
Ulysses

Hard Disk Cartridges for Tape Libraries

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Presented at the THIC Conference

National Center for Atmospheric Research

1850 Table Mesa Drive, Boulder, CO 80305

19-20 July 2005



Agenda

- Ulysses overview
- Benefits
 - What need Ulysses fulfills
 - Primary technical issues Ulysses addresses
 - How is it different to other d2d
 - Why it is complementary to tape and the tape industry
- Technical details
 - Emulator
 - Cartridges
- Performance results

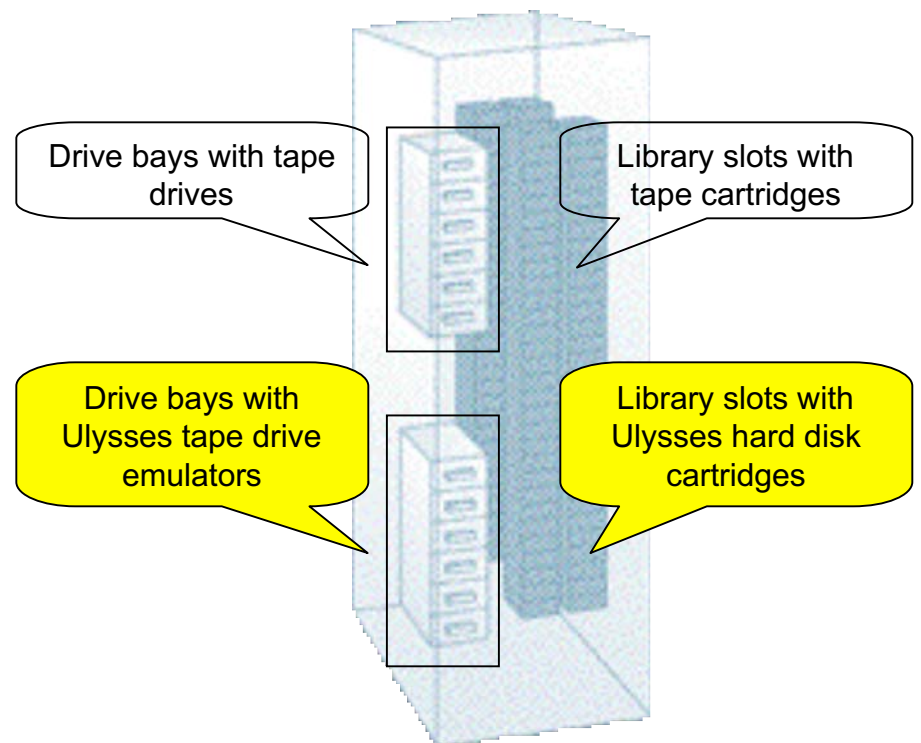
Ulysses

- Ulysses is a tape emulation product that resides within a tape library.
 - A hard drive in an industry-standard tape cartridge
 - Fits in any standard drive bay
 - Recognized by the host, backup software, and storage management software as a standard tape drive
 - Accelerates tape performance



Ulysses brings D2D “inside the library”

- Accelerates current tape automation by adding HDD to a portion of the slots
- Compatible with existing tape automation and software
- Complementary to tape by bringing D2D inside the library



Example configuration

Product Overview

Emulator



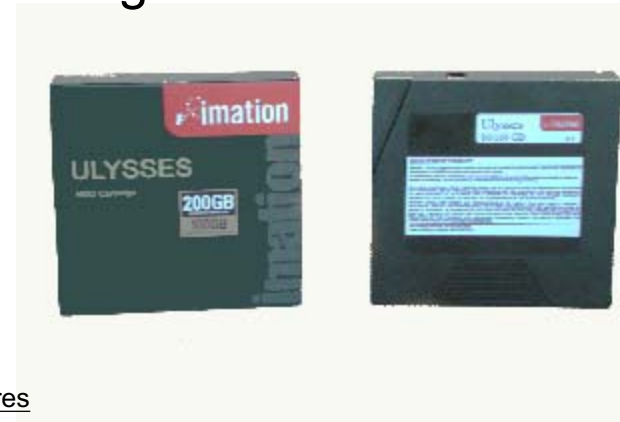
Features

- Emulates SCSI tape drives
- Industry-standard 1/2-height form factor
- LZS hardware compression

Benefits:

- **Fast** No repositioning; restores significantly faster than tape alone
- **Reliable** Demonstrated 500k loads/unloads with no failures
- **Compatible** Complements tape backup procedure – compatible with existing hardware and software
No extra footprint
- **Affordable** Lower cost than other D2D alternatives

Cartridge



Features

- Capacity: 100 GB native (200GB with 2:1 compression)
- Sealed 2.5" SATA HDD
- Industry-standard form factor

Benefits:

- **Removable in the field** Hard drives can be secured off-site or used
- **Reliable** Demonstrated 60,000 load/unloads w/no failures
- **Compatible** Forward compatibility with higher capacity Ulysses cartridges
Same gripper and indent features as tape cartridges
- **Flexible** Customize the mix of HDD to tape as needed

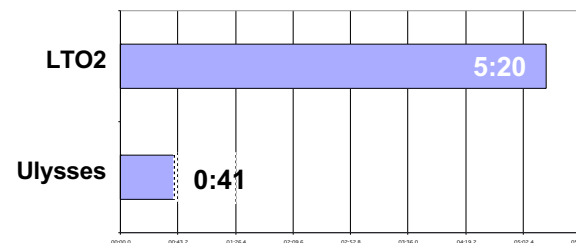
Ulysses was created to accelerate tape

- Tape media is best suited for most backup and archiving, because it is
 - Lowest cost per GB
 - Removable and portable
 - Infinite capacity
- However, tape systems are unable to deliver sufficient performance in certain applications, for example:
 - Slow restores of complex backup jobs, or
 - Tape drive performance with inconsistent data rates



Ulysses can economically improve tape automation performance by up to 10X

- Ulysses dramatically improves tape automation performance
- But not at the typically high cost of standalone D2D systems which are often out of reach or impractical for those with limited IT budgets
- Imation testing* shows Ulysses can restore 6 out of 100K files 7-10 times faster than LTO2 tape



- Ulysses can be installed for about the price of a tape drive and media

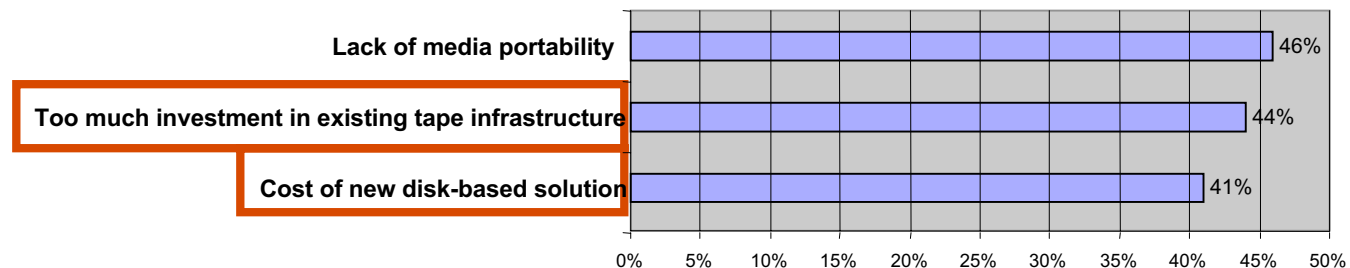


*Testing platform: Dell PowerVault 132t library
Data set: 20GB; 100,000 files
Timing in min:secs; inclusive of automation
Targeted restore: 3.5GB extracted from data set

Ulysses meets tape users' primary business requirements

- Users want to leverage their current infrastructure

Why do you believe your organization would not consider replacing its enterprise-class tape libraries with large-scale near-line disk solutions? (Percent of respondents, N = 39, multiple responses accepted)



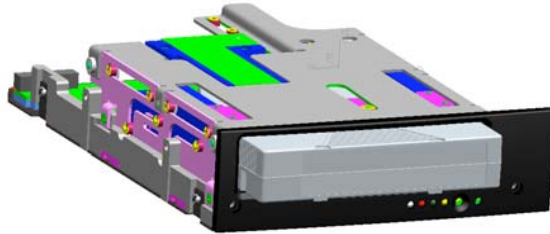
- Ulysses is very reliable and doesn't impact current IT processes

System Benefits

- Restore up to 10x as fast as an LTO drive
- Random access sequential tape preserve compatibility while offering higher performance
- Very reliable mechanism and cartridge
- Compatible with current automation and software
- Emulator is forward compatible with higher-capacity and higher-speed cartridges
- Flexible tape emulation (can emulate any kind of tape)

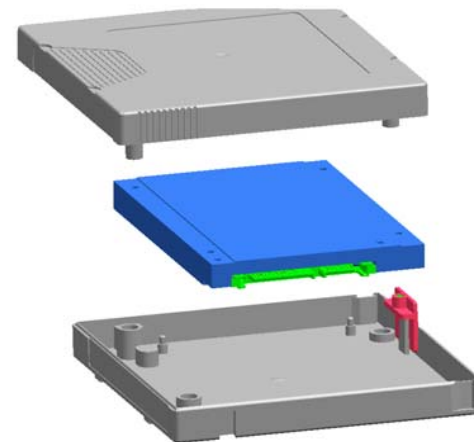
Ulysses Design Objectives

Emulator



- Designed for automation
- Identical size to a 1/2-height LTO drive.
- Identical mounting hole locations
- Identical cartridge opening location with extended cartridge lead-in
- Compatible insertion and extraction forces
- Serial library interface
- ALDC (LZ) hardware data compression
- Weight ~3 lbs
- Power 8 watts total during Read/Write.
- 1g operating vibration

Cartridge



- Dimensions are identical to an LTO cartridge
- Contains 2.5" SATA HDD instead of tape spool
- Same gripper and indent features as tape cartridges
- Cartridges weight about 75% of tape cartridge

Key Emulator Design Attributes

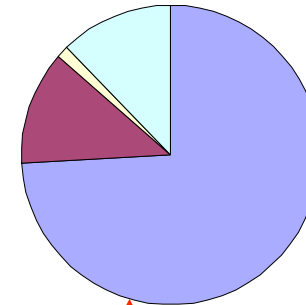
- Robust Cartridge/Emulator Interface
 - Issues associated with threading, tape motion & head clogging are eliminated.
 - Robust electrical interface between the Ulysses Cartridge & Emulator
 - Cartridge successfully performed over 100,000 load cycles under typical environmental test conditions (well beyond the design target of 20,000 cycles)
 - Supports transfer rates up to 80 MB/s
- 1g operational vibration
 - 3 times the LTO operational specification

HDD Reliability

- Ulysses utilizes the reliability enhancements of robust, mobile disk drives.
 - Power cycling
 - Lifetime writes/reads
 - Shock resistance
 - Sealed head-disk interface precludes interchange-related contamination and dependability issues presented with such products as the Iomega REV.
- Mean Time Between Failure (MTBF) rates for Ulysses are dramatically higher than rates for mid-range tape. 2,000 full file access cycles compares with 200 cycles for mid-range tapes.
- Cartridge Drop Resistance
 - The Ulysses Cartridge has been designed to withstand a drop from a height of 30 inches onto commercial grade carpeting. This drop strength requirement is motivated by similar specifications for mid-range tape cartridges. The mobile HDD embedded in the Ulysses Cartridges are rated for a 900 G half-sine wave shock of \Rightarrow 1 ms duration. This metric was used as a design point in the evaluation of Cartridge drop resistance. The shock imparted by the 30 inch drop test falls well within the margins of the HDD specification regardless of orientation.
- Imation anti-static housing protects HDD inside cartridge

Ulysses emulates tape cartridges while eliminating positioning delays

- Threading and positioning accounts for more than 80% of the time to first byte.
- This can be dramatically improved by using random access media.

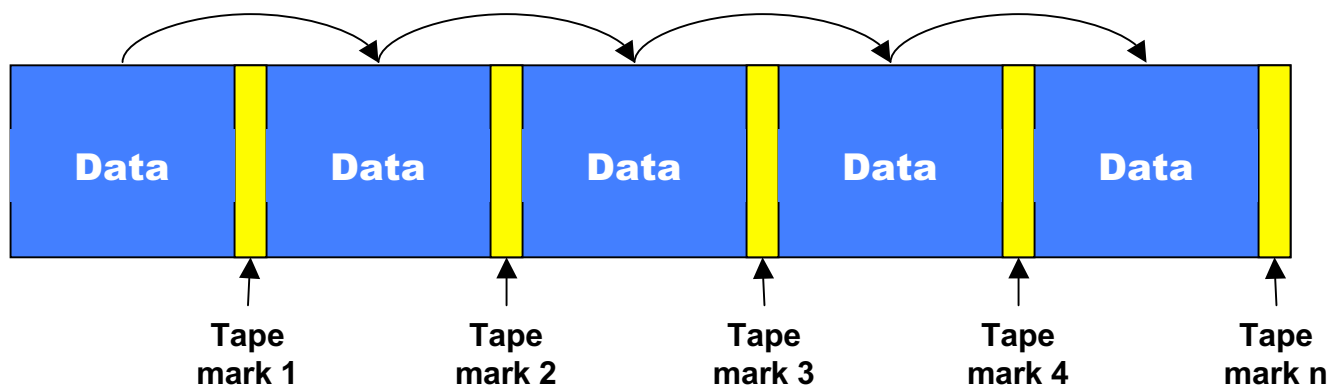


	Load from media slot	Insert into drive	Thread into drive	Position at first job	Position at 2nd job
Tape	5 seconds	1 second	10 seconds	60 seconds	60 seconds
Ulysses	5 seconds	1 second	4 seconds	0 seconds	0 seconds

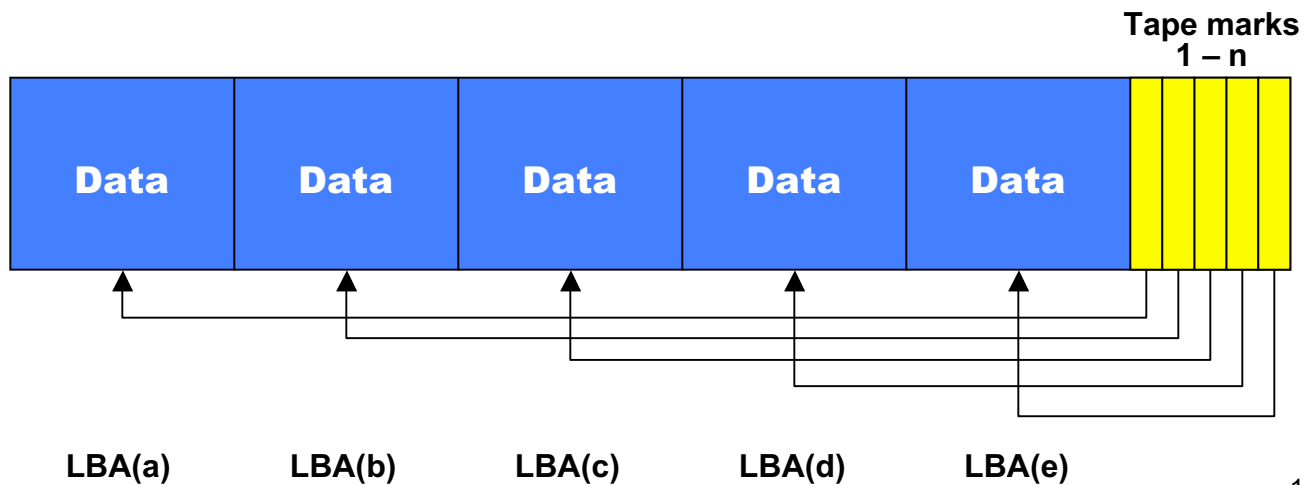
The Ulysses emulation takes advantage of the random access of the HDD. When tape data is parsed to disk, the sequential file marks are assigned pointers to its file location on disk, and stored in a separate file marker library.

Instead of seeking through discreet file markers interspersed in data fields, the Ulysses Emulator only has to locate the file marker in the library, and then directly access the data field on disk.

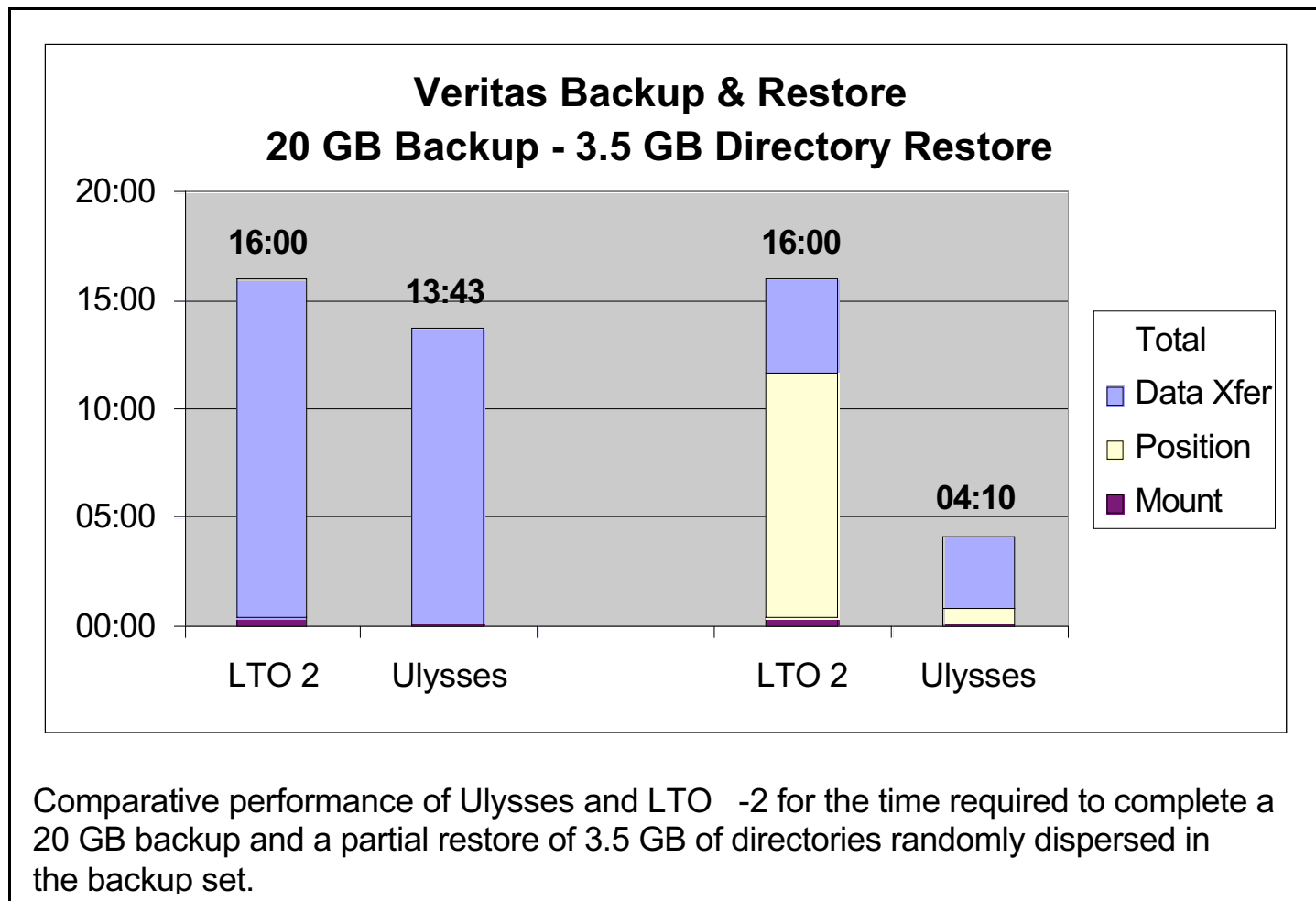
Read sequentially through tape to find desired tape marks, read/write files, then move sequentially to the next file marks.



Locate tape marks and associated data instantly, at random access speeds.

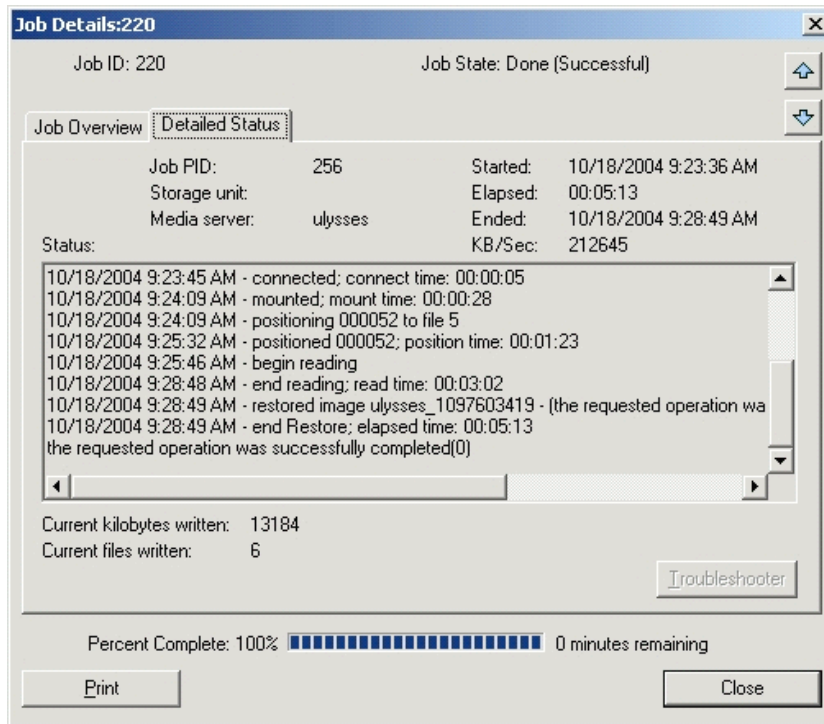


Data to support positioning claim



Ulysses Performance

(min:sec)	LTO -2	Ulysses
Library Mount Time	00:28	00:27
Position to 1 st Byte	01:23	00:01
Read Time	03:02	00:07
Total Job Time	05:13	00:41



Job Details:220
Job ID: 220 Job State: Done (Successful)

Job Overview Detailed Status

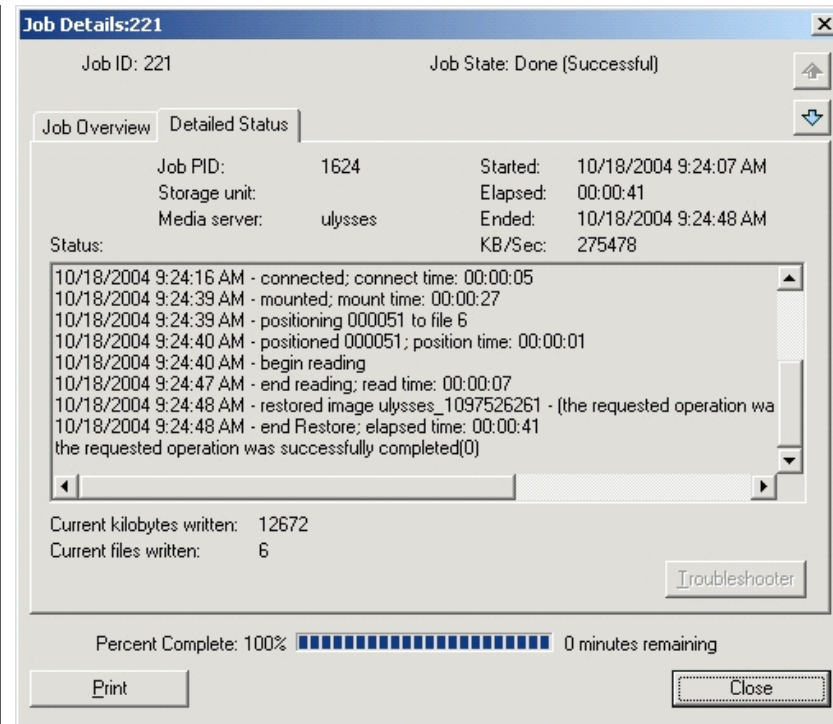
Job PID: 256 Started: 10/18/2004 9:23:36 AM
Storage unit: Elapsed: 00:05:13
Media server: ulysses Ended: 10/18/2004 9:28:49 AM
Status: KB/Sec: 212645

10/18/2004 9:23:45 AM - connected; connect time: 00:00:05
10/18/2004 9:24:09 AM - mounted; mount time: 00:00:28
10/18/2004 9:24:09 AM - positioning 000052 to file 5
10/18/2004 9:25:32 AM - positioned 000052; position time: 00:01:23
10/18/2004 9:25:46 AM - begin reading
10/18/2004 9:28:48 AM - end reading; read time: 00:03:02
10/18/2004 9:28:49 AM - restored image ulysses_1097603419 - (the requested operation was
10/18/2004 9:28:49 AM - end Restore; elapsed time: 00:05:13
the requested operation was successfully completed(0)

Current kilobytes written: 13184
Current files written: 6

Percent Complete: 100% 0 minutes remaining

Print Close Troubleshooter



Job Details:221
Job ID: 221 Job State: Done (Successful)

Job Overview Detailed Status

Job PID: 1624 Started: 10/18/2004 9:24:07 AM
Storage unit: Elapsed: 00:00:41
Media server: ulysses Ended: 10/18/2004 9:24:48 AM
Status: KB/Sec: 275478

10/18/2004 9:24:16 AM - connected; connect time: 00:00:05
10/18/2004 9:24:39 AM - mounted; mount time: 00:00:27
10/18/2004 9:24:39 AM - positioning 000051 to file 6
10/18/2004 9:24:40 AM - positioned 000051; position time: 00:00:01
10/18/2004 9:24:40 AM - begin reading
10/18/2004 9:24:47 AM - end reading; read time: 00:00:07
10/18/2004 9:24:48 AM - restored image ulysses_1097526261 - (the requested operation was
10/18/2004 9:24:48 AM - end Restore; elapsed time: 00:00:41
the requested operation was successfully completed(0)

Current kilobytes written: 12672
Current files written: 6

Percent Complete: 100% 0 minutes remaining

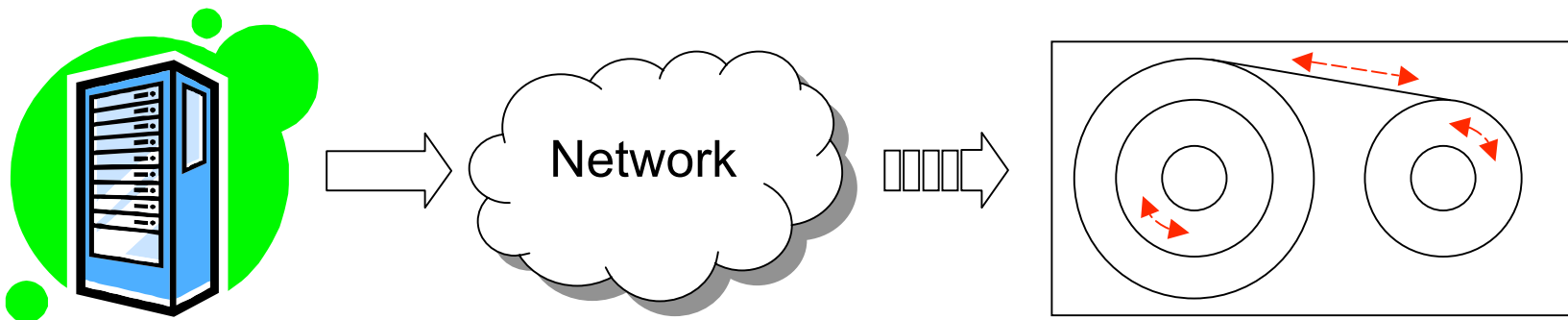
Print Close Troubleshooter

Performance

- Raw system transfer rates similar to LTO2 tape in an IBM 3580 LTO2 drive;
- Backup times equivalent to LTO2 tape when performing tasks with Veritas NetBackup software;
- Targeted restore times 4 to 10 times faster than LTO2 tape in an IBM 3580 LTO2 drive;

Tape shoe-shining results in inadequate backup performance

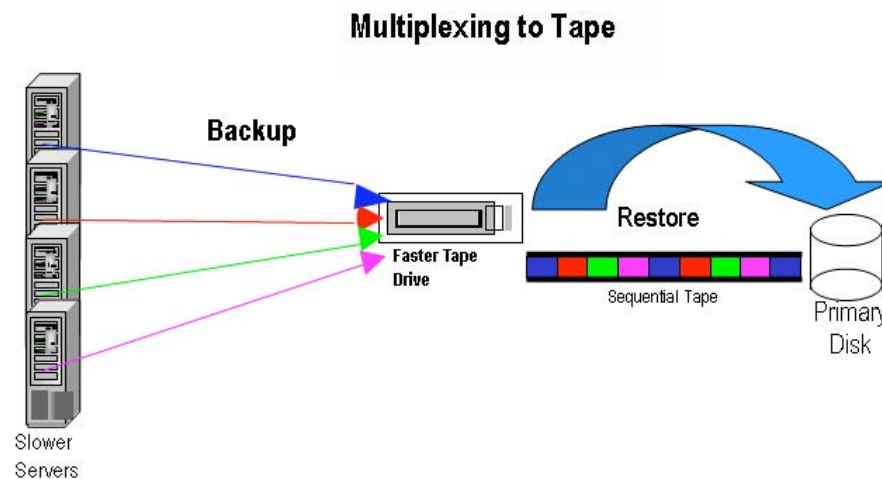
- When system latencies cause shoe-shining (the tape stops, reverses, and waits for the data buffer to fill) seriously degrading backup rates
- HDD can absorb data transmissions that arrive in bursts, so latencies are not a problem



Tape drives obtain optimized data transfer rates when the host server can continuously keep the drive data buffer partially full. With the HDD in the Ulysses system, the disk simply continues to spin until data is available in the buffer, in the event that the host cannot maintain the data rate of the Emulator. The latency associated with this operation is only a few revolutions of the disk, or approximately 5 milliseconds. Thus the system will self-synchronize to slower hosts without noticeable performance degradation.

Multiplexing Performance

- Multiplexing is used when individual servers are not able to meet the optimum transfer rate of the tape drive, and data from several servers are multiplexed into one stream to optimize the process. Multiplexing optimizes the backup window, but restoring from a multiplexed source increases the latency multifold.



- This latency is eliminated with random access media

Q&A / Discussion

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