



Quantum LTFS (Linear Tape File System) User Guide

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Introduction

This guide provides information about Quantum Linear Tape File System (Quantum 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.

Note: A firmware update may be required. Quantum LTFS will check and tell you if your tape drive needs updating. Firmware revision V3082 or greater is required.

Features

Quantum LTFS includes the following features:

- Provides all you need to use LTO-5 tape media like a disk
- Based on open source software, subject to EULA terms and LGPL 2.1 requirements
- Precompiled application versions provided for supported platforms
- Full source code available
- Supported on Linux® and Mac OS® X

Benefits

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

- **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 the Quantum LTFS application can be exchanged more easily between users working in different operating systems, using different software and in different locations.
- **A single storage media standard.** Unify organization-wide file sharing with Quantum LTO-5. 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

The 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, and therefore there are some best practices to follow to ensure satisfactory performance and a good user experience.

- 1 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.
- 2 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).
- 3 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 streaming large files to/from tape.
- 4 The Quantum LTFS application will work in conjunction with graphical file explorer programs such as Nautilus (on Linux). 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.
- 5 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.
- 6 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.
- 7 Quantum LTO 5 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.

Architecture

Quantum LTFS is a user space application, making use of the FUSE kernel mode subsystem included in Linux systems. On the Apple® Mac OS platform it uses the MacFUSE module.

Supported configurations

Quantum LTFS supports:

- LTO-5 Tape Drives with SAS interfaces
- Red Hat EL 5 Update 4 x86 or later
- Red Hat EL 5 Update 4 x64 or later
- SUSE Linux Enterprise SP1 x86 or later

- SUSE Linux Enterprise SP1 x64 or later
- Mac OS X 10.6 (Snow Leopard) 32-bit kernel mode

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 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 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. XTalk is not supported under Mac OS.

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
```

* 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.

For SLES 11:

The required FUSE packages are fuse and libfuse2, version 2.7 or later.

* 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:

qtmltfs-x.x.x-x.i386.rpm (32-bit), or

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

For SLES:

qtmltfs-x.x.x-x.i586.rpm (32-bit), or

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](#) on page 8 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 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 MacFUSE kernel module
- 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 that the MacFUSE module version 2.0.3,2 is present and loaded.

If the module is not present on your system, you must first obtain and install it. FUSE may be downloaded from the following location:

<http://code.google.com/p/macfuse/>

Mount and open the Apple disk image (.dmg) file. Double-click the enclosed package (.pkg) file to install the module.

- 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 open the Quantum LTFS source disk image:

qtmltfs-x.x.x.src.dmg

The following files are included in the disk image:

qtmltfs-x.x.x.tar.gz

icu4c-x.x.x-src.tar.gz

icu-license.html

Unpack the qtmltfs-x.x.x.tar.gz archive to a local folder and then follow the instructions in /doc/BUILDING.macosx.

- 4 To use precompiled utilities, download the file:

qtmltfs-x.x.x.dmg

- 5 Open the binary disk image by double clicking on it in a Finder window. The disk image contains the Snow Leopard (Mac OS 10.6) installation package, qtmltfs-x.x.x.pkg as well as the following support file:

ICUFramework-4.0.1.pkg

- 6 Install the ICU package first by double-clicking on the file ICUFramework-4.0.1.pkg and following the instructions.

Now install the LTFS package by double-clicking on the file **qtmltfs-x.x.x.pkg** and following the instructions.

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

- 7 Quantum LTFS is now installed. See [Using Quantum LTFS](#) on page 8 for the next steps.

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.

Using Quantum LTFS

How to use LTFS

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:

e.g., for Linux:

```
$ mklts -d /dev/st0
```

e.g., for Mac OS X:

```
$ 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.

Linux example - \$ mklfts -d /dev/st0 -f

Mac OSx example: \$ mklfts -d 0 -f

mklfts Options

-d<name> OR --device=<name>	Tape device (required). For Linux use the device name such as /dev/st0. For MacOS X, use the instance number of the tape drive, assigned sequentially by the system starting from 0.
-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]>	Rules for choosing files to write to the index partition. The syntax of the rule argument is: 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). 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).
-o OR --no-override	Disallow mount-time data placement policy changes
-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.

3 Mount the formatted tape cartridge

```
$ mkdir /mnt/lto5
$ ltfs /mnt/lto5
```

Note: Some operating systems require creating each folder or subfolder in separate commands. For example:

```
$ mkdir /mnt
$ cd /mnt
$ mkdir lto5
$ cd lto5
```

ltfs Options:

-o devname=<dev>	Tape device (required if not using the default device: /dev/ st0 for Linux, 0 for Mac OS)
-o work_directory=<dir>	LTFS work directory (default: /tmp/ltfs/)
-o trace	Enable function call tracing (only useful for debugging)
-o eject	Ejects the cartridge after an unmount command.
-o sync_type=<type>	Specify sync type (default: time@5) <type> should be specified as follows time@min: LTFS attempts to write an index each min minutes. Min should be the decimal number from 1 to 15372286728912 (default: min=5). 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 sync_type 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.
-o force_mount_no_eod	Skips eod existence check when mounting (read only mount). Only use for a CM corrupted medium.
-a	Advanced help, including standard FUSE options
-V	Output version information and exit

<code>-h</code> OR <code>--help</code>	Display this help and exit
<code>-o umask=M</code>	Set file permissions (octal)
<code>-o uid=N</code>	Set file owner
<code>-o gid=N</code>	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 prepares for eject.

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

or

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

Note: fusermount is only available on Linux.

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.

Usage details

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

- 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

- The `ltfs` program will currently always run in the foreground (equivalent to passing `-f` option). This is done automatically and may be changed in future releases.
- 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

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".

Both `ltfs` and `mkltfs` 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/`) and will take the form `ltfs_datestamp_timestamp_driveSerialNum.svm`.
- On Mac OS X systems: the snapshots are stored in the directory `~/Library/Logs/LTFS/`.

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 `mklts` 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.

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/st0` 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

<code>-g<generation></code> OR <code>--generation=<generation></code>	Specify the generation to roll back
<code>-t<time></code> OR <code>--time=<time></code>	Specify the time to rollback. Time value should be "yyyy-mm-dd HH:MM:SS.nanosec"
<code>-r</code> OR <code>--rollback</code>	Rollback to the point specified by <code>-g</code> or <code>-t</code>
<code>-n</code> OR <code>--no-rollback</code>	Do not roll back, just verify the point specified by <code>-g</code> or <code>-t</code> (default)
<code>-f</code> OR <code>--full-recovery</code>	Recover extra data blocks into directory <code>_ltfs_lostandfound</code>
<code>-z</code> OR <code>--deep-recovery</code>	Recover cartridge which has EOD missing. NOTE: Some blocks may be erased, but can recover to a final unmount point which has an index version "2.0.0" or earlier. Data written to tape before the final unmount point still can be recovered. Blocks that were written when power to the drive was lost however, are not recoverable. Note that the <code>-z</code> (or <code>-deep-recovery</code>) option is applicable to drive firmware later than V30857000. 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.
<code>-l</code> OR <code>--list-rollback-points</code>	List rollback points
<code>-j</code> OR <code>--erase-history</code>	Erase history at rollback. If the <code>-j</code> option is utilized, the <code>ltfsck</code> 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 <code>-j</code> option is not utilized, any existing generation can be recovered even following a rollback operation.
<code>-k</code> OR <code>--keep-history</code>	Keep history at rollback (Rollback)
<code>-q</code> OR <code>--quiet</code>	Suppress informational messages
<code>-a</code> OR <code>--trace</code>	Enable function call tracing
<code>-h</code> OR <code>--help</code>	This help

Frequently asked questions

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 [Supported configurations](#) on page 4.

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 drives. Quantum's LTFS also recognizes other LTO vendor's LTO-5 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 drive?

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

Q: Can I use LTO-5 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 qtm1tfs
```

Mac OS X: 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 12. 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 LGPL 2.1 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: Why doesn't Quantum LTFS work on Mac OS X with a 64-bit kernel?

A: Quantum LTFS utilizes MacFUSE. MacFUSE currently does not support a 64-bit operating system.

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**.

Contacting Quantum

More information about this product is available on the Service and Support website at www.quantum.com/support. The Service and Support Website contains a collection of information, including answers to frequently asked questions (FAQs).

For further assistance, or if training is desired, contact Quantum:

United States	800-284-5101 (toll free) 949-725-2100
EMEA	00800-4-782-6886 (toll free) +49 6131 3241 1164
APAC	+800 7826 8887 (toll free) +603 7953 3010
For additional contact information:	www.quantum.com/support

To open a Service Request:

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