Tape Best Practice:
A Quantum White Paper

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Overview

The advantages of tape storage in power consumption, carbon footprint and cooling requirements are providing good reasons beyond its traditional values of cost per TB, longevity and portability to reconsider this mature technology. Tape has become unfashionable as cost of SATA disk and now de-duplicated disk provide attractive acquisition costs, improved reliability and simpler management. But tape still has a role in long term, cost effective storage in most organisations, and if reliability and management expectations can be realised, tape becomes a very attractive, environmentally efficient final storage tier. This white paper explores best practice for the handling of tape media and management of tape environments in order to maximise reliability and to minimise management overheads.

Media handling and storage

There are a few simple rules to follow in the physical handling, storage and transportation of tape media that will assist greatly in its long term reliability:

- Keep cartridges in protective case and store vertically when not in use.
- Ensure that no loose labels in the storage container stick to the cartridge.
- Never touch the tape or tape leader. Do not open cartridge doors.
- Avoid direct sunlight.
- Use the finger grips (moulded to the side of the cartridges) when handling cartridges.
- Protect cartridges from dust, shock, vibration, moisture and magnetic fields.

Ensure that all operators are trained to handle tape media and encourage honesty in dealing with accidents. The cost of scrapping a box of cartridges is considerably less than the cost of data loss.
New media acceptance

All new tape media should be inspected prior to acceptance and use. Specifically any media where there is evidence of damage to packaging or extreme conditions during transportation should be rejected. Cartridges should remain boxed until ready for use and should not be unpacked in a goods staging area.

Physical cartridge handling

As a removable media, tape cartridges provide great benefits in their portability and scalability of storage capacity – the incremental cost of 1.6TB of storage on LTO-4 media is the cost of the cartridge and the cost of shelf space. Removable media though, is susceptible by its nature to mishandling, physical damage, environmental conditions and loss. One simple way to minimise risk from these factors is to permanently contain tape media within a tape library in a controlled environment. In this case, movement of data off site for disaster recovery must then be achieved by replication over networks. Once a very expensive proposition, de-duplication technology has reduced necessary bandwidths for replication by up to 50 times making it a far more affordable practical proposition for business of all sizes. Physical tape movement is still an essential part of many organisations DR or archiving strategy and so it is important to follow some simple procedures to minimise risk of damage to tape media.

Dropped cartridges

If a cartridge is dropped more than 1 meter, damage can occur that it not visible on a simple external inspection. If a cartridge is dropped:

- If damage is present – do not insert cartridge in a tape drive, discard the tape or seek advice in recovering the data from it.
- If cartridge appears undamaged – transfer data to a new cartridge and discard the old one.

Media write protect switch

The cartridge write protect switch prevents overwrite or erasure of data by a tape drive. You can change the position of the write protect switch at any time.
Environment

Tape media has different limits for acceptable temperature and humidity levels for transportation, non-archival and archival storage. Archival storage is where the same data is intended to be stored on the piece of media for greater than one year. Following transportation, tape cartridges should be allowed to acclimatise to their new environment for at least 24 hours.

<table>
<thead>
<tr>
<th>MEDIA TYPE</th>
<th>MEDIA USE</th>
<th>PROPER CONDITIONS</th>
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</table>
| DLTtape    | Transportation | • Between -23° to 49° C  
| Super DLTtape | • Between 5% and 80% relative humidity, non condensing |
| Ultrium LTO | Non-archival storage | • Between -16° to 32° C  
|            | • Between 20% and 80% relative humidity, non condensing |
|            | Archival storage (greater than 1 year) | • 23° ± 5° C  
|            | • Between 40% and 60% relative humidity, non condensing |

Drive cleaning

Tape drive manufacturers recommend that drives are periodically cleaned with an approved cleaning cartridge according to the specific instructions for that drive. Failure to clean tape drives can cause build up of deposits on the tape drive heads and cause recording or reading errors. Drive cleaning will be requested by the drive, by the tape library hosting the drive or can be automated from the backup application. The preferred method for indication that the drive needs cleaning is a message generated by the drive itself; this ensures that over-cleaning does not occur, which can also damage the drive head.

Tape durability

Modern tape drives have multiple protective mechanisms for ensuring that data is written or read from tape despite errors caused by worn, damaged tapes or by dirt on drive head. Tape drives will correct data, attempt re-writes or reads and even move data to different parts of the tape before giving up and reporting a permanent write or more seriously, permanent read error. Permanent errors can be avoided by following guidelines for physical tape management and by restricting usage of tape media within specified limits. The limits of tape cartridge use are defined as media passes and load/unload cycles.
Media passes

Media durability is sometimes specified as a number of passes on the number of times the tape can be passed over a tape drive head. A typical specification may warrant over 1,000,000 passes but linear tape technologies employ multiple track sets and will pass the tape over the drive head many times for each full write or read of the cartridge. A more useful measure is full tape uses, which if exceeded will result in a rise in the soft error count (recoverable) and eventually will result in a permanent error.

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Full Tape Uses Specification</th>
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<tbody>
<tr>
<td>DLT, DLT VS, DLT V</td>
<td>Up to 200</td>
</tr>
<tr>
<td>Super DLT, DLT S</td>
<td>Up to 260</td>
</tr>
<tr>
<td>LTO Ultrium</td>
<td>Up to 260</td>
</tr>
</tbody>
</table>

Quantum iPlatform tape libraries have sophisticated advanced functionality which tracks tape errors and can predict likely permanent errors and failure of media. The Advanced Reporting software license option of the Scalar i2000 takes this one step further providing reporting tools to enable administrators to view trends in errors on cartridges and discriminate between media and drive issues likely to cause problems. By identifying media degradation before any loss of data occurs, this functionality can considerably improve backup reliability and simplify management. It can reduce media costs as media replacement cycles can be based on accurate data on quality rather than rough usage estimates. In any tape storage system, media costs are significant and can exceed the cost of hardware over a 3 year period.

Media load and unload cycles

Tape media will also have a specified maximum number of load and unload cycles, one cycle being a load and eject from a tape drive. A typical load/unload specification for LTO media is 20,000 cycles. When used once per day this would equate to 54.79 years use. So for backup applications, even allowing for restore operations it is unlikely that the specification will be exceeded. Greater consideration has to be taken for load/unload cycles in HSM or nearline applications where tapes are mounted far more frequently.
Data protection environment

Reliability, manageability and performance of tape based data protection environments can be significantly enhanced by use of data protection environment management tools such as Quantum’s StorageCare Vision. StorageCare Vision enables management of an entire data protection environment from a single screen, the benefits of which include: reduced management costs, enhanced data availability and reduced backup windows.

Management of the entire environment from a single screen speeds up fault reporting and root cause analysis, provides comprehensive reporting for tuning the backup environment and even enables charge back and compliance management.
Dos and don'ts

<table>
<thead>
<tr>
<th>Tape Best Practice Dos</th>
<th>Tape Best Practice Don’ts</th>
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<tbody>
<tr>
<td><strong>STORAGE</strong></td>
<td></td>
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<tr>
<td>Store cartridges in their protective casings</td>
<td>Don’t expose to direct sunlight, magnetic fields, extreme temperature and humidity.</td>
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<tr>
<td><strong>HANDLING</strong></td>
<td></td>
</tr>
<tr>
<td>Handle cartridges with care</td>
<td>Don’t touch media or leader with bare fingers</td>
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<tr>
<td>Use the right label for your cartridge</td>
<td>Don’t open cartridge door</td>
</tr>
<tr>
<td>Inspect new media.</td>
<td>Don’t drop more than 1 meter</td>
</tr>
<tr>
<td><strong>USAGE</strong></td>
<td></td>
</tr>
<tr>
<td>Before using new previously stored cartridges, allow at least 24 hours for acclimatisation</td>
<td>Exceed full media use specification</td>
</tr>
<tr>
<td>Unload cartridges prior to powering down drives</td>
<td>Exceed tape load/unload cycle specifications</td>
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<tr>
<td>Clean drives according to manufacturer’s schedule with approved cleaning cartridge</td>
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<tr>
<td>Use media write protection switch</td>
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<tr>
<td>Maintain specified temperature and humidity limits</td>
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<tr>
<td><strong>MANAGEMENT</strong></td>
<td></td>
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<tr>
<td>Use media error reporting tools such as iPlatform and Advanced Reporting</td>
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<tr>
<td>Use data protection environment management tools such as StorageCare Vision.</td>
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Further information

**STORAGE CARE VISION**
http://www.quantum.com/Products/Software/Storagecarevision/Index.aspx

**QUANTUM SCALAR I2000**

**QUANTUM SCALAR I500**
http://www.quantum.com/Products/TapeLibraries/ScalarI500/Index.aspx

To receive a copy of Quantum’s Media Care Guide please email info-uk@quantum.com

For contact and product information, visit quantum.com or call +44 (0) 1344-353500

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Quantum Corp. (NYSE:QTM) is the leading global storage company specializing in backup, recovery, and archives. Combining focused expertise, customer-driven innovation, and platform independence, Quantum provides a comprehensive range of disk, tape, media, and software solutions supported by a world-class sales and service organization. As a long-standing and trusted partner, the company works closely with a broad network of resellers, OEMs and other suppliers to meet customers’ evolving data protection needs.