DLT LIBRARY PERFORMANCE BRIEF

CONTENTS

High Performance Backup of Enterprise Servers

Since its introduction in June1997, the Compaq DLT 15 Cartridge Library Model 1530 (Compaq 1530 Library) has been an industry leader in high performance backup capabilities. The Compaq DLT 15 Cartridge Library Model 3570 (Compaq 3570 Library) was announced in November 1997. This Library uses 35/70-GB DLT drives and sets new standards in high-speed backup performance, capacity, and ease of use.

Late in 1997, Compaq performed a series of tests to examine the performance of the Compaq 3570 Library. The objective of these tests was to find the highest-performance configurations while performing realistic backup tasks on Compaq servers running Windows NT 4.0 network operating system.

The Compaq 3570 Library provides high capacity, high-speed tape storage for use in local and remote backup strategies. This brief addresses the technical aspects of high-performance backups that can reach and exceed 165[1] gigabytes per hour (GB/hr) with standard Compaq hardware.
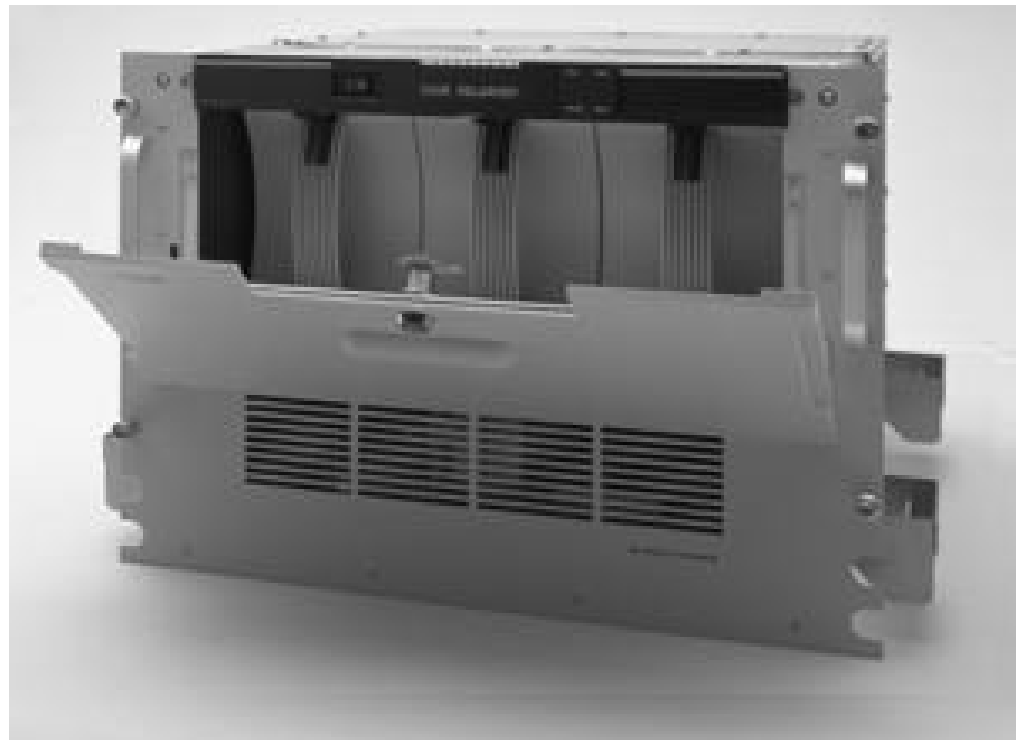
Figure 1-- Compaq 3570 Library

COMPAQ

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[1] Four Compaq 3570 Libraries with 8 35/70 DLT Drives running 8 concurrent jobs in a local (non-LAN) backup with data compression of 4:1 can achieve this performance level. See the data in the appendix 1.

NOTICE

The information in this publication is subject to change without notice.

HIGH PERFORMANCE BACKUP OF ENTERPRISE SERVERS

High Performance Backup of Enterprise Servers

Raid

*RAID technology was developed to improve performance and reliability of inexpensive disk drives. Hence the acronym **R**edundant **A**rray of **I**nexpensive **D**rives. These systems employ multiple drives to improve the performance and reliability of less expensive drives.*

*When applied to tape drives, system performance and data protection are most important. For tape systems, the acronym is **R**edundant **A**rray of **I**ndependent **T**ape— **RAIT**. Whatever the acronym, the purpose is the same, improved performance and data protection. Just remember – RAIT is RAID technology applied to tape.*

There are five techniques, each offering unique features to meet differing speed and data protection needs. These techniques are referred to as levels.

RAID 0 offers greatest speed. RAID 1 offers the greatest data protection. RAID 2, 3, 4 and 5 offer high speed, with data protection. The speed is not as high as RAID 0, and data protection is not as great as RAID 1. Each level offers features best suited to a particular type of hardware configuration or operational environment.

INTRODUCTION

The primary objective of this paper is to provide performance data for one or more Compaq Model 3570 DLT Libraries using RAID and non-RAID software technology. As more companies migrate to server solutions to meet company data storage and retrieval requirements, system unavailability during scheduled backup windows is a significant issue.

Operation has expanded to seven days a week and 24 hours a day. Concurrent (hot) backups with the database in use, or small scheduled windows for backup are common practice. In either case, shorter times to accomplish the task result in greater customer satisfaction.

Fault tolerance has become even more important with the large storage media prevalent today. Statistically, as the volume of data increases, the number of faults increases. RAID 5 fault tolerance technology allows a Library backup to complete successfully, even if a single tape drive fails or one tape is missing or damaged. The data on the failed or missing tape is recoverable, without requiring another backup.

Until the introduction of the Compaq Model 1530 DLT and Compaq Model 3570 DLT Libraries, customers requiring tape RAID functionality needed to implement a Compaq DLT Tape Array. A major disadvantage of this solution is that unattended data capacity is limited to a single tape cartridge.

The Compaq Tape Array does not have the automation to remove and replace tapes. The Compaq DLT Library products provide the automated functionality and capacity to eliminate the tedious but necessary swapping of tapes. This automation permits backup scheduling during off-peak hours, without an operator present to change tapes.

Libraries do not inherently have the ability to utilize RAIT. The backup software that supports the library provides this functionality. Software products that support the Compaq Model 1530 and Model 3570 DLT Libraries include Cheyenne ARCserve and Seagate Backup Exec. Of these, only Cheyenne ARCserve 6.5 presently supports RAIT for the Compaq DLT Libraries.

Compaq, along with Cheyenne Software, a division of Computer Associates, can now provide the automation and capacity of the DLT Library and the fault tolerance and performance of the DLT Tape Array. Combining these features provides a reliable method of high-speed, automated backups over a period of days or weeks without user intervention.

With the creation of the concept of a Virtual Library, Cheyenne ARCserve 6.5 allows management of up to sixteen DLT Libraries and 32 DLT Drives as a single entity. A backup administrator can easily manage multiple libraries from a single control point. The libraries may be physically attached to any server on the LAN. The tape drives and cartridge slots in the physical libraries are grouped together to form a single logical group, or pool. Multiple RAIDs of Libraries form pools that can be viewed in ARCserve as a larger Virtual Library. The size of the pool is dynamically adjustable by changing the defined RAID size to meet changing backup requirements. Pools of Libraries can accommodate very large multi-terabyte databases, yet maintain the flexibility to backup even the smallest remote office with the appropriately sized pool.

For ARCserve 6.5 running on one server, a maximum of sixteen Compaq 3570 Libraries (thirty-two 35/70 DLT Drives) per server can run 32 concurrent local backup jobs. Appendix 1 presents the hardware environments used and details of performance measurements made for this white paper.

The Compaq 1530 Library is the best choice for installations requiring a price/performance tradeoff matching current LAN speeds and capacities[2]. Where maximum storage capacity and performance are required, the Compaq 3570 Library is able to meet the demands. Regardless of the needs of the installation, Compaq offers a state-of-the-art answer that meets current requirements and will continue to do so in the future.

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[2] Current Ethernet 100Mbit/second LAN speeds allow a up to 35GB/Hr backup transfer rates with DB Agent and compression at the source. An additional white paper, planned for later in 1998, will detail these limitations and techniques to improve backups over the LAN.

TEST BED DESCRIPTION

Hardware

The Compaq ProLiant 6000 server was equipped with a Compaq Netelligent 10/100Mbit/s TX PCI Ethernet Controller. Compaq ProLiant 6000 features relevant to this test include four (4) 200-MHz Pentium processors, 33-MHz PCI bus, and 100-MHz synchronous memory.

Additional test bed details are discussed in Appendix 2.

Figure 2 -- Compaq ProLiant 6000

Hard Drive Array

The server was equipped with four SMART/2 SCSI 'RAID' Hard Disk controllers feeding two channels of five Compaq 10K 9.1-GB Wide Ultra SCSI-3 hard drives. This provides a total of 364-GB per server. Older or non-Compaq hard drives may not be fast enough to keep pace with other backup components, and may be a significant performance bottleneck.

The DLT Libraries were connected to SCSI cards with the Dual Channel Ultra Wide SCSI-3 controllers. The use of a Compaq 32-bit Fast-Wide (SCSI-2) controller or the Ultra–wide integrated SCSI-3 controller for the DLT Library attachment is also possible. Use of other controllers may result in lower performance, and is not recommended. For additional details of system and SCSI channel-device attachment see Appendix 2, Standard Test System.

Memory

The server is populated with 320-MB main memory for these performance demonstrations. This is sufficient to prevent performance limitations due to insufficient memory.

Software

The operating system and backup software chosen for these tests is commercially available. Since Seagate Backup Exec does not support RAID, only ARCServe was used in testing. The software on each server was configured for optimum performance in accordance with the manufacturers recommendations.

Operating System

The server had Windows NT Server, version 4.0, build 1381 installed. Service pack 3 was also installed.

Backup Software

Cheyenne ARCserve version 6.5, Enterprise edition, build 600, with the Tape Library Option, RAIT Option, and Image Option was installed for these tests. The Tape Library Option specifically supports the Compaq 3570 and 1530 Libraries.

PERFORMANCE DEMONSTRATIONS

Case 1 – Local Flat File Backup – Non RAIT

Case 1 demonstrates local backup performance. Figure 3 illustrates this network, consisting of a single Compaq ProLiant 6000 server with four Compaq 3570 Libraries attached.
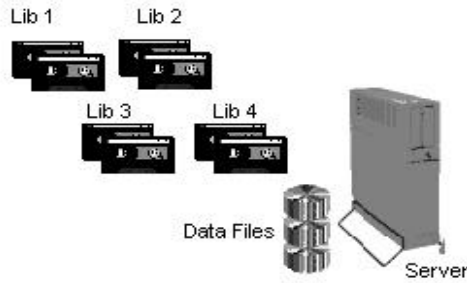
Figure 3 -- Flat File Network

Image Backup

This test demonstrates image backup performance from a single Compaq ProLiant 6000 server to one, two, and four Compaq 3570 Libraries. Cheyenne ARCserve 6.5 image backup copies all used blocks from the storage media to the backup media.

The total volume of data was 364-GB. The data for this test was compressible at a 4:1 ratio[3]. The results of this test, presented in Figure 4, demonstrate the performance improvements obtainable from additional Compaq 3570 Libraries. Each additional library, which houses two 35/70 DLT drives, allows the addition of two jobs.

Figure 4 -- Flat File Performance – Multiple Jobs

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[3] The compression ratio of data is a key factor in backup performance. For estimated compressibility of several types of data files, refer to appendix 4.
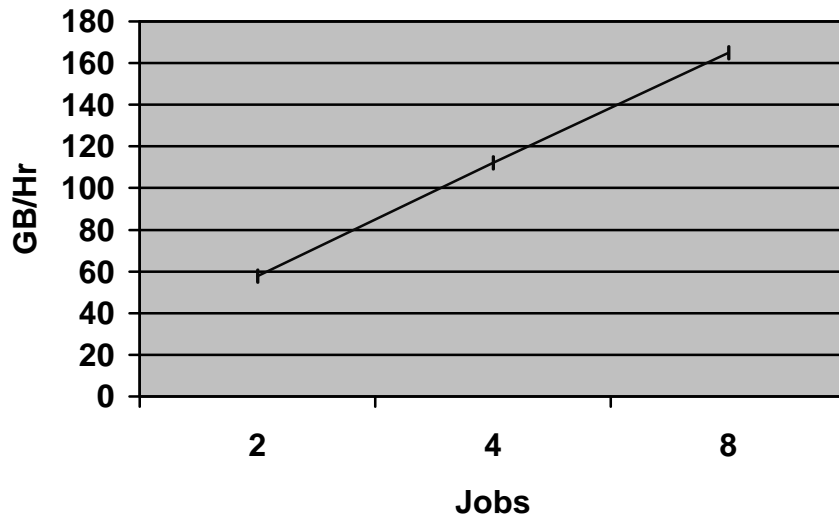
Case 2 – Local Flat File Backup – RAIT

These tests demonstrate local backup tasks. A single Compaq ProLiant 6000 server has from one to four Compaq Model 3570 DLT Libraries attached. Image backup tasks were tested. The files are simple flat (non-relational) files. Figure 3 illustrates this network with four Compaq 3570 Libraries attached to the Compaq ProLiant 6000.

ARCserve 6.5 will operate the Compaq Model 3570 DLT Libraries in RAIT 0, RAIT 1, or RAIT 5 configurations. RAIT 0 typically yields highest performance. RAIT 1 offers the greatest protection for the data. RAIT 5 retains up to 80% of the speed performance, with data protection.

RAIT 0 stripes the data block across two or more tapes. These tapes may be mounted on one library if only two drives are used, or the tapes may be in different libraries. This is the highest performance configuration, but there is no data redundancy. If a fault occurs in any tape, the entire data set may be lost. Figure 5 illustrates RAIT 0 data distribution across three tapes.

A potential performance limitation exists in the way applications software, such as ARCServe, launches threads and the way the Windows NT processes those threads. Launching concurrent tasks will start more threads, thus improving time slicing and backup efficiency.
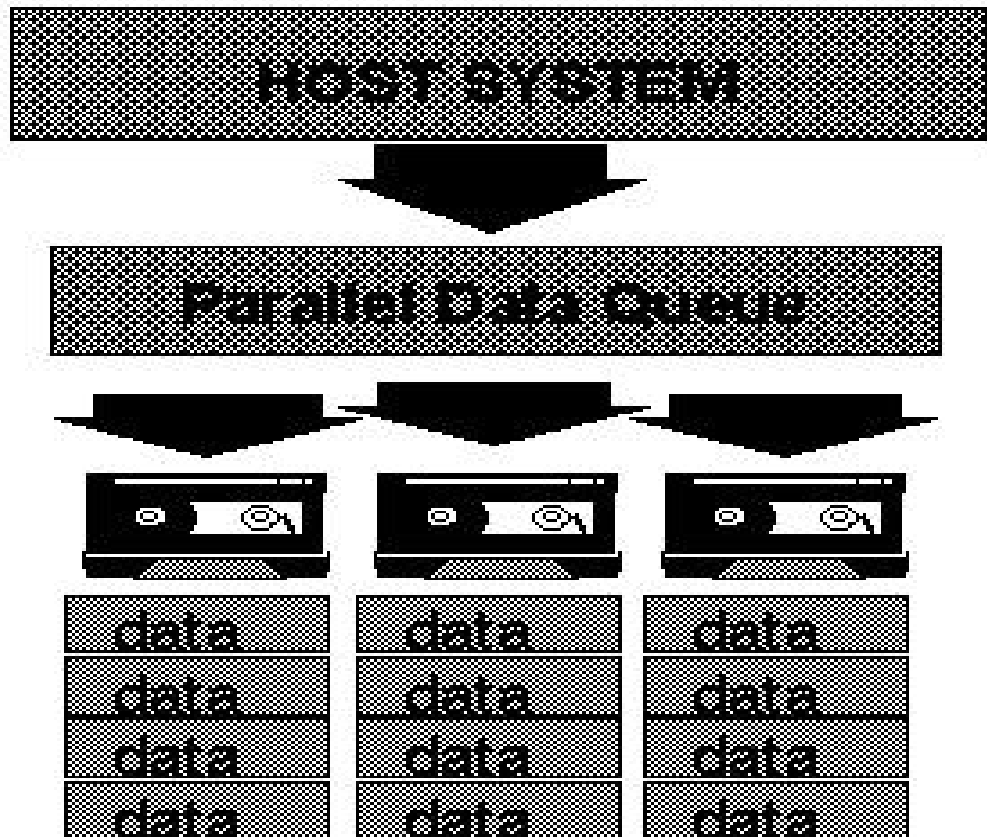

Figure 5 -- RAIT 0 Data Distribution

ARCserve 6.5 RAIT 1 mirrors both 35/70 GB LT drives in one Compaq 3570 Library. Each 35/70 GB DLT drive receives identical data. If there is a failure in one library during either reading or writing, the data on the other drive is intact. This configuration is more secure than RAIT 0, but does not take full advantage of the capacity and performance benefits available from the Compaq 3570 Library. Figure 6 illustrates mirroring data to two tapes.
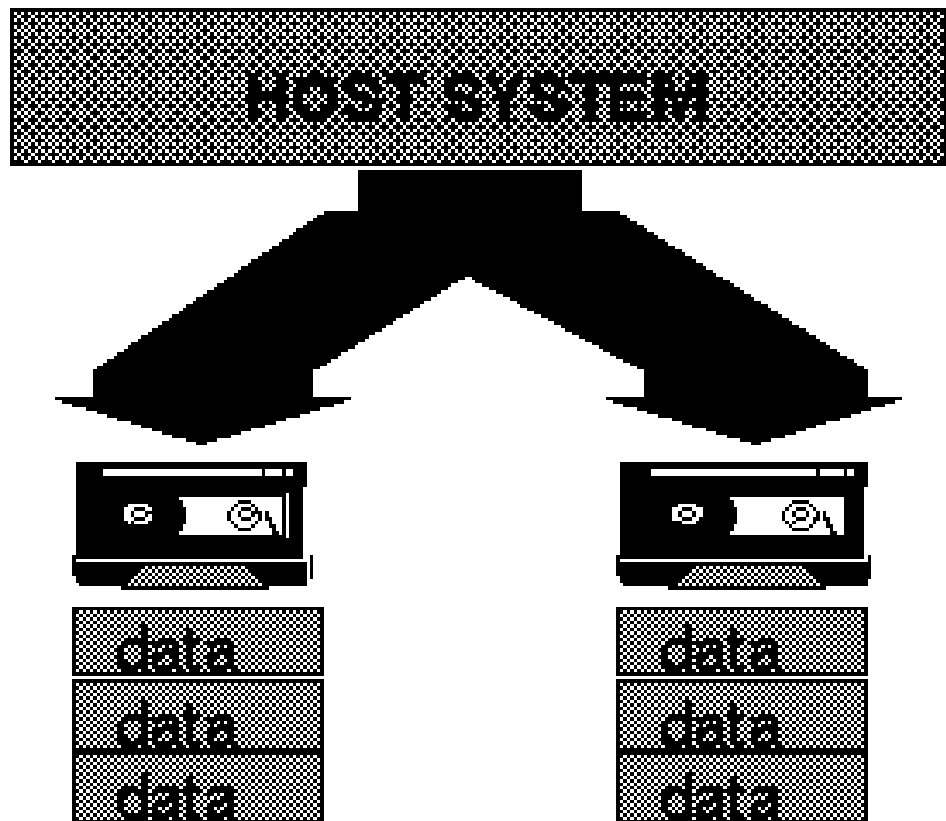
Figure 6 -- RAIT 1 Data Mirroring

It is also possible to create automatic off-site backups using a configuration with two Compaq Model 3570 DLT Libraries physically in different locations while connected to the same network. The server and one library are connected locally, with a second library attached to the network, but physically located in a remote location. Since RAID is not currently supported over a network, one job is run locally, and a second job backing up the same files is run to the remote library over the network. This would limit backup performance to that of the LAN.

RAIT 5 retains up to 80% of the performance benefit of RAIT 0 while adding fault tolerance. Each data block is striped across three or more tapes, a parity code is calculated for each block, and that parity code is stored on another tape. The data and parity rotate among all tapes in the Virtual Library. The Virtual Library concept permits mounting the tapes in a single backup set in different libraries. Since each Compaq 3570 Library houses two 35/70 DLT Drives, this concept is essential in order to operate the library in RAIT 5. Figure 7 illustrates RAIT 5 data and parity placement across five tapes.
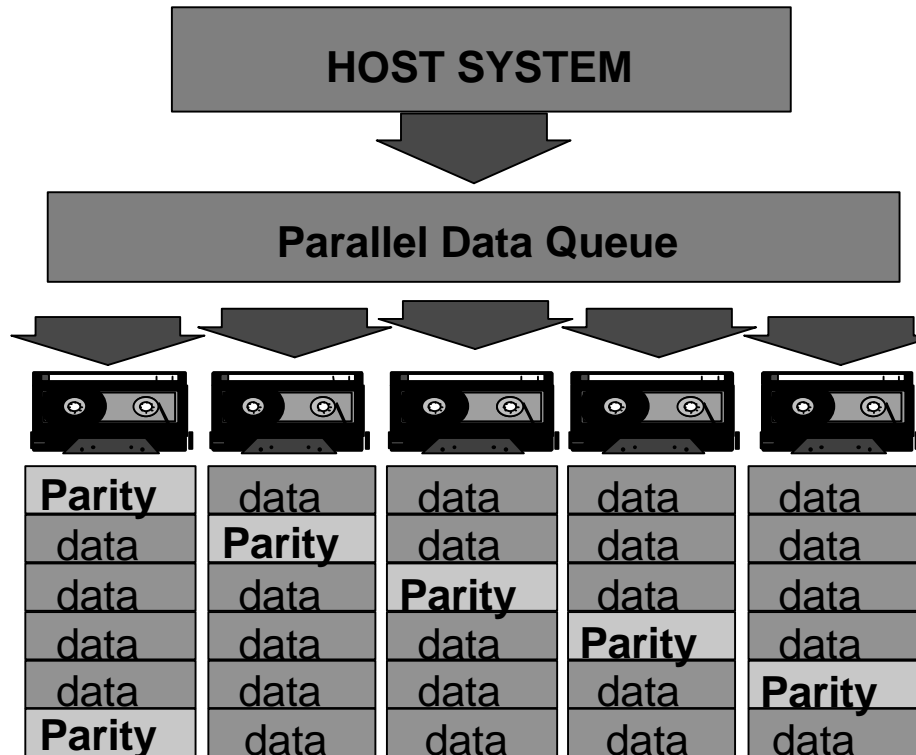
Figure 7-- RAIT 5 Writing Pattern

Image Backup – RAIT 0

For this test, a single Compaq ProLiant 6000 server had four Compaq Model 3570 DLT Libraries attached. Tests were performed with one job running to eight 35/70 GB DLT drives, two jobs running to four 35/70 GB DLT drives each, and four jobs running to two 35/70 GB DLT drives each. The data was 364-GB, 4:1 compressible, as in the previous tests. Figure 8 shows the results of these tests.
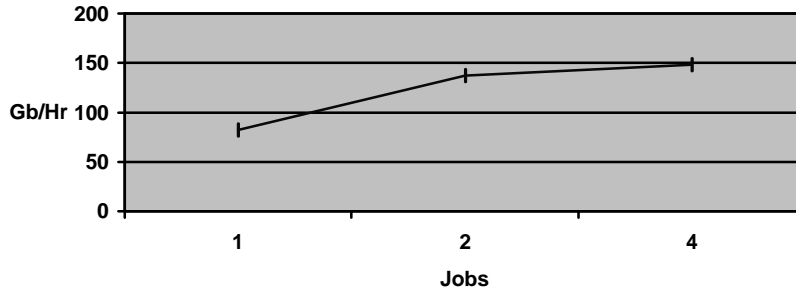
Figure 8 -- Flat File RAIT 0 Performance – Image Backup

Image Backup – RAIT 1

This test was performed with one Compaq ProLiant 6000 server and 1 dual drive Compaq 3570 Library attached. Both 35/70 GB DLT drives in the library were mirrored. Data volume was 364-GB. This test, shown in Figure 9, demonstrates the effect of data compressibility on performance.

Figure 9 -- Flat File RAIT 1 Performance – Image Backup

Data Compression

For these tests, all compression was accomplished in the 35/70 GB DLT drives.

Image Backup – RAIT 5

This test was performed with one Compaq ProLiant 6000 server with four Compaq Model 3570 DLT Libraries attached. Data volume was 364-GB. Though somewhat slower than the RAIT 0 performance presented in Figure 8, data security is much greater. The results of these tests are shown in Figure 10. As demonstrated in Figure 9, compressibility of the data has a dramatic influence on performance up to 2:1 compression ratio. Compressibility of the data beyond a 2:1 ratio yields diminishing performance improvements. Running two jobs with four drives per job produced the data for Figure 10.
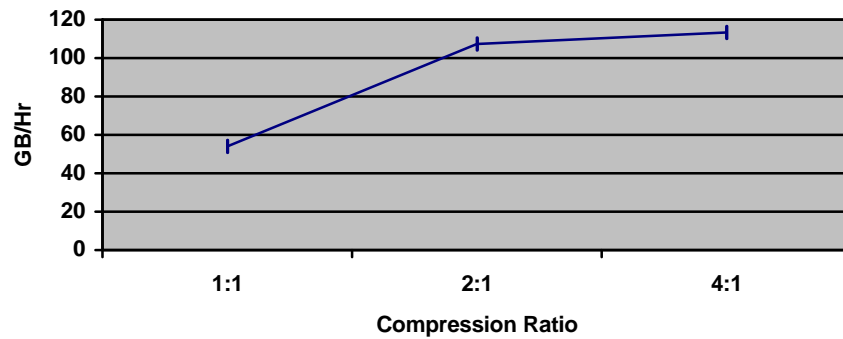
Figure 10 -- Flat File RAIT 5 Performance – Image Backup

Case 3 – Local Relational Database Backup

This case demonstrates a Lotus Notes database local backup task. One Compaq ProLiant 6000 server has two Compaq 3570 Libraries attached. Both 35/70 GB DLT drives in each library were used. ARCserve 6.5 operated the Compaq 3570 Libraries in RAIT 0, RAIT 1, and RAIT 5 configuration during these tests. The database was backed up both while the database was in use (hot) and with the database offline (cold). For each of the tests, one backup task was running.

During a hot backup, ARCServe 6.5 must be aware of the state of the individual records in the database. If the record is being updated, the backup process must wait until the transaction is complete before copying the data. NoteBench's Mail and DB test simulated three hundred users on the Lotus Notes database for the hot backup testing. Slightly higher performance is evident with the database hot, but with no users. ARCserve uses an Open File Agent and part of its Lotus Notes Agent to backup open or in use files.

The cold backup was with the server running, but with Lotus Notes shut down and the database inaccessible to users. In this case, ARCServe treats the database as if it were a flat database file. The Lotus Notes Agent and Open File Agent are not used.

Figure 11 illustrates comparative backup performance using RAIT 0, RAIT 1, and RAIT 5 configurations. The same 20-GB Lotus Notes database was used for each of the tests. Average data compressibility was 1.7:1. In each test, one backup job used four DLT Drives in two Libraries.

Performance improvements are possible by running more than one job with each job backing up different databases.
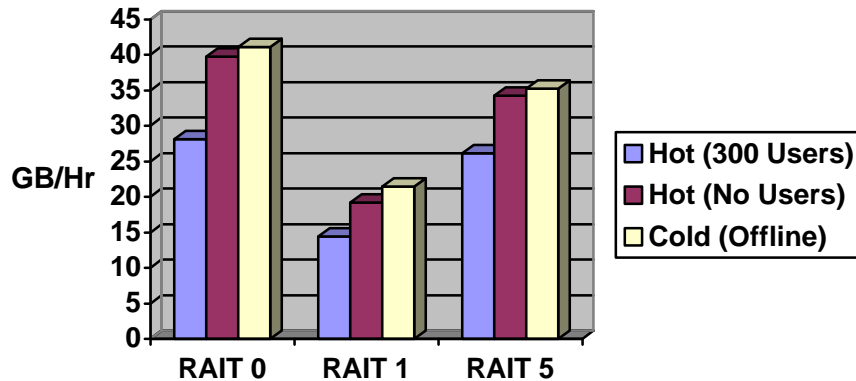

Figure 11 – Comparative Performance – Relational Database Local Backup

Case 4 – Local Flat File Restore – Non RAIT

Case 4 demonstrates local restore performance. A single Compaq ProLiant 6000 server has four Compaq 3570 Libraries attached. These tests demonstrate simple flat file (non-relational) database) file restore. Figure 3 illustrates this network with four Compaq 3570 Libraries attached to the Compaq ProLiant 6000.

Image Restore

This test demonstrates image restore performance from four Compaq 3570 Libraries to one Compaq ProLiant 6000 server. Cheyenne ARCserve 6.5 image restore copies data from the backup media to the server. An image restore is usually the fastest method to restore an entire file system. Cheyenne ARCserve 6.5 supports selective restore (single file selection and restore). This is slower than when a selective restore archive is used for this purpose. Selective restore was not evaluated.

As was previously demonstrated during backup testing, increasing the number of drives and jobs improves restore performance. This performance boost is due to greater utilization of the hardware capabilities made possible by running multiple threads. Launching concurrent tasks that will use these threads improves efficiency significantly. This improvement is apparent in Figure 12.
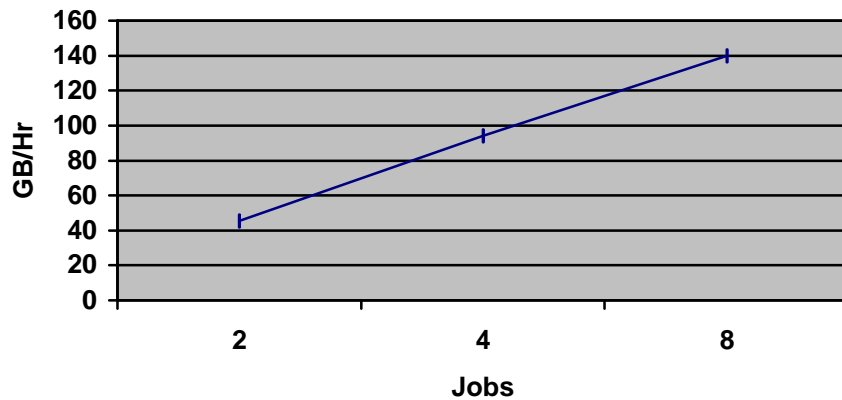
Figure 12 -- Flat File NON-RAIT Performance – Image Restore

Case 5 – Local Flat File Restore – RAIT

This case demonstrates local restore performance. A single Compaq ProLiant 6000 server has four Compaq 3570 Libraries attached. These tests demonstrate simple flat file (non-relational database) file restore. Figure 3 illustrates the network hardware with four Compaq 3570 Libraries attached to the Compaq ProLiant 6000. ARCServe 6.5 operated the Compaq 3570 Libraries in RAIT 0, RAIT 1, and RAIT 5 configuration for these tests.

Image Restore – RAIT 0

Four configurations were tested for this performance demonstration. All configurations used a single Compaq ProLiant 6000 server. Tests were performed with one, two, and four Compaq Model 3570 DLT Libraries attached. Both drives in each library were used. The data volume was 364-GB, as in the previous tests. Figure 13 shows the results of these tests.
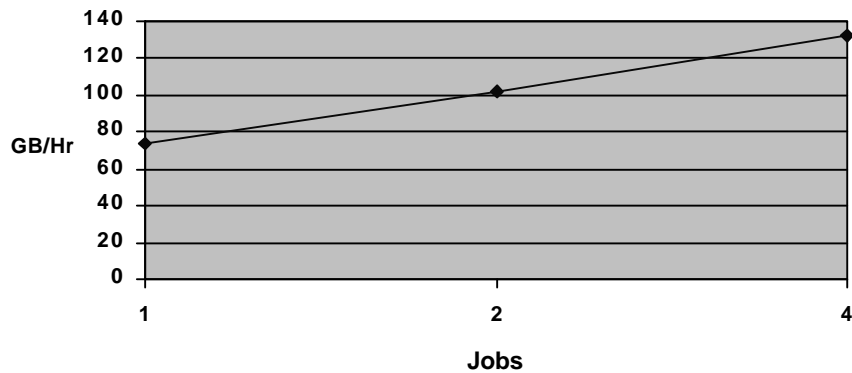
Figure 13 -- Flat File RAIT 0 Performance – Image Restore

Image Restore – RAIT 1

This test was performed with one Compaq ProLiant 6000 server with a two drive Compaq 3570 Library attached and both 35/70 GB DLT drives mirrored. One job was launched. Data volume was 364-GB. Compressibility of the data impacts the maximum achievable data rate.
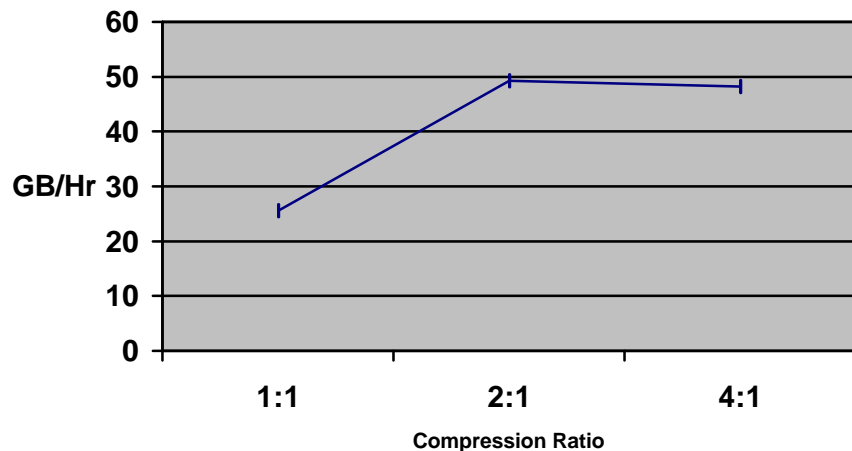
Figure 14 -- Flat File RAIT 1 Performance – Image Restore

Image Restore – RAIT 5

This test was performed with one Compaq ProLiant 6000 server with four Compaq Model 3570 DLT Libraries attached. Two jobs were running for each test. Data volume was 364-GB. Data compressibility has a significant impact on data throughput, as indicated by Figure 15
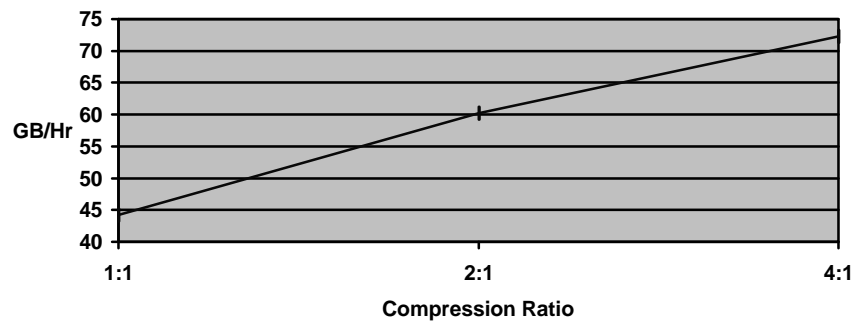
Figure 15 -- Flat File RAIT 5 Performance – Image Restore

A significant point to observe in the data presented above is that with 2:1 compressible data and a single job running, 50- to 60-GB/Hr data rates are typical under Windows NT and ARCServe 6.5. This is true regardless of the number of libraries or drives in the array. Other software implementations and operating systems may yield different results.

Case 6 – Local Relational Database Restore

This case demonstrates a Lotus Notes restore task. In this scenario, the Compaq ProLiant 6000 server has two Compaq 3570 Libraries attached. The database is stored locally, e.g. attached to the same server.

The data set for this test was a Lotus Notes database. The total volume of data was 20-GB of approximately 1.7:1 compressible data. A single restore job was running. The results below are normal: if a backup ran at 50- to 60-GB/Hr, restore normally runs at 40-GB/Hr. The database was offline for all restore testing. The Lotus Notes server can not be running while restoring the databases.
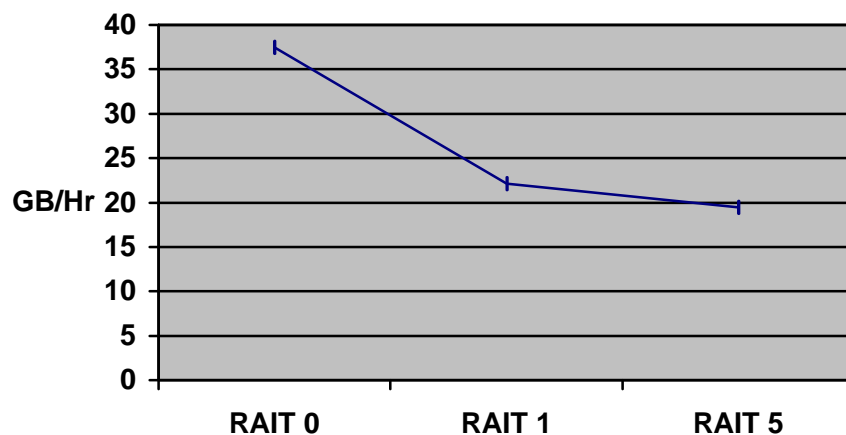
Figure 16 – Comparative Performance - Relational Database Restore

Figure 16 compares the results of RAIT 0, RAIT 1 and RAIT 5 testing. Backup performance is slightly faster than restore performance.

RAIT Tape Management

The backup administrator can create a logical grouping of resources, a Virtual Library, larger than is possible with a single Compaq 3570 Library. Physical resources are assigned to meet data volume requirements exceeding a single library, or to allow implementation of RAIT functionality. The Virtual Library concept requires advanced media management features to keep media organized.

Media management features are included in ARCserve 6.5 through the RAIT Option and the Library Option to support the Compaq 3570 Library. Media serial numbering and bar code support assist in efficiently automating management of DLT media cassettes. If you use a Grandfather/Father/Son backup rotation scheme, media automatically moves from scratch set to rotation set, rotation set to save set and save set to scratch set based on user defined retention periods.

Data Migration Option with Tape library Option

Data Migration or Hierarchical Storage Management (HSM) allows the backup administrator to utilize available storage resources efficiently. Infrequently used data is migrated to less expensive storage devices until users request it. ARCServe 6.5 allows the backup administrator to establish policies to automatically migrate data to and from any NTFS formatted Windows NT volume on tape drives and libraries, optical storage devices, and magnetic hard disks.

Disaster Recovery with Tape Library Option

Due to the size of the programs necessary to operate the changer, disaster recovery procedures are more complex than with a single tape drive. ARCserve and other backup software support disaster recovery that utilizes the tape changing ability of the library. The library can create a set of backup tapes that can be used either on a single standalone drive or in a drive within the library for disaster recovery. ARCServe 6.5 has the ability to create a set of disks for use with this backup set.

CONCLUSION

The Compaq 3570 Library sets new standards in high-speed backup performance where LAN speed is not a limiting factor. Note that the 20+GB/Hr in performance backup rates measured above are not sustainable by a single Ethernet 100Mbit/second LAN and the 15/30 Library, at 1/3 the cost, may be a better price performer.

For ARCserve, when using RAIT (0 or 5) and a single job, performance is limited to 60GB/Hr or less regardless of the number of tape drives in the RAIT. When using multiple concurrent jobs backup rates increase at approximately 30GB/Hr/tape up to a maximum of 165GB/Hr. These numbers are consistent and equivalent whether the tape drives are used in a physical Compaq DLT Tape Array or in multiple Compaq DLT Libraries.

Both Libraries, when used with ARCserve and other backup software applications, make operation and control of multiple Libraries much easier to use. When combined with Cheyenne ARCseve 6.5, the capacity to make fast, reliable backups using similar configurations of high-performance Compaq products is multiplied.

APPENDIX 1

Raw Performance Data

FLAT FILE RESULTS

Jobs	Compression	Raid Level	DLT Drives	35/70 Libraries	Backup (GPH)	Fig	Restore (GPH)	Fig
2	1:1	None	2	1	29.29		24.52	
2	2:1	None	2	1	54.02		39.25	
2	**4:1**	**None**	**2**	**1**	**57.71**	Figure 4	**45.23**	Figure 12
4	1:1	None	4	2	58.25		54.25	
4	2:1	None	4	2	102.25		86.25	
4	**4:1**	**None**	**4**	**2**	**112.12**	Figure 4	**94.25**	Figure 12
8	1:1	None	8	4	82.45		72.45	
8	2:1	None	8	4	165.23		134.22	
8	**4:1**	**None**	**8**	**4**	**164.83**	Figure 4	**139.49**	Figure 12
2	1:1	0	4	2	60.23		54.23	
2	2:1	0	4	2	97.03		75.25	
2	4:1	0	4	2	107.11		89.26	
1	1:1	0	8	4	39.22		35.22	
1	2:1	0	8	4	83.56		75.12	
1	**4:1**	**0**	**8**	**4**	**82.48**	Figure 8	**74.25**	Figure 13
2	1:1	0	8	4	67.23		55.25	
2	2:1	0	8	4	134.64		97.25	
2	**4:1**	**0**	**8**	**4**	**137.52**	Figure 8	**101.54**	Figure 13
4	1:1	0	8	4	78.46		66.81	
4	2:1	0	8	4	153.22		126.76	
4	**4:1**	**0**	**8**	**4**	**148.12**		**132.12**	Figure 13
2	**1:1**	**1**	**4**	**2**	**28.89**	Figure 9	**25.56**	Figure 14
2	**2:1**	**1**	**4**	**2**	**54.24**	Figure 9	**49.25**	Figure 14
2	**4:1**	**1**	**4**	**2**	**57.21**	Figure 9	**48.21**	Figure 14
2	**1:1**	**5**	**8**	**4**	**54.14**	Figure 10	**44.25**	Figure 15
2	**2:1**	**5**	**8**	**4**	**107.25**	Figure 10	**60.25**	Figure 15
2	**4:1**	**5**	**8**	**4**	**113.24**	Figure 10	**72.25**	Figure 15

Lotus Notes 4.5.3a using ARCserve 6.5 with Raid and Lotus Notes Agent for ARCserve. Database was 20-GB with an average of 1.7:1 compression. Backup data is presented in Figure 11. Figure 16 presents the results of the restore performance tests.

HOT (NO USERS) DATA

Raid Level	DLT Drives	35/70 Lib	Backup (GPH)
0	4	2	39.75
1	4	2	19.25
5	4	2	34.23

HOT (300 USERS)

Raid Level	DLT Drives	35/70 Lib	Backup (GPH)
0	4	2	28.12
1	4	2	14.45
5	4	2	26.11

COLD (OFFLINE)

Raid Level	DLT Drives	35/70 Lib	Backup (GPH)	Restore (GPH)
0	4	2	41.12	37.45
1	4	2	21.45	22.11
5	4	2	35.23	19.44

APPENDIX 2

Standard Test System

System	Compaq ProLiant 6000 with dual peer PCI bus architecture
Processor	Quad Pentium Pro processors with 512K L2 cache
Memory	320-MB ECC DIMMs
Disk Array Configuration	Four Compaq SMART-2 Array Controllers feeding Eight channels (40 drives total)
Disk Drives	Compaq 9.1-GB Ultra Wide SCSI-3
SCSI Cards	Compaq Wide-Ultra PCI SCSI Controller for the DLT Libraries
Network Cards	Compaq Netelligent 10/100Mbit/s TX PCI Ethernet Controller
Operating System	Windows NT 4.0, Build 1381 with Service Pack 3
Backup Software	Cheyenne ARCserve 6.5 Build 600, w/Tape Library Opt. V3, Image and RAID 0pt. V2
Database Software	Lotus Notes

The Compaq ProLiant 6000 features a dual peer-to-peer PCI bus connected to a common 1,919-GB/hr or 540-MB/s Gunning Transceiver Logic (GTL+) host processor bus. This feature permits a path to the processor that is twice the width of buses in many servers on the market today. Figure 17 illustrates the dual PCI bus architecture.
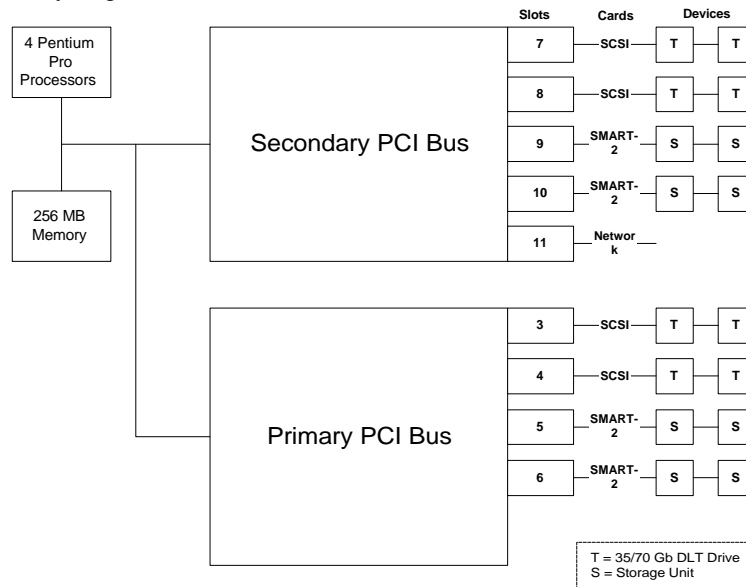

Figure 17 -- ProLiant 6000 peer-to-peer bus architecture.

APPENDIX 3

Operating the Compaq 3570 Library

Cable Quality

The cables provided with the various Compaq option kits are of very high quality. If they are ever damaged, replace them with identical Compaq parts. SCSI data transfers will operate poorly (or not at all) when signal conditions are degraded due to low-quality cabling. Excessive cable length also contributes to slower performance.

Data and Equipment Protection

Always screw the external cable heads into the SCSI cards and Compaq 3570 Library chassis to prevent damage to the connectors and possible loss of data.

Transfer Speed

Use a Compaq 32-bit Ultra-Wide (SCSI-3) controller with the Compaq 3570 Library for best performance. To identify the card, look at the main logic chip in the center of the card and verify that it is a Symbios Logic 53c875 part. Cards with the NCR 53c825 part will not deliver maximum library performance.

Cleaning

Clean the drive by loading a cleaning tape (PN 199704-001). It will clean the drive, then automatically unload.

The cleaning tape is effective for 20 cleaning cycles. Do not exceed this. If a backup tape causes the cleaning light to come on during a backup operation, copy the tape or recover it and remove it from service.

Such a tape can contaminate the drive, which may then contaminate other tapes if the drive is not cleaned between loads. Never try to clean a DLT drive with anything other than a cleaning tape.

Operating Considerations

Dropping or physically shocking DLT cassettes can damage the tape. Damaged tapes can damage the drive. If the cartridge appears damaged, do not use it.

DLT cassettes should be kept in the magazine supplied with the Compaq 3570 Library. This magazine protects the cassettes from handling damage or contamination.

APPENDIX 4

DLT Media Considerations

Performance

The 35/70 GB DLT drive can read half-inch DLT media labeled DLT Tape Type III, DLT Tape Type III XT or DLT Tape IV. The DLT Tape Type IV delivers optimum performance and maximum capacity when used with the 35/70 DLT drive. The DLT Tape IV medium holds a minimum of 35 GB of uncompressed data.

The 70 in 35/70 GB DLT refers to the drive's ability to compress data, usually at a factor of at least 2:1. Higher compression ratios are achievable, but to be conservative, the industry uses 2:1 as an average figure. When backing up servers containing an assortment of general end-user file data, the Compaq 3570 Library can exceed 100 GB per tape cartridge. Typical data compressibility of uncompressed data is listed in the accompanying table.

TYPICAL DATA COMPRESSIBILITY[4]

These figures are typical, and were not tested by Compaq. Your results may vary, depending on the actual data.

Data Type	Compressibility
Bitmaps	6.9:1
CAD	3.8:1
Source	2.9:1
Spreadsheet	2.5:1
Desktop Publishing	2.5:1
Database	1.7:1

If the data is already compressed on the source drive, the opposite will occur. When compressed data is passed through a compression process a second time, it typically occupies more space. This is due to the overhead of the compression algorithm.

Durability

The DLT Tape IV has a minimum shelf life of 30 years if stored properly. Its rated usage is 500,000 passes; however, it is suggested that tapes be rotated on a more frequent schedule.

Media and Drive Compatibility

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[4] These compression ratios are meant to be approximations useful for estimating backup performance and capacity. The numbers were originally published by Sony. Only the database compression ratio was directly measured for this paper. This number was measured for the Lotus Notes database used in testing for this whitepaper. The number of users, number of notes or attachments and other variables can substantially affect this number. Databases other than Lotus may compress at a different ratio.

The DLT Library uses either the 15/30 GB DLT Drive or the 35/70 GB DLT Drive specially modified to work in the Library. Non-Library Ready drives cannot be used in the Library. The 15/30 and 35/70 Drives cannot be mixed in the Library. The 35/70 GB DLT Drive is 'downward' or 'backward' compatible. This means that the 35/70 GB DLT Drive can read and write any DLT tape (data) cartridge type in the maximum density available for the cartridge type. The converse statement, 'upward' or 'forward' compatible is not true. A 20/40 DLT Drive cannot read type IV tape cartridges formatted and written on a GB DLT Drive. The 35/70 GB DLT Drive will automatically select the proper density and recording pattern appropriate for the tape type and any data recorded on it. The 'recording pattern' is essentially either 2 'head' or 4 'head' technology, the 35/70 GB DLT drive being the only 4 head (Symmetric Phase Recording SPR) recording pattern technology at present.

Here are some examples to clarify this:

- if a type IV cartridge containing data written on a 20/40 GB DLT Drive is used in a 35/70 GB DLT Drive, the 35/70 GB DLT Drive will read and write data in a manner readable by the 20/40 GB DLT Drive

- if a type IIIxt cartridge containing data written by a 15/30 DLT Drive is loaded into a GB DLT Drive, it can be read and written in a density and recording pattern usable by the 15/30 GB DLT Drive

- if a type IV cartridge containing no data is used in a 35/70 GB DLT Drive it will be formatted, read and written using 70GB density and 4 head(SPR) recording pattern – thereafter if this tape cartridge is inserted in a 20/40 GB DLT Drive it cannot be read

- If a type III cartridge is written by a 10/20 DLT Drive then used in a 15/30 DLT Drive it can be read and written in 20 GB density – the type IIIxt cartridge is longer to hold more data but is otherwise the same as the type III cartridge. The following table lists the compatibility of DLT tape (data) cartridge types and DLT tape drives.

DLT Drive	Type III		Type IIIxt		Type IV		Notes
	Read	Write	Read	Write	Read	Write	
10/20 (2000)	Yes	Yes	No	No	No*	No*	*2 head, can read/write but max 20GB(2:1), can't read/write if tape formatted using 35/70
15/30 (2000xt)	Yes	Yes	Yes	Yes	No*	No*	*2 head, can read/write but max 30GB(2:1), can't read/write if tape formatted using 35/70
20/40 (4000)	Yes	Yes	Yes	Yes	Yes*	Yes*	*2 head, max 40GB(2:1), cant read/write if tape formatted using 35/70
35/70 (7000)	Yes	Yes	Yes	Yes	Yes	Yes	4 head(SPR), max 70GB(2:1), type IV cartridges written in SPR format cannot be read by previous drives

Drive Duty Cycle

Most tape drives have a 15 to 25 percent duty cycle, which means the manufacturer expects them to actually be writing tape some small percentage of time during their installed lives. The DLT drive is a 100 percent duty cycle rated device. While it won't be writing 100 percent of the time, the drive is tougher and can be used more often, with greater confidence in its reliability than drives with a lower percentage duty cycle.

APPENDIX 5

Table of Figures