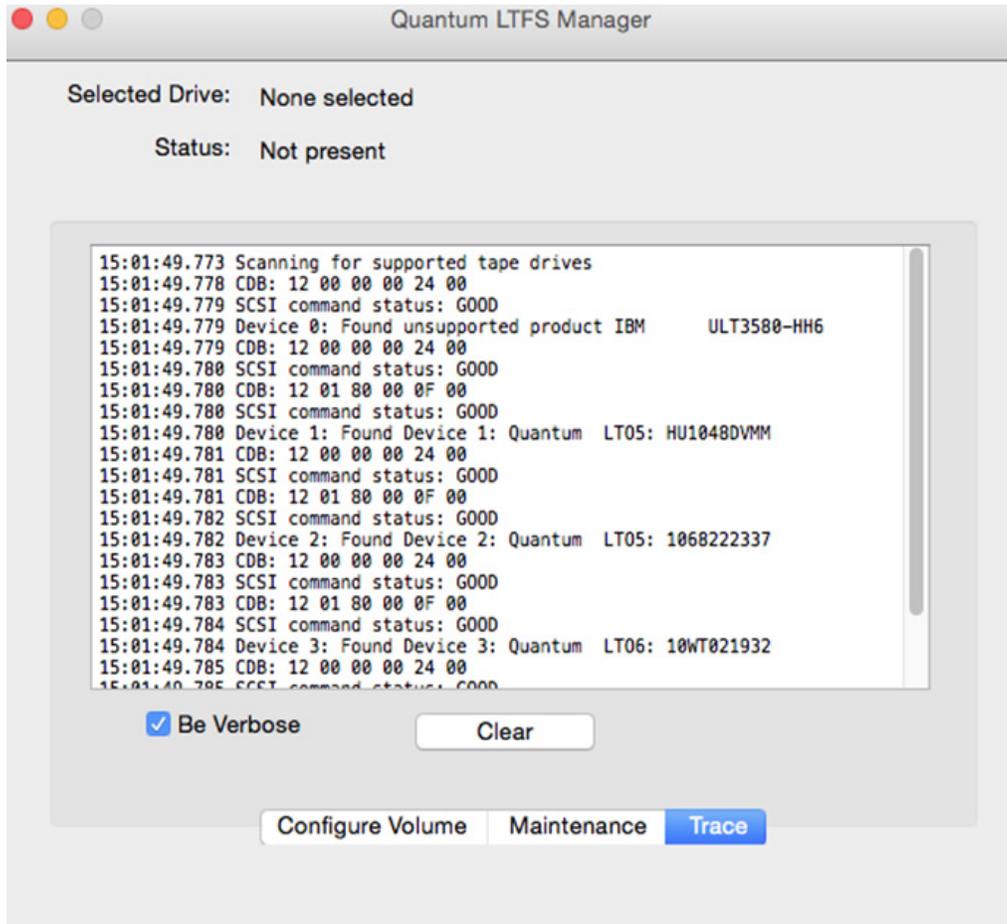
- If this option is checked, then when a volume is unmounted, a copy of the index is saved in the configured working directory.
- The file is saved in its raw (XML) form and will require some interpretation.

8 When finished with the tape, click the **Unmount** button. Wait until all tape motion to complete (This can take several minutes) before ejecting that tape using the eject button.

Caution: Do not use the eject button on the appliance itself until the tape has been properly unmounted using the Unmount button on this screen. Failure to do this will cause the tape to be corrupted and could result in data loss.

9 You can click the **Trace** button to display the **Trace Screen**.

Figure 4 Trace Screen



The **Trace Screen** displays the output of the commands being run. This screen is used exclusively to troubleshoot LTFS issues.

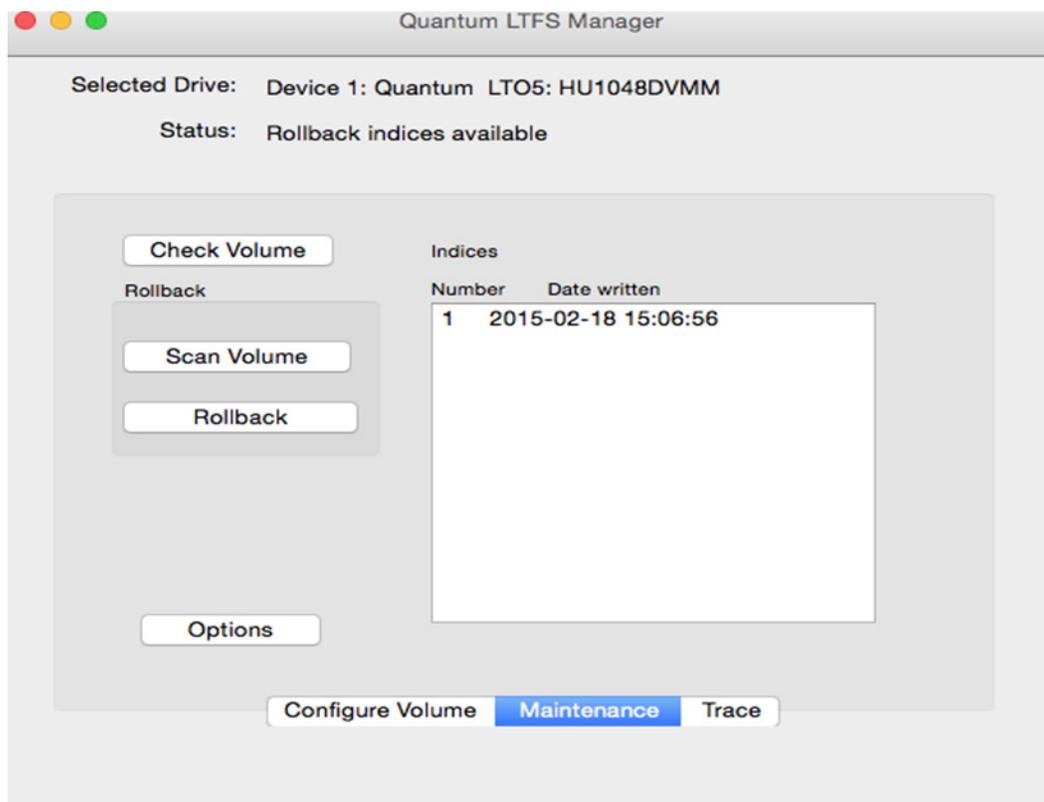
If the **Be Verbose** checkbox is marked, detailed debug information is being captured. It should almost never be required in normal operation; however should errors occur then the verbose output may help to track down the problem.

In addition to the textual output, LTFS will generate a log file each time a volume is unmounted (or whenever an error occurs).

- These are typically stored in the user's home directory under Library/Logs/LTFS.
- LTFS will keep only the ten most recent log files for each drive, deleting older logs as needed.
- These log files contain internal drive debug information and are not normally required unless requested by a support person while investigating an issue.

10 If the LTFS volume becomes corrupted for some reason, the tools provided on this **Maintenance Screen** can assist in recovering the content of the volume to a known state.

Figure 5 Maintenance
Screen



Recovery Actions

The first recovery action available is to check the LTFS volume for integrity. If a volume fails to mount and the Trace Screen indicates a problem with the volume, this action will normally be able to recover the volume into a stable state. The behavior of the checking operation can be fine-tuned via the Options.

The second recovery action allows you to “roll back” the LTFS volume to its state at a previous point in time.

- On completion, mounting the volume will cause its contents to appear as they did at that earlier time.
- There are two rollback variations available, one of which retains knowledge of changes since that earlier date so that you can in future “roll forward” to a more recent view; and the second mode which permanently erases all recent changes.
- Refer to Maintenance Options for more information on these two modes.

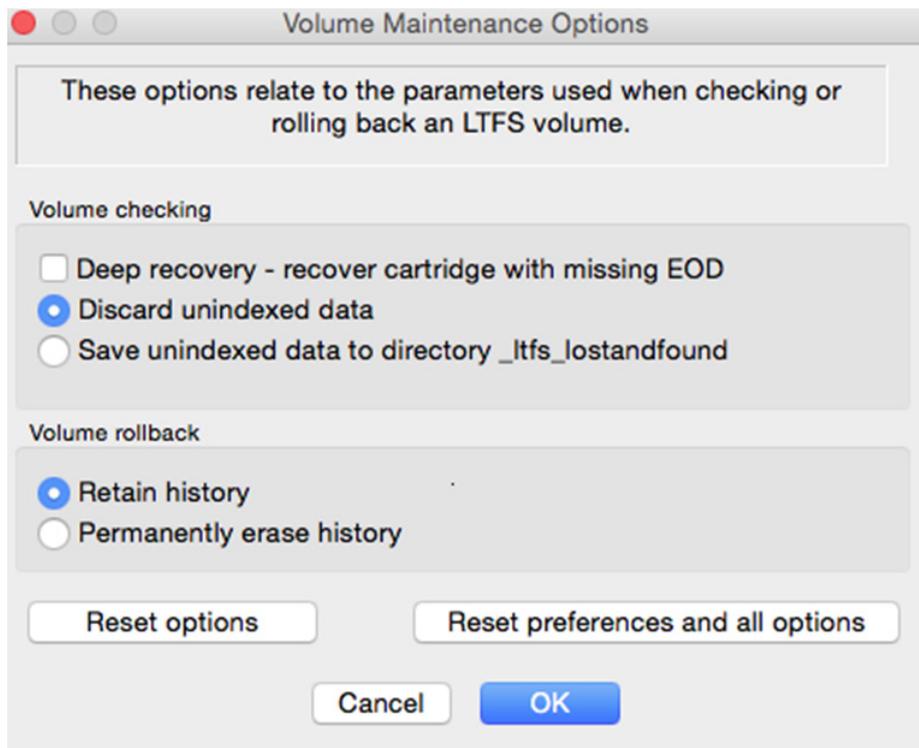
Rollback Process

There are three stages to the rollback process:

- a Initiate the process by clicking the **Scan Volume** button.
 - This will start reading the entire volume looking for suitable index points on the tape.

- Note that the scan process for a full cartridge may take several hours to complete.
- b Once the scan is finished, the potential rollback points are listed according to their time and date of generation. Click on the entry to which you wish to roll back.
- c Click the **Rollback** button.
The volume content will be modified to reflect its state at your chosen time/date point.

Figure 6 Maintenance Options



Caution: The Rollback operation may irretrievably modify the tape content, depending on options selected. Also interrupting the check or rollback operation may leave the volume in an inconsistent state. Ensure that you really intend to carry out the operation before using these buttons.

If the tape drive loses power while writing, it is possible that the volume may end up in a state where there is no "End of Data" (EOD) marker.

- In this case the volume will normally be unusable, and special action must be taken to attempt to recover the content.
- Selecting the Deep Recovery check box enables that special action; however because it may add considerably to the processing time, it should not normally be checked unless you have a reason to believe the volume is in this damaged state.

Depending on the nature of the problems encountered when checking the volume, some data blocks may be encountered for which no index information is available.

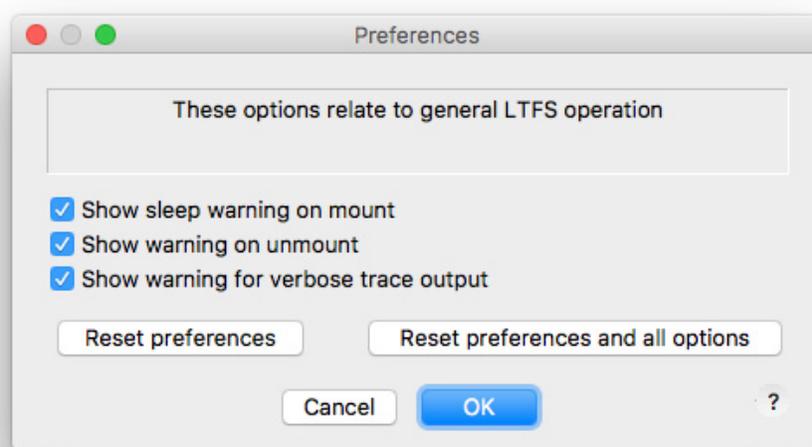
- This means that the file content has become disconnected from the file name, and there is no (automatic) way for the software to know which file the blocks belong to.
- One way this may occur is if power is removed after the file has been written to tape, but before the index has been written.
- Unindexed data options allow you to decide whether to discard any unindexed data blocks, or to save them in a special directory so that you can attempt to identify and restore them manually.

In the rollback mode of recovery operations, you have the ability to modify the index to an earlier state.

- The two options presented here determine whether the modified index is written in such a way as to permit a future "roll forward" (because all history has been retained), or whether the modified index will erase all later history such that no future roll forward will ever be possible.
- The latter may reclaim some tape space, but should be used with caution because it cannot be undone. If in doubt, it is recommended to use the "Retain" option.

11 Occasionally it may be desirable to modify some aspects of the **Quantum LTFS Manager** behavior, and the **Preferences** dialog can be used to do that.

Figure 7 Preferences



- Normally a warning box is displayed when a volume is mounted; clear the **Show sleep warning** on mount checkbox to suppress this warning.
- Normally a warning box is displayed when the Unmount button is clicked; clear the **Show warning on unmount** checkbox to suppress this warning.
- Normally a warning box is displayed when verbose mode is enabled on the Trace tab; clear the **Show warning for verbose diagnostic output** checkbox to suppress this warning.

Each of the warning dialogs has a check box "**Don't show this message again**". A user could go to the preferences dialog to restore the warnings.

How to Use LTFS - Mac Terminal Commands

Note: The GUI application will guide you through the steps required to select a tape drive, load and format a tape cartridge and then mount the cartridge into the file system.

However, command line tools are also installed and, if you prefer, you can use them instead of the GUI application.

In Mac OS X the root user is disabled by default. Mac OS X LTFS commands require that the root user is enabled. Instructions for enabling the root user in Mac OS X can be found at the following link: <http://support.apple.com/ht1528>

To use Quantum LTFS:

- 1 Ensure that `/usr/local/bin/` is in your command search path. For example:

```
$ export PATH="$PATH:/usr/local/bin
```

- 2 Load a tape cartridge into the drive, and then format it in LTFS format:

```
$ mklfts -d 0
```

Note: If the cartridge already has been formatted for LTFS, you need to use the force reformat option (`-f`) in some cases.

Mac OS X example: `$ mklfts -d 0 -f`

mklfts Options

[Table 3](#) provides `mklfts` options.

Table 3 `mklfts` Options

mklfts Option	Explanation
<code>-d<name></code> OR <code>--device=<name></code>	Tape device (required). For MacOS X, use the instance number of the tape drive, assigned sequentially by the system starting from 0.
<code>-s<id></code> OR <code>--tape-serial=<id></code>	Tape serial number (6 alphanumeric ASCII characters)
<code>-n</code> OR <code>--volume-name=<name></code>	Tape volume name (empty by default)

mklfts Option	Explanation
-r<rule[/rule]> OR --rules=<rule[,rule]>	Rules for choosing files to write to the index partition. The syntax of the rule argument is: <ul style="list-style-type: none"> • size=1M • size=1M/name=pattern • size=1M/name=pattern1:pattern2:pattern3 A file is written to the index partition if it is no larger than the given size AND matches at least one of the name patterns (if specified). <ul style="list-style-type: none"> • The size argument accepts K, M and G suffixes. • Name patterns may contain the special characters '?' (match any single character) and '*' (match zero or more characters).
--no-override	Disallow mount-time data placement policy changes
-w OR --wipe	Restore the LTFS medium to an unpartitioned medium (format to a legacy scratch medium)
-f OR --force	Force reformat of existing LTFS volume (normally prevented)
-q OR --quiet	Suppress progress information and general messages
-t OR --trace	Enable function call tracing (only useful for debugging)
-h OR --help	This help.
-p OR --advanced-help	Full help including advanced options.
--syslogtrace	Enable diagnostic output to stderr and syslog
-V	Version information
-g OR --interactive	Interactive Mode

3 Mount the formatted tape cartridge.

```
$ mkdir /mnt/ltfs
$ ltfs /mnt/ltfs
```

Note: Some operating systems require creating each folder or sub-folder in separate commands.

For example:

```
$ mkdir /mnt
$ cd /mnt
$ mkdir ltfs
$ cd ltfs
```

ltfs Options

Table 4 provides `ltfs` options.

Table 4 `ltfs` Options

ltfs Option	Explanation
<code>-o devname=<dev></code>	Tape device (required if not using the default device: 0 for Mac OS)
<code>-o work_directory=<dir></code>	LTFS work directory (default: <code>/tmp/ltfs/</code>)
<code>-o trace</code>	Enable function call tracing (only useful for debugging)
<code>-o eject</code>	Ejects the cartridge after an unmount command.
<code>-o sync_type=<type></code>	Specify sync type (default: <code>time@5</code>) <type> should be specified as follows: <ul style="list-style-type: none"> • time@min: LTFS attempts to write an index each min minutes. <ul style="list-style-type: none"> • Min should be the decimal number from 1 to 15372286728912 (default: <code>min=5</code>). • Specifying an integer greater than 35791394 on 32-bit Linux systems will result in an error message and the value will not be accepted. • Therefore, on 32-bit Linux systems the maximum value displayed for <code>sync_type</code> field is the maximum allowed integer, 35791394. • close: LTFS attempts to write an index when a file is closed. • unmount: LTFS attempts to write an index when the medium is unmounted.
<code>-o force_mount_no_eod</code>	Skips eod existence check when mounting (read only mount). Only use for a CM corrupted medium.
<code>-o rollback_mount=<gen></code>	Attempt to mount on previous index generation (read-only mount)
<code>-o release_device</code>	Clear device reservation (should be specific with <code>-o devname</code>). Note: This option can only release legacy reservation and will also unload the cartridge.
<code>-o symlink_type=<type></code>	Specific symbolic link type (default: <code>posix</code>) <type> should be specified with one of the following values: <ul style="list-style-type: none"> • posix: LTFS behavior is the same as standard symbolic link • live: LTFS replaces mount point path by current mount point
<code>-a</code>	Advanced help, including standard FUSE options
<code>-V OR --version</code>	Output version information and exit
<code>-h OR --help</code>	Display this help and exit

ltfs Option	Explanation
-o umask=M	Set file permissions (octal)
-o uid=N	Set file owner
-o gid=N	Set file group

4 Write files to the LTFS volume. For example:

```
$ cp -r /root /mnt/ltfs/
```

5 Unmount the tape cartridge. This flushes the data buffer of the file system to the tape cartridge, and prepare for eject.

```
$ umount /mnt/ltfs
```

Note: The **umount** command will return immediately, but the drive may still be busy writing cached data to tape.

- Do not attempt to remove the tape cartridge, power down the system or tape drive, or delete the folder where the LTFS volume is mounted, until all tape activity has finished.

- Check the front panel LEDs and wait for them to stop flashing.

- Attempting these actions before tape activity has finished may cause corruption of the tape format.

Usage Details

This section provides the following information:

<ul style="list-style-type: none"> • Format Version Compatibility 	<ul style="list-style-type: none"> • File Names
<ul style="list-style-type: none"> • Use of sync_type Options 	<ul style="list-style-type: none"> • Limitations
<ul style="list-style-type: none"> • File Permissions 	<ul style="list-style-type: none"> • MAC OS X only
<ul style="list-style-type: none"> • File Types 	

Format Version Compatibility

Earlier versions of the Quantum LTFS application supported the original LTFS 1.0 format specification; version 2.1.0 onwards supports the updated LTFS 2.1.0 format specification. LTFS volumes created with v2.1.0 or later will not be readable in older versions of the LTFS application, as shown in [How to Use LTFS - Mac Terminal Commands](#) on page 20:

[Table 5](#) provides the LTFS compatibility information.

Table 5 LTFS Compatibility

LTFS Application	Cartridge Written by LTFS Application V2.0.0 or Earlier	Cartridge Written by V2.1.0 or Later
V2.0.0 or earlier	Can be read and written	Cannot be mounted
V2.1.0 or later	Can be read; will automatically be converted to the new format if written	Can be read and written

Quantum recommends that all instances of Quantum LTFS should be updated to v2.1.0 or later to avoid these compatibility issues. If, for some reason, it is important to maintain cartridges readable by previous versions of the Quantum LTFS application, care should be taken to avoid writing to those cartridges with the new version of the application. This may be accomplished by mounting the volume as read-only, or by using the cartridge write-protect tab to prevent cartridge updates. However, this should be regarded as a temporary measure until all the application instances can be updated to v2.1.0 or later.

Use of sync_type Options

Previous versions of Quantum LTFS supported a single mechanism for updating the tape index, in which the index was written to tape only when the volume was unmounted. In normal operation this is sufficient since the LTFS usage model requires the volume to be unmounted after use, so there is always a valid index. However, if power is removed from the drive without unmounting, for example due to an unplanned power outage or accidental unplugging, the volume will be left in an inconsistent state and all files added since the last dismount operation will be inaccessible. The `ltsck` utility may be able to recover the file data to the `_ltsf_lostandfound` directory but the metadata (such as filename, access dates) will be lost.

To address this exposure, Quantum LTFS offers two additional mechanisms for updating the tape index. The first is to write a copy of the index to tape periodically while writing data; this is the new default behavior and the index is written out every five minutes. The time interval can be set with a resolution of one minute. This method of index update reduces the window of exposure to power loss events, since there will always be an index on tape no more than five minutes old (if using the default interval).

The second additional mechanism provided in Quantum LTFS is to update the index every time a file is closed after writing. This further reduces the exposure window to a single file, or (if several processes are using the volume simultaneously) to the number of files being written concurrently. However, this does add some overhead to LTFS, both in terms of the tape capacity used for each index, and also in terms of performance since the writing of the index will take bandwidth away from writing data. These overhead effects are more severe with smaller file sizes.

In most cases the default Quantum LTFS behavior offers the best solution but the new features allow the behavior to be tailored to a particular situation. [Table 6](#) summarizes the options now available for choosing when the index is updated.

Table 6 Index Update Options

sync_type	Index is flushed to tape	Potential benefits	Potential downsides
umount	When a volume is unmounted (default LTFS v1.0.0 behavior)	Minimal capacity overhead No impact on performance	Exposure to risk of power fails during writing
time@n	Every n minutes during writing (default LTFS behavior from v1.2.0, n=5)	Exposure to risk of power fails is limited to the last n minutes	Some capacity overhead since the index is written more frequently Negligible impact on performance
close	When any file opened for writing is closed	Exposure to risk of power fails is limited to a single file (more if several processes are writing to different files concurrently)	Greater capacity and performance overhead, especially if writing small files

File Permissions

The Quantum LTFS application manages a common set of file permissions for all files and users; file and directory ownership is not recorded to tape media.

- The only permission that is tracked is write-protect information.
- Files or directories that are write-protected will have permission bits set to 555; write-enabled files and directories have permission set to 777.
- By default the user and group information is set to that of the current user; this can be overridden by use of the `-o uid` and `-o gid` options to the LTFS application.

File Types

The Quantum LTFS application does not support the creation of symbolic links or hard links within the tape file system. Attempting to create a link or copy a link to tape will result in a Function not implemented error. If using the `cp` command to copy to tape, the `-L` option may be helpful to follow symlinks.

The Quantum LTFS application also does not support creation of special files and will report Function not implemented.

File Names

To maintain compatibility when copying files between multiple platforms, it is strongly recommended that the following characters should not be used in Quantum LTFS for file names, directory names, or extended attributes: * ? < > : " | / \

Limitations

Limitations include:

- When the tape cartridge is almost full, further write operations will be prevented. The free space on the tape (e.g. from the `df` command) will indicate that there is still some capacity available, but that is reserved for updating the index when the tape is unmounted.
- Future mounts of a cartridge that is almost full (has passed the point at which "early warning" is reported) will mount as Read Only, to prevent further modifications which may not fit on tape. This status is cleared when a cartridge is reformatted (using `mkltfs`) or when the volume is rolled back, erasing history (using `ltfsck`).

MAC OS X only

LTFS does not support moving a folder within LTFS. Any attempt to move a folder in such a manner will result in an operation not permitted error, and the operation will be ignored. The user can still move a file within LTFS, and the user can also move a folder from LTFS to non-LTFS file system or vice versa.

Mac OS X's Spotlight will not display the files on LTFS as a result of search.

Troubleshooting

This section provides the following information:

- [General](#)
- [Shared Libraries](#)

General

If problems occur during Quantum LTFS operation, entries may be made in the system log (e.g., `/var/log/messages` on Red Hat systems). Check for entries made with the service name "ltfs."

`ltfs` and `mkltfs` all have command line options to report further details of the operations undertaken, which may be of assistance when trying to troubleshoot problems.

If there is a problem with drive interaction, Quantum LTFS will attempt to create a snapshot of the drive internal state at the time of failure.

On Linux systems: this will be stored in the system log directory (e.g. `/var/log`).

On Mac OS X systems: the snapshots are stored in the directory `~/Library/Logs/LTFS/`.

Note: Mac OS X version 10.7 (Lion) and later by default hides the user Library folder (`/Users/ {username}/Library` or `~/Library`) and thus is not displayed in Mac OS X Finder or by any other terminal command which lists folder contents.

There are several methods to display the user Library:

- 1 For quick and temporary access to the user Library folder, in Finder select "Go", "Go to Folder" (or use (Command+Shift+G) and enter "~/Library."
- 2 For permanent access to the user Library folder, enter the terminal command "**chflags nohidden ~/Library**"
- 3 Enter the terminal command "**open ~/Library**" which will access and display the user Library folder via Finder

These files are not otherwise used by Quantum LTFS and they may safely be removed from the system, if they are not needed for troubleshooting.

Shared Libraries

On some systems, trying to execute the **ltfs** and **mkltfs** commands may result in an error message of the form **libltfs.so.0: cannot open shared object file: No such file or directory.**

To resolve this, it is necessary to tell the linker/loader how to locate the required dynamic library files.

There are several ways of doing this:

Add **/usr/local/lib/** to the environment variable **LD_LIBRARY_PATH**, or (As root) Add **/usr/local/lib/** to the file **/etc/ld.so.conf**, and then execute **/sbin/ldconfig**

Refer to the man pages for **ld.so** and **ldconfig** for further details.

Similar error messages may occur if one or more required shared libraries are not present on the system, or are present but at the wrong revision.

Drive Connection

The Quantum LTFS application requires that the LTO-5 or later tape drive is powered up and properly connected to the system. Issue the following command to verify:

For Linux:

```
cat /proc/scsi/sg/device_strs
```

For Mac OS X:

Use the **Mac OS X System Profiler** utility to check LTO tape drives connected to your SAS controller.

If a LTO drive is not properly connected, check the power status and cabling from the SAS connector to the LTO drive. Quantum LTFS will not be able to operate until a LTO-5 or later drive is detected.

Using Quantum LTFS to Check the Cartridge

Every time a cartridge is mounted onto the system, the Quantum LTFS application will perform a consistency check to ensure that the index information is accurate and up-to-date with the data on the tape. If for some reason there is a problem, the mount operation will fail.

In order to recover the tape to a consistent state, the **ltfsck** utility may be used to check and repair the LTFS volume. The options to **ltfsck** are shown below; the only required parameter is the device name (e.g. **/dev/sg0** on Linux) but the behavior of **ltfsck** can be controlled through the following:

Usage: **ltfsck <options>filesys** where **filesys** is the device file for the tape drive

[Table 7](#) provides **ltfsck** options.

Table 7 **ltfsck** Options

ltfsck Option	Explanation
-g<generation> OR --generation=<generation>	Specify the generation to roll back
-r OR --rollback	Rollback to the point specified by -g
-n OR --no-rollback	Do not roll back, just verify the point specified by -g (default)
-f OR --full-recovery	Recover extra data blocks into directory <code>_lufs_lostandfound</code>
-z OR --deep-recovery	Recover cartridge which has EOD missing. Note 1: Some blocks may be erased, but can recover to a final unmount point which has an index version "2.0.0" or earlier. <ul style="list-style-type: none"> Data written to tape before the final un-mount point still can be recovered. Blocks that were written when power to the drive was lost however, are not recoverable. Note 2: The -z (or -deep-recovery) option is applicable to drive firmware later than V30857000. <ul style="list-style-type: none"> This option requires index information from cartridge memory (CM) to recover as much data as possible. CM corruptions can prevent the successful completion of this option.
-l OR --list-rollbackpoints	List rollback points
-m OR --full-index info	Display full index information (effective only for -l option).
-v OR --traverse=<strategy>	Set traverse mode for listing roll back points. Strategy should be forward or backward (default: backward).

Ltfscck Option	Explanation
-j OR --erase-history	Erase history at rollback. <ul style="list-style-type: none">• If the -j option is utilized, the ltfsck command erases all index files and appended data up to the designated rollback to generation.• Data newer than this generation cannot be recovered.• If the -j option is not utilized, any existing generation can be recovered even following a rollback operation.
-k OR --keep-history	Keep history at rollback (Rollback)
-q OR --quiet	Suppress informational messages
-t OR --trace	Enable diagnostic output
-h OR --help	This help
-p OR --advanced-help	Advanced help option
--syslogtrace	Enable diagnostic output to stderr and syslog
-V	Version information

Frequently Asked Questions

This section provides answers to frequently asked questions for Quantum LTFs.

Q: How do I get Quantum LTFs?

A: All application downloads and documentation are available from the website at: www.quantum.com/LTFs

Q: What are the minimum system requirements?

A: Any server that fulfills the needs of the supported configurations detailed in:

- [Linux Installation and Configuration](#) on page 4 and
- [Mac OS X Installation and Configuration](#) on page 6.

Q: Does Quantum LTFs support DDS/DAT devices?

A: No. The application will only work with LTO drives.

Q: Does Quantum LTFs support non-Quantum tape drives?

A: Quantum's version of LTFs has been validated to work with both the Quantum and HP LTO-5 and LTO-6 drives.

- Quantum's LTFs also recognizes other LTO vendor's LTO-5 and LTO-6 drives although Quantum does not perform complete testing on these drives.
- Quantum's technical support is only equipped to provide support for Quantum LTFs using the Quantum drive.

Q: Why doesn't Quantum LTFS work with my LTO-4 or earlier drives?

A: Quantum LTFS relies on a drive feature called partitioning, which was added to the LTO-5 format. It is not part of the LTO-4 or earlier tape formats and they cannot be used.

Q: Can I use LTO-4 media in my LTO-5 or LTO-6 drive?

A: The LTO-5 drives can load, read and write LTO-4 media and LTO-6 drives can load and read (but not write) LTO-4 media. However, the LTO-4 format does not support partitioning. Therefore, LTO-4 media cannot be used with Quantum LTFS.

Q: Can I use WORM media with Quantum LTFS?

A: No, WORM media cannot be partitioned and so is not usable with Quantum LTFS.

Q: Can I uninstall Quantum LTFS?

A: Yes.

- **Linux:**
 - Use the following command in a terminal window:
 - `$ rpm -e qtmLtfS`

Mac OS:

- Delete the tree under `/Library/Frameworks/LTFS.framework`.
- To also delete the ICU package, delete the tree under `/Library/Frameworks/ICU.framework`.

Q: Where do I go if I have a problem?

A: For most common issues, see [Troubleshooting](#) on page 26. If this does not address the issue, call Quantum support.

Q: Does Quantum LTFS replace my existing backup software?

A: In most cases Quantum recommends that you continue to use your existing backup application. Quantum LTFS provides a good method of storing and transporting large files but is not generally a direct replacement for a backup application.

Q: Is source code available for Quantum LTFS?

A: Yes, full source code is released under the terms of the 3 Clause BSD license and can be downloaded from www.quantum.com/LTFS.

However Quantum is not equipped to support customers who choose to download and build their own versions of the Quantum LTFS application.

Q: How do I verify that Mac OS X is running with a 32-bit kernel?

A: From a terminal window, issue the following command:

- `$ uname -a`
- The command response should indicate `i386`, not `x86_64`.

Q: How do I modify Mac OS X to boot with a 32-bit kernel?

A: From a terminal window, issue the following command:

- **\$ sudo systemsetup -setkernelbootarchitecture i386**
- Reboot the system.
- From a terminal window, issue the following command:
- **\$ uname -a**
- The command response should indicate **i386**, not **x86_64**.

Q: Under what conditions is LTFS log file not created and updated?

A: The LTFS log file may not be created and warning messages issued in either of the following cases:

- The LTFS process does not have write permission for the log directory.
Resolution: Run **ltfs** as root or use the **log_directory** option to specify a directory for which the **ltfs** process does have the required write permissions
- The log directory does not exist.
Resolution: Create the default log directory or use the **log_directory** option to specify a directory for which the **ltfs** process does have the required write permissions

Q: The LTFS process will not start?

A: LTFS requires that a LTO-5 or later tape drive is powered on and properly connected to the system before it will start LTFS.

Contacting Quantum

More information about this product is available on the Service and Support website at <http://www.quantum.com/ServiceandSupport/Index.aspx>. The Service and Support Website contains a collection of information, including answers to frequently asked questions (FAQs). You can also access software, firmware, and drivers through this site.

For further assistance, or if training is desired, contact the Quantum Customer Support Center:

United States	1-800-284-5101 (toll free) +1-720-249-5700
EMEA	+800-7826-8888 (toll free) +49-6131-3241-1164
APAC	+800-7826-8887 (toll free) +603-7953-3010

For worldwide support:

<http://www.quantum.com/ServiceandSupport/Index.aspx>

