

Quantum's Guide To
PROTECTING YOUR DATA

b a c k u p

a r c h i v e

r e c o v e r y

Quantum[™]
CAPACITY FOR THE EXTRAORDINARY[™]

*“Quantum offers a
DLTtape™ system and
a growth path that
will meet your backup
needs today and in
the future.”*

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Your Most Valuable Business Asset

Your most valuable asset is your *DATA*. Access to data is what you depend on to run your business. Without it, people are nonproductive, your network is inoperable, and often your business is at risk. It could be said that the success of your company rests in your ability to keep data accessible and protected from loss. This notion implies that a business' success rests in the hands of its storage media. Many efforts have been made to scale the value of data. Here are some typical benchmarks that put the value of data in perspective.

\$50,000 per MB

To re-create

\$18,000 per hour

In downtime cost for PC LANs

\$75,000 per hour

In downtime cost for UNIX networks

To protect your most valuable asset, you need a good backup, archive, recovery, and storage plan.



b a c k u

Protecting Your Data

BACKUP

is the process of making a redundant copy of disk storage, allowing file and system recovery. A variety of file versions is necessary to ensure that you are able to restore the most recent usable copy of the data required. Creating this history can be achieved by using proper media rotation schemes, such as Grandfather-Father-Son or Tower of Hanoi.

ARCHIVE

means to copy disk file systems and to place the copy (usually on tape) into long-term storage. Archives create a legally acceptable business history. Archives can also be used to free up hard disk space by allowing you to create an off-line version of static data or files and delete the on-line copy. If needed, this data can be restored from tape.

DISASTER RECOVERY

is the process of recovering from a site-level outage or disaster. In “remote vaulting,” backup media is taken off-site (daily is best) and stored in a secure location as part of the tape rotation scheme. This off-site media is available for system recovery if the on-site data is lost or damaged in a disaster.

STORAGE

is not restricted to hard disk. Reference data, customer records, drawing sets, pre-press images and publications, and similar batch-oriented data types are often more efficiently stored “near-line” on tape. The portable nature of removable media has many benefits to these types of applications. For application data storage, a high transfer rate is essential for maintaining user productivity.



Backup Program

A single layer of data redundancy has proven to be inadequate. If it were adequate, we would all just make another disk copy of our files and be done with it. Backup was created as a data protection and availability process to fill the gap. With any backup program, multiple copies of files are created on inexpensive media, allowing for short-term data protection, recovery versions, and long-term archive.

Quantum's DLTtape system (drive and cartridge) has become the backup solution of choice for many network applications, especially those considered business critical. The performance, scalability and reliability of the DLTtape system fits well with all backup programs.

Successful operation of a backup program needs to consider these points:

Fundamentally you are operating a recovery system, not a "write-once, read-never" process. Everything in the backup process has to be centered on reliable recovery, from drive and media technology, quality and reliability of media, and care and handling of media, to read verification testing of the backed-up data. Do not take shortcuts with your important backup data.

A single copy or even copies on a single piece of media is inadequate. Remember that the purpose of backup is to protect against disaster, data loss, damage, or deletion of the primary on-line copy. Backup also provides version history of files so that prior work can be recovered. It takes many copies of files stored on separate pieces of media to fully ensure that each of these requirements can be met reliably. The costs of re-creating data are extremely high. Why expose your company to these risks, when they can be avoided by using an adequate media rotation schedule?

No backup strategy is complete without off-site storage of some of the media in the backup rotation cycle. These extra backup copies serve many purposes, including disaster recovery, archive, and version histories. Storing your backup tapes with your servers does not adequately protect your business. If your site experiences physical damage, such as a fire or water damage, you run the risk of losing both your on-line data and your backup copies. Simply by storing backup tapes off-site, you can protect yourself from this danger.

Use a robust backup application to streamline management of the backup process.

This streamlining is especially important in a network environment where multiple servers and many workstations are under management. Because of the complexity and lack of automation in a manually run backup system, the responsibility for backup cannot be delegated to workgroups or an operator, but must remain with the network manager. Backup administrative labor costs can run anywhere from tens of thousands of dollars per year to hundreds of thousands depending on the size of the company.

Tape backup is the traditional data protection process. However, backup is conducted in many different ways utilizing many different software applications and user-written scripts. The common thread is how media is handled and rotated to create multiple redundant copies in addition to versions of files as they change and evolve throughout their life cycle.

Recommendations for Backup

- Verify that your backup data can be recovered.
- Create a version history.
- Store backup copies off-site.
- Have a management system in place.

*“Do not take
shortcuts with
your important
backup data.”*

Backup Rotation Schemes

A good tape rotation schedule is vital to ensure data recovery. The best rotation schedule is one that provides you with a long and varied history of file versions. Media not in active use should be stored in a secure, off-site location. Following are descriptions of two popular rotation schedules. Both provide a great depth of file versions and are offered as configurable backup patterns by most backup application software.

Sites using a Tape-a-Day scheme, in which one tape or a limited set of tapes are repeatedly reused for backup, are doing themselves a disservice. By writing over the last backup, the history of file versions is destroyed. If last week's version of a file is required, these sites simply cannot restore it. Instead, they must re-create the data. This type of media usage is common at sites using scripts for backup. Tape-a-Day is inadequate for a comprehensive backup and archive program. Instead, we recommend that you use the Grandfather-Father-Son rotation schedule.

Grandfather-Father-Son

The most commonly used media rotation schedule is "Grandfather-Father-Son." This scheme uses daily (Son), weekly (Father), and monthly (Grandfather) backup sets. Four backup media are labeled for the day of the week each backs up; for example, Monday through Thursday. Typically, incremental backups are performed on the "Son" group of media. This media is reused each week on the day matching its label. A set of up to five weekly backup media is labeled "Week1," "Week2," and so on. Full backups are recorded weekly, on the day that a "Son" media is not used. This "Father" media is reused monthly. The final set of three media is labeled "Month1," "Month2,"

Grandfather-Father-Son Media Rotation Schedule

The white squares represent the most recent backups while the shaded squares represent previous backups. Only the daily tapes have been reused. Note that the weekly backup is performed on Fridays.

Month 1				
Mon	Tues	Wed	Thurs	Fri
				W1
				W2
				W3
		Wed	Thurs	W4
Mon	Tues	Month 1		

and so on, according to which month of the quarter they will be used. This “Grandfather” media records full backups on the last business day of each month and is reused quarterly. Each of these “media” may be a single tape or a set of tapes, depending on the amount of data to back up. A total of 12 media sets are required for this basic rotation scheme, allowing for a history of two to three months. Because a longer history is often required, archive tapes are periodically pulled from the rotation and replaced with new tapes.

Tower of Hanoi

The Tower of Hanoi rotation scheme is also widely used. In this schedule, one media set “A” is used every other backup session (daily sessions in this example). Start Day 1 with “A” and repeat every other backup (every other day). The next media set “B” starts on the first non-“A” backup day and repeats every fourth backup session. Media set “C” starts on the first non-“A” or non-“B” backup day and repeats every eighth session. Media set “D” starts on the first non-“A,” non-“B,” or non-“C” backup day and repeats every sixteenth session. Media set “E” alternates with media set “D.”

With each additional media set added to the rotation scheme, the backup history doubles. The frequently used media sets have the most recent copies of a file, while less frequently used media retain older versions. This schedule can be used in either a daily or weekly rotation scheme. The decision regarding the frequency of rotation should be based on the volume of data traffic. To maintain the required history of file versions, a minimum of five media sets should be used in the weekly rotation schedule, or eight for a daily rotation scheme. As with the Grandfather-Father-Son rotation scheme, tapes should be periodically removed from the rotation for archive purposes.

*Tower of Hanoi
Media Rotation Schedule*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Media Set	A		A		A		A		A		A		A		A	
		B				B				B				B		
			C									C				
							D									
																E

Archive Program

While data may be kept for years, you shouldn't keep data on the same media for years without a media and data management infrastructure. Don't just pretend to have an archive program. Having one is critical to your business health, as well as essential for legal reasons. Think of archive as an additional data protection program in the same way as you save tax records, only even more important. Because of the importance of this program, don't be fooled into thinking that backup gives you all the secure archive media you need. You need long-term archived media in *addition* to routine backup.

The distinction between data in archive and media in archive is important. Multiple copies of data on a single piece of media leaves that data at risk. Data security is achieved only through media redundancy on reliable media. The foremost principle is that the quality of media used should always be suitable for the data application. With its long shelf life, high capacity, and durability, DLTtape media is an excellent choice for archiving.

Most backup applications can create media suitable for archive; either the backup tapes themselves can be retained long-term for archive, or special archive tapes can be created using an "export" function. The negative side of using a backup application for long-term archive is that the media is recorded in a proprietary logical format readable only by the originating application. True long-term archive would also require archiving the entire backup system (computer, recording hardware, and software) as well as the media (and in multiple copies). The alternative is to use a backup or archive application that is capable of writing in an industry-standard format such as "tar," "cpio," "UDF," "MTF," or "SIDE." Even then, the recording drives need to be archived as well. Don't forget this element. A unique factor with Quantum's DLTtape system is the backward-read compatibility. New-generation drives can read media recorded on older drives.

It is also appropriate to see archive as a hierarchy of media that is generated by different processes working in concert. Backup creates short-term media. When coupled with data removed from active storage via hierarchical storage management (HSM) or explicit archive grooming, it is considered medium-term archive. Long-term archive forms a legal record.

SHORT-TERM ARCHIVE

located on active media that backed up the live system. This archive includes data interchange and export data.

MEDIUM-TERM ARCHIVE

located on media that is stored away from the system to free up storage space on the system.

LONG-TERM ARCHIVE

located on media that is required to be kept as a master or for historical, legal, financial, and academic purposes.

Standards for Data Retention

The U.S. Internal Revenue Service has recognized the importance of data and information stored on media and has provided tax incentives for users to purchase and administer media management systems. The penalties for companies not maintaining and recovering tax records are severe. The computer user is legally and personally liable for any loss of computer data. A fine of up to \$100,000 U.S. or a five-year prison sentence can be imposed. The Standards for Data Retention vary by application and state. But in general, they range from three years to permanent. Legally, you need to keep redundant copies of business data long term. We recommend you store archive copies of all on-line data, in addition to backups, to ensure compliance with federal and state regulations.

DATA RETENTION STANDARDS

Minimum Records Retention Requirements

Varies by state and specific data type

Business Records	7 years to Permanent
Contracts, Leases, Agreements	7 years to Permanent
Employee and HR Records	3 years
Payroll and Benefits Records	3 to 7 years

Title VII, Federal Discrimination Laws
Fair Labor Standards Act
Age Discrimination in Employment Act of 1967
Americans with Disabilities Act
Title 36, Code of Federal Regulations, Sections 1228 and 1234

Recommendations for Archive

Listed below are recommendations for the archive program that will result in safely protecting your data and giving you long-term success.

- Use the most reliable media available. Your data is an irreplaceable asset, and the cost of loss far outweighs the investment in protection. Mainframe data centers have years of investment in archive technologies.
- Store multiple copies of your valuable data on multiple pieces of media. Redundancy is the only true safeguard.
- For long-term archive, store the recording systems (and all components) as well as the media.
- Consider data to be archived as soon as it is stored on removable media and taken out of the tape system. Treat it with care, paying close attention to proper care and handling procedures.
- Record your archive data using the verification feature in your software, and even then ensure that your recorded data set is readable before assuming you have safely recorded what you need. Reading data is not the same as writing it. Too often, administrators are surprised that data is missing, although it was never recorded properly to begin with.
- Retain archive data for a period of time appropriate to the legal standards for the type of data you are protecting. You may need to retain data permanently.
- Long-term archives need to be stored in a secure, environmentally controlled facility as an extension of your in-house media library or shelf storage.
- Media management and library management procedures should be employed to track all the various media in backup, archive, and disaster recovery roles.
- Periodically inspect archive media for obvious damage or contamination.

Disaster Recovery Program

Whereas backup provides redundancy for recovery of files and disks, a disaster recovery program is the real insurance policy in the data protection world. Disaster recovery uses the media that you hope you will never need, but if you do you will be happy to have. The value of off-site vaulting of disaster recovery media is a “bet your business” event. For example, after the World Trade Center bombing in New York, *more than 50 percent of the businesses that did not have off-site recovery media went out of business.*

If you operate a backup and archive program that utilizes enough media for off-site rotation, you have the basis for a disaster recovery system. All that is required is to ensure that your full system backup media is moved off-site at least weekly. Just as redundant pieces of media are required for local backup and recovery, multiple redundant sets of full system backup are required off-site for disaster recovery. Backup, archive, and disaster recovery activities are tightly related. Backup media can be used for disaster recovery if it is taken off-site regularly. In a mission-critical environment, off-site movement may occur daily. Archive data sets are often generated by the backup program, but the media is retained separately from the backup pool. Archive media, if it is a full system copy, can be used for disaster recovery.

Recommendations for Disaster Recovery

Listed here are recommendations for a disaster recovery program.

- Make sure your off-site storage facility meets the environmental storage requirements for archive defined in the media handling section.
- If you have operations and data vulnerable to loss, move the media off-site daily. Use a service bureau or do it yourself if you have corporate facilities.
- Remote means off-campus, far enough away to not be impacted by the nature of any local disaster. For example, in an earthquake zone such as San Francisco, remote is not Oakland, but perhaps greater than 100 miles away.
- Ensure that you have adequate redundancy in your off-site backup pool for disaster recovery. A single recent backup may not be enough. It is better to have several. Plan this redundancy into your media requirements.
- Periodically retire media holding full backups from the backup pool and retain it for historical version recovery and archive. Place this retirement requirement into your media plan.

Data Storage Program

All three processes discussed (backup, archive, and disaster recovery), as well as storage, consume media independent of each other. It is important to have adequate media to ensure redundancy, reliability, legal compliance, and business continuity insurance.

Applications for tape span traditional backup and archive to near-line application storage. In recent years tape has been relegated to data copy applications, such as backup and archive. Tape meets the requirements for these applications, but its uses do not end there. Consider tape for storage of application data, such as video, CAD/CAM, and imaging files. The low cost per megabyte of tape storage makes tape an economical alternative to on-line storage.

The media calculator at right is a planning tool to assist you in determining your annual media requirements. By completing the form and adding up the right-hand column, you can create a media plan. This planner encourages you to consider all aspects of tape use: backup, archive, disaster recovery, and storage. Compare your current practices and usage against the numbers you calculate here. Remember that you need media both on-site and off-site. Are you adequately protecting your business data?

*“Are you
adequately
protecting
your business
data?”*

Calculating Media Requirements

Backup Tape Requirement

Number of Backup Drives	x	Number of Tapes in a Media Set	x	Number of Sets in a Media Rotation Schedule	x	Number of Rotation Schedules per Year	=	Number of Tapes Required per Year
_____		_____		_____		_____		_____
							=	_____
						<i>Add for retirements</i>		_____

Archive Tape Requirement

Number of Tapes Required to Copy Each Server	x	Number of Servers	x	Number of Archive Sets per Year	=	Number of Tapes Required per Year
_____		_____		_____		_____

Disaster Recovery Requirement

(in addition to off-site backup unless backup rotation tapes are always rotated to a secure off-site location)

Number of Tapes per Server	x	Number of Servers	x	Number of Disaster Recovery Sets per Year	=	Number of Tapes Required per Year
_____		_____		_____		_____

Application Storage Requirements

Number of Tapes per Month	x	Months per Year	=	Number of Tapes Required per Year
_____		_____		_____
		Total Annual Tape Requirements		=====

The Right Media for Protecting Your Data

Today, with the volume of information increasing exponentially, dependable recording and preservation of data is crucial to the successful operation of a corporation. One of the most critical links in this process is the quality of the backup tape itself.

Why Use Quantum DLTtape Cartridges?

The Quantum DLTtape family of half-inch cartridge tapes, designed and formulated specifically for Quantum DLTtape systems and libraries, delivers what you need: proven performance and durability with the highest capacity of any cartridge used in 5.25-inch tape drives – up to 70 GB in compressed mode. Quantum's DLTtape media also gives users protection from data loss resulting from tape wear. DLTtape media provides industry-leading performance and reliability through comprehensive statistical process control.

Quantum's DLTtape system technology offers the highest capacity, performance, and reliability when compared with 8mm and 4mm technologies. DLTtape systems stand out as the obvious choice for the mid-range server market or enterprise computing. DLTtape systems offer a faster transfer rate and a higher native capacity per cartridge than either 4mm or 8mm tapes, while being equivalent in cost. *(See the Drive Performance and Media Cost charts at right.)*

Quantum offers a growth path, boosting both capacity and performance, which will meet tomorrow's backup needs. This growth path ensures your investment in DLTtape products.

The linear recording method used in Quantum's DLTtape systems provides much higher reliability than the helical scan technology used by 4mm and 8mm tape drives. Quantum DLTtape media is reliable for 1,000,000 head passes, compared with only 2,000 for 4mm and 1,500 for 8mm. This high reliability is important – ensure protection of your most valuable asset – *your data!*

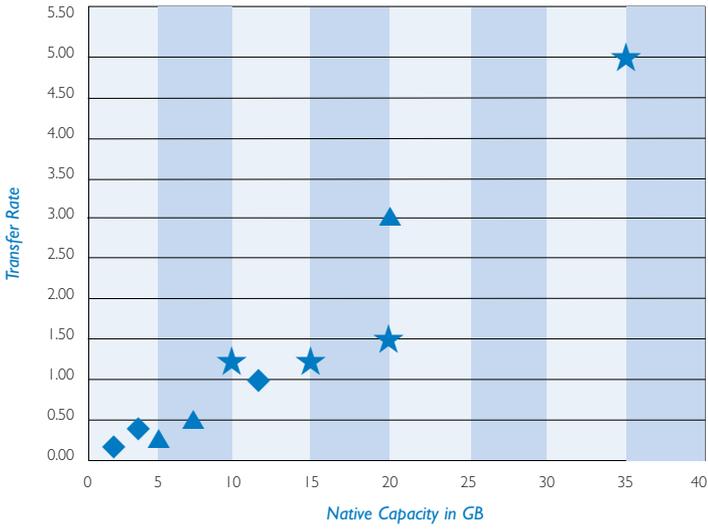
DLTtape media and drives are extremely robust. Given proper usage and care, they should reward the user with a long, productive life. However, problems do arise from a lack of proper drive care and poor media management. This section provides you with recommendations on media care as well as on optimum media usage, all aimed at protecting your data.



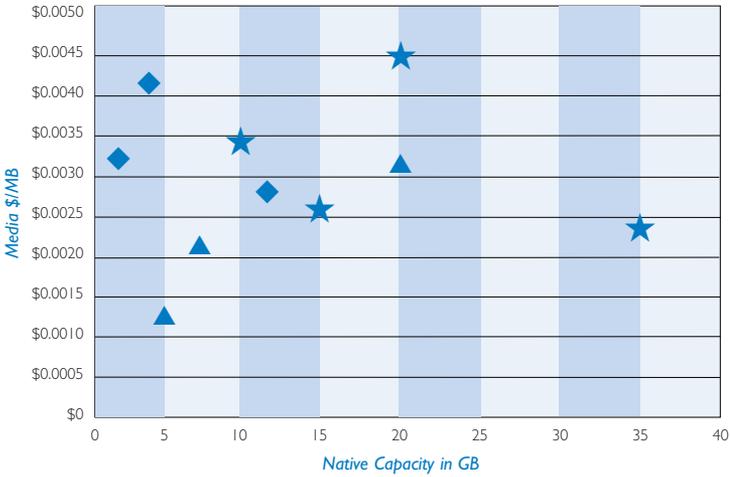
DLTtape Logo

Look for the words "DLTtape" or this logo when you purchase your DLTtape products.

Drive Performance



Media Cost



ackup

Recommendations for Media Handling

Quantum DLTape media has an archival life of more than 30 years. To ensure that you can restore your data after a period of 30 years or more, we recommend that you follow these guidelines. Treat your media with the care your data deserves.

Media Acclimation

If the tapes come from a different environment, allow them to stabilize for a period of at least 24 hours before use.

Operating Environment

Control the environment in which you use the tapes. Hostile environments can cause physical and/or chemical damage to the tape. Stay within the following ranges:

Ambient Temperature (°F)	50 to 104
Non-Condensing Relative Humidity (%)	20 to 80
Maximum Wet Bulb Temperature (°F)	77

Storage Environment

Store your DLTape cartridges within the follow specifications:

Non-Archival		Archival	
Ambient Temperature (°F)	61 to 90	Ambient Temperature (°F)	64 to 79
Non-Condensing Relative Humidity (%)	20 to 80	Non-Condensing Relative Humidity (%)	40 to 60
Maximum Wet Bulb Temperature (°F)	78	Stray Magnetic Field	<4,000 G

Handle with Care

Do not drop or try to open the DLTtape cartridges. Take care not to label outside of the label area. And always keep cartridges away from magnetic sources. To protect media from being overwritten, use the “Write-Protect” switch.

Errors

As a tape begins to wear out, a small number of “soft errors” begin to occur. The DLTtape system contains a high degree of error correction circuitry and utilizes a recording format that can correct most errors. The tape drive signals when these errors are encountered, including those that are corrected. Media that experiences too many soft errors should be retired before unreadable “hard errors” occur.

Error Correction

Many causes of recording or reading errors are temporary and can be corrected by cleaning the drive or retensioning the tape. Periodic drive cleaning with a Quantum cleaning tape may be required when prompted by the drive cleaning light.

*“Treat your
media with
the care your
data deserves.”*

ch i v e

Recommendations for Media Storage

DO

- Have a media and data management policy and structure.
- Seek advice if the media is suspect.
- Inspect media for damage before use.
- Acclimate storage media before use.
- Observe environmental controls (storage, operation, and transportation).
- Store media in specially designed racks or storage boxes.
- Write-inhibit the media before long-term storage or data interchange.
- Conduct periodic clinical cleaning of the storage areas.
- Observe media labeling recommendations.
- Observe data disaster and recovery procedures.
- Monitor system and performance statistics and records.
- Secure and control access to data and media.
- Take care in handling.
- Ensure that media and drives are kept clean.

DO NOT

- Retain just one copy of critical data.
- Use suspect or physically defective media.
- Wait for the system to reject your media.
- Accept new media at face value.
- Use media on dirty subsystems and equipment.
- Expose media to extreme heat, cold or humidity.
- Store media near fire extinguisher points.
- Carry or transport media loosely in a box.
- Export media without environmental protection.
- Smoke, eat, or drink within the media area.
- Store media near debris-producing devices.
- Touch the media surface with your fingers.
- Store media in hostile areas.
- Store media horizontally.
- Stack media one on top of another.
- Drop media.
- Store data without periodically reading and copying it.
- Retain media that has been exposed to environmental disasters.
- Dispose of the storage media without destroying the data first.

Quantum DLTtape Media Specifications

Quantum DLTtape Media Compatibility

Media	Recorded Format	Capacity	Tape Drive Transfer Rate			
			DLT 2000	DLT 2000XT	DLT 4000	DLT 7000
DLTtape III	DLT 2000	10 GB	1.25	1.25	1.5	1.5
DLTtape IIIXT	DLT 2000XT	15 GB	NA	1.25	1.5	1.5
DLTtape IV	DLT 4000	20 GB	NA	NA	1.5	1.5
DLTtape IV	DLT 7000	35 GB	NA	NA	NA	5.0

NA = Tape format is not compatible with the drive.
 Native Capacity (in GB) and Native Transfer Rate (in MB per second).

Tape Characteristics

	<i>DLTtape III</i>	<i>DLTtape IIIXT</i>	<i>DLTtape IV</i>
Archive Storage	> 20 years	> 30 years	> 30 years
Durability (head passes)	500,000	1,000,000	1,000,000
Tape Type	Metal Particle	Metal Particle	Metal Particle
Overall Length (feet)	1,200	1,828	1,828
Color	Gray	White	Black
Warranty	Quantum DLTtape half-inch cartridges are covered by a limited lifetime warranty.		

For more information about Quantum's quality products, call toll-free 1-800-624-5545 in the U.S. and Canada, or visit our World Wide Web site: www.quantum.com

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