

# Next Generation Solutions for Optimizing Disk-to-Disk Backup and Recovery

**“... VTL IS A  
BUILT-IN TAPE  
EMULATION  
FEATURE THAT  
GIVES DISK  
STORAGE THE  
“LOOK AND FEEL”  
OF A TAPE LIBRARY  
WITH THE ADDED  
BENEFITS OF  
GREATER SPEEDS,  
REDUCED COSTS  
AND SOPHISTICATED  
MEDIA MANAGEMENT  
CAPABILITIES.”**

**Highlighting NetVault: Backup’s VTL and SVTL**

# whitepaper

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## Introduction

Disk-based backup is gaining market momentum as an economical and highly effective way to reduce backup windows and boost recovery timeframes while ensuring compliance with mounting regulations and corporate governance demands. Since disk technology is faster and inherently more reliable than tape, it's an ideal nearline backup method for restoring recently lost files or accelerating disaster recovery efforts. In addition, new iSCSI disk-based solutions and the emergence of inexpensive SATA (Serial ATA) drives have lowered overall costs, leading to an even more compelling value proposition for disk-to-disk (D2D) backup and recovery.

Disk drives offer direct random access, enabling multiple concurrent backup sessions and read/write efficiency improvements. The resulting productivity gains and lowered operating expense can lead to significant time and cost savings. In comparison, tape technology, which uses sequential access, is much slower. Still, tape plays a vital role in backup and recovery operations, especially when it comes data retention and archival.

A virtual tape library (VTL) offers the best of both worlds: the advantages of high-speed disk technologies for expediting backup processes while benefiting from the portability and security of tape for longer-term, offline storage. When used together, VTL and tape-based backup yield optimal data protection with improved performance, streamlined operations and increased reliability. BakBone Software Inc. has capitalized on this capability with its VTL plug-in module for NetVault: Backup, which lets administrators design any number of customized virtual tape libraries, each with its own specific number of tape drives, slots and sizes to meet particular requirements. BakBone has applied the same paradigm and nomenclature used with physical tape libraries (e.g., drives, media pools, rotation cycles, etc.) to streamline overall management.

Since NetVault: Backup treats the VTL like a physical tape library, it doesn't require different or additional administration. BakBone's VTL supports full, incremental and differential backups while integrating seamlessly with real tape library resource management. In addition, the direct-access restore feature simplifies overall operation by supporting file restores from disks or tapes without any disk re-staging. The increasing popularity of BakBone's VTL has led to the development of a next-generation solution, NetVault: Backup's shared virtual tape library (SVTL). SVTL enables administrators to create and share a VTL with multiple NetVault: Backup machines for extended functionality, higher performance D2D backup and even faster restores.

## NetVault: Backup Virtual Tape Library

### WHAT IS A VIRTUAL TAPE LIBRARY (VTL)?

A VTL is a built-in tape emulation feature that gives disk storage the "look and feel" of a tape library with the added benefits of greater speeds, reduced costs and sophisticated media management capabilities. A VTL lets an administrator "virtualize" a tape resource on disk. With BakBone's capability, the VTL structure and backup data are stored on top of the file system host, which can be a NetVault: Backup server or any other heterogeneous NetVault: Backup Client Node licensed as a Smart Client. A NetVault: Backup domain can host one or more VTLs, and a host can own one or more VTLs. A VTL can be used independently of the file system (e.g., NTFS, UFS, ext3, etc.) as well as the disk system (e.g., IDE, RAID, SCSI, Fibre Channel, DAS or iSCSI). Both file- and block-level backups and restores are supported. When acting as a tape library, a VTL can host one or more client backups connected through a local area network (LAN).

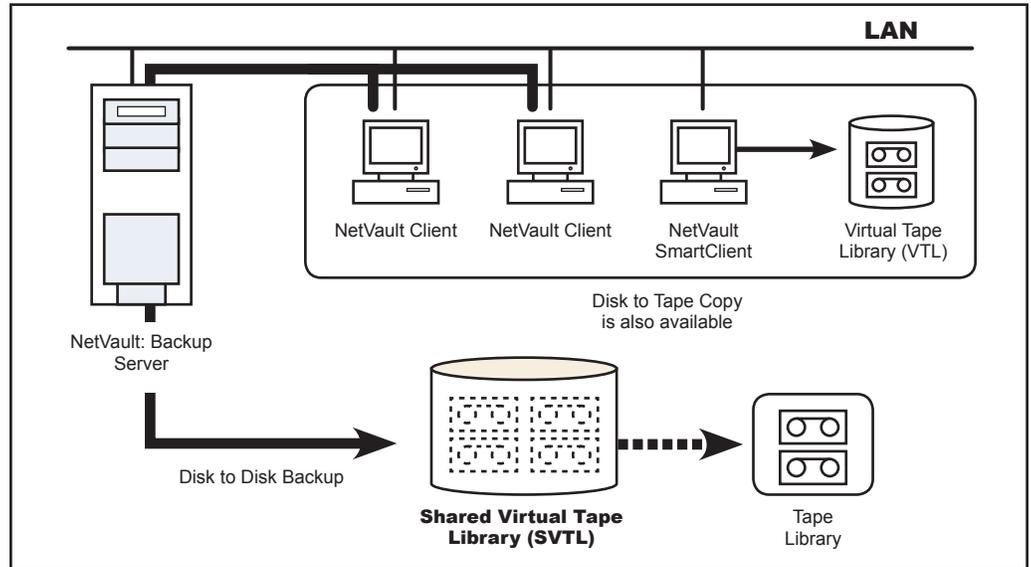
The media manager doesn't distinguish between a VTL and a physical tape library, which simplifies the process of setting specific backup policies, including retention dates, rotation schemes and media groups. Save sets can be accessed wherever they reside and incremental backups can be sent to disk for ultra-fast restores. With BakBone's VTL strategy, tape becomes a crucial component of a broader data protection strategy— rather than its primary ingredient.

With NetVault: Backup, multiple copies of backup jobs can be created from the VTL to tape or vice versa. By storing backup data on a VTL, administrators can run data copy or duplication jobs off-line, without impacting network, application server or workstation performance. VTLs eliminate the

mechanical penalties of tape backup over a network, such as “shoe-shining,” or a slow data-stream host. VTLs capture data—whether it’s trickled, blasted, or gently passed along—and saves it on virtual media slots as a “saveset.” Ultimately, this method of capturing data produces substantial performance improvements while slashing backup windows dramatically.

As the diagram below illustrates, an automatic, two-phase approach is used to copy data to a VTL:

**Diagram 1: VTL Two-Phase Data Copy Process**

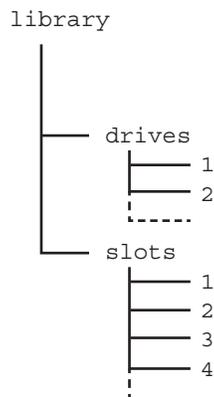


During the first phase of a staged job, all selected data is backed up to the VTL. Once this process is completed, the second, “data copy” phase begins and copies the “saveset” from the VTL to physical tape. This automatic, two-phase process is defined in the job. After the data copy completes, the space used in the VTL is cleared and available for another backup

### How VTL Works

A VTL consists of directories, called drives and slots, on a disk. These drives and slots each contain unique, numbered directories. The media file that resides in each numbered slot directory represents a “tape” in the virtual library, while a media file that resides in each numbered drive directory represents a “drive.”

**Diagram 2:**

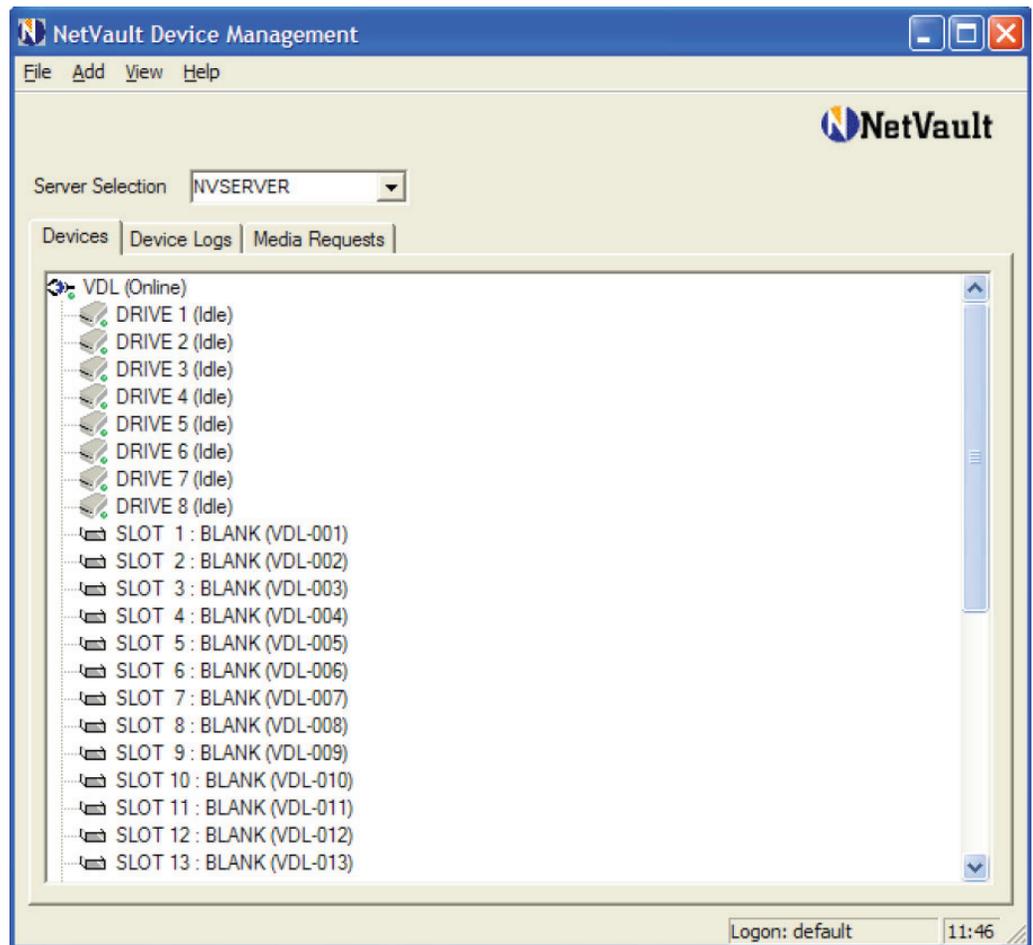


The above diagram illustrates VTL structure built upon an O/S file system.

Since NetVault: Backup treats virtual libraries just like real physical libraries in every way, administrators don't need to manage a VTL any differently than their physical tape libraries. As with a physical library, the number of drives contained in the VTL dictates how many simultaneous backups can be performed. To function properly, there must always be as many or more slots as there are drives, which allow for optimal handling of backup retention cycles.

Also, different operating systems may impose limits on the maximum file size, which can affect the number of slots required. When configuring the VTL, the administrator will establish the number of slots and media capacity. NetVault: Backup then will create the appropriately sized media files and pre-allocate sufficient space in the VTL.

**Diagram 3:**



The screenshot depicts a VTL in the NetVault: Backup Graphical User Interface (GUI).

## Optimal VTL Deployments

### Backing up Large File Systems

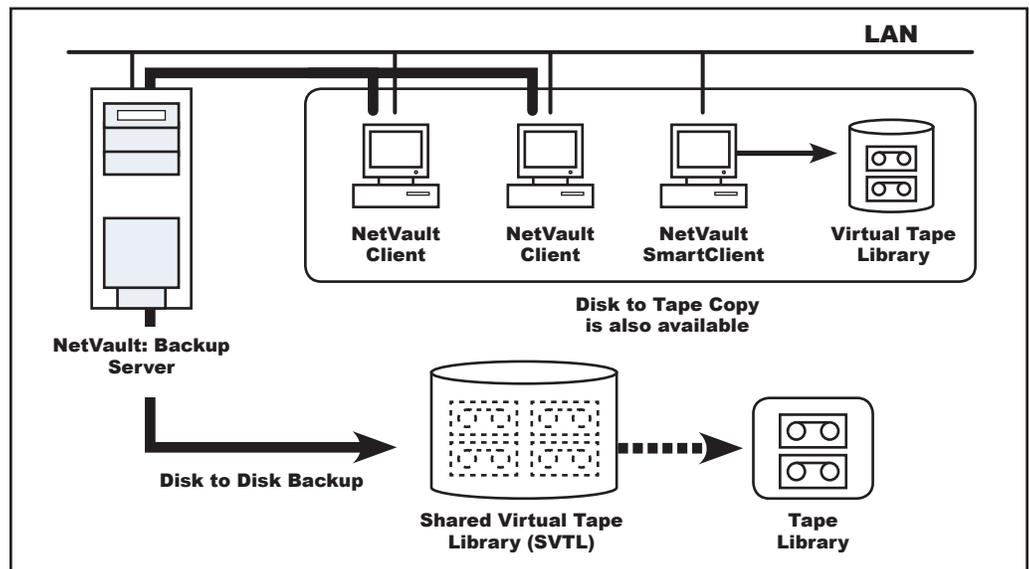
VTLs are ideally suited for LAN and network-attached storage (NAS) environments with large file-system backup requirements as well as backup window constraints. For example, if a company has a massive file system containing millions of files, a typical server might not be able to read the files fast enough to stream data to high-performance tape drives. The resulting problem, called "shoe-shining," can cause premature drive or media failures. It is always important to stream tape hardware at its native rates. Disk storage, however, is immune to this problem and isn't affected by shoe-shining. As a result, VTLs don't suffer a performance penalty if a huge file system slows the backup process.

### Backing up Clients Simultaneously

Another fitting scenario for a VTL could involve a backup window that simply is too small to back up several clients onto a limited number of tape drives. In this particular instance, a VTL can be created with ample virtual drives to back up all clients simultaneously. While overall performance would depend on network bandwidth, a Gigabit Ethernet network would provide sufficient capacity for handling the additional network traffic created by the backup window restriction.

The following diagrams depict typical VTL deployments:

**Diagram 4: VTL for Local Backup and LAN Backup**



*This diagram illustrates backup process involving a SmartClient and its attached VTL as well as a centralized VTL attached to the backup server in addition of a physical tape drive.*

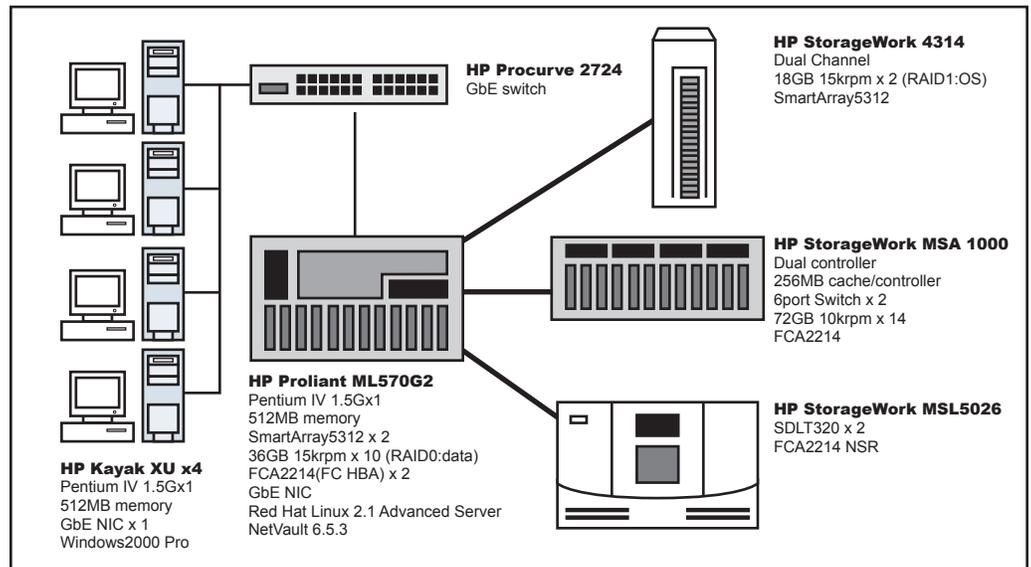
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## VTL Performance Comparison

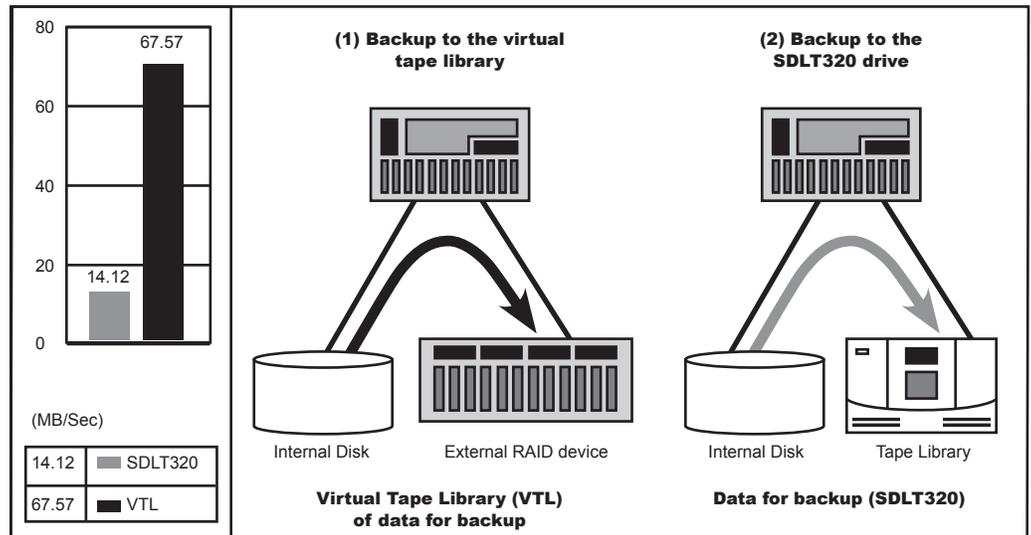
As the following performance comparison demonstrates, VTL facilitates faster backup and restores than single tape. In weighing performance, key parameters must be taken into consideration, including network, client file-system and disk performance as well as the total number of tape drives. VTL also is faster than other D2D solutions that don't support simultaneous disk streaming. With NetVault: Backup, tape drive virtualization lets administrators create as many virtual tape drives as they need to meet specific performance requirements. In addition to speeding backups, BakBone's VTL facilitates near-instantaneous restores on average and significantly faster restores when compared to tape. Overall, VTL boosts backup and recovery performance while reducing hardware costs in most cases.

The following performance evaluation pitted NetVault: Backup's VTL capability against a SDL320:

**Diagram 5: VTL Evaluation Environment**

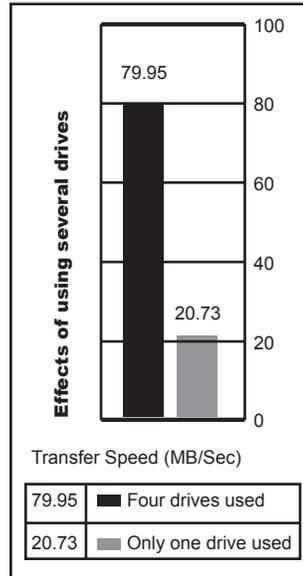


**Diagram 6: Performance Evaluation: Disk-to-VTL versus Disk-to-Tape**



Overall backup performance using a VTL is nearly five times greater when compared backing up directly to tape.

**Diagram 7: Comparing Simultaneous Backups in a LAN Environment**



Four networked clients are backed up simultaneously to a NetVault: Backup server-attached VTL configured with four virtual tape drives. Average transfer speed was estimated based on starting the backup jobs at the same time and then determining how long it took to complete the jobs. Overall, VTL backup performance on four virtual drives was four times faster than a single virtual tape drive and nearly six times superior to performance on a single SDLT320 tape drive.

**Diagram 8: Data Restore Performance Comparison\***

	Restore from tape	Restore from VTL
Cartridge swap	15 sec	<1sec
Cartridge load time	12 sec	<1sec
Average file access time	70 sec	<1sec
Transfer time	16MB/sec	160MB/sec (per controller)

\*Based on hardware technical specifications

Restoring a small, single file from a VTL is nearly instantaneous while it can take an average of 97 seconds to recover from a tape due to the mechanics of tape-drive operations. Restoring larger files is also faster from a VTL than tape, depending upon the client disk- and file-system write performance.

## NetVault: Backup Shared Virtual Tape Library

### What is a Shared Virtual Tape Library (SVTL)?

A shared virtual tape library (SVTL) is an extension to NetVault: Backup's existing VTL allowing administrators to share a Virtual Library with multiple client machines as if it were a conventional tape library in a storage area network (SAN) or iSCSI SAN environment. In contrast, a VTL requires that a single-node file system (i.e., server or smart client) own the library and handle all data transfers through this node and its associated filesystem overhead. With SVTL, on the other hand, "raw device data movers" are used for all read and write operations, without the single-node ownership constraint. As a result, SDVL operations deliver increased performance while providing administrators with greater levels of flexibility.

The benefits of this next-generation, unique D2D solution are higher performance backups, expedited restores and lower total cost of ownership (TCO). For example, a NetVault: Backup server and multiple other machines can share a single virtual library in Linux, Solaris and Windows environments. BakBone's SVTL solution is the first of its kind on the market and especially well suited for centralized D2D backup while eliminating the need for multiple disk units or distributing partitioned disks across multiple client nodes.

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Centralized backups lower overall TCO while easing administration by providing a comprehensive, cohesive view of total disk capacity. This approach also yields improved storage utilization because administrators have greater control and more flexibility to share free disk space between all clients instead of dealing with fixed free space for every client.

While NetVault: Backup's SVTL can be used independently of the disk hardware, it is designed for use in SAN or iSCSI environments that permit disk sharing between multiple client nodes.

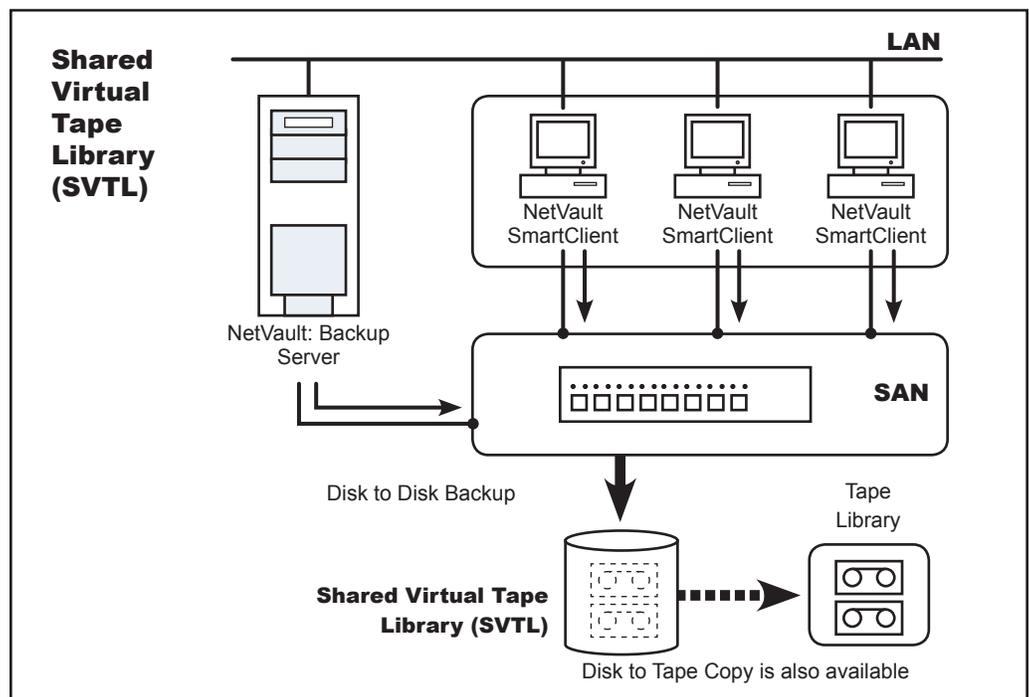
### How SVTL Works

SVTL structure is quite simple and does not generate additional maintenance considerations as it relies on "raw device data movers" and propriety file format types. With the identical "look and feel" of its VTL counterpart, SVTL only differs in that a virtual drive can be accessed by a single client or multiple client nodes if they are licensed with DSD-dynamically shared drives. Many of the VTL configuration rules also apply to SVTL except when defining the quantity of slots and media capacity. With SVTL, NetVault: Backup doesn't pre-allocate disk space, so SVTL initialization occurs almost immediately, which is an improvement over VTL initialization. As a natural evolution to its existing VTL capability, SVTL offers unprecedented functionality and flexibility.

### Optimal SVTL Deployments

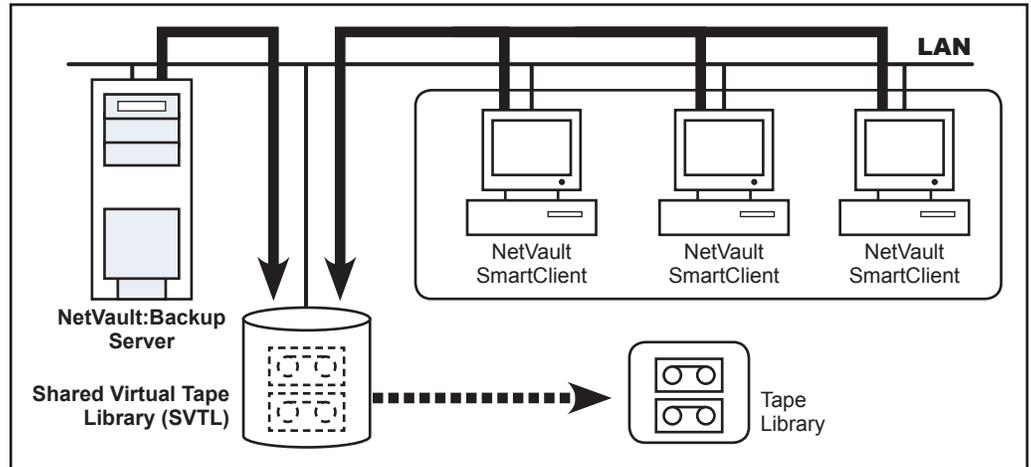
- Improved D2D Backups with Significantly Reduced Backup Windows. As an advanced D2D backup operation, SVTL maximizes performance while slashing backup windows. In particular, the use of "raw devices" eliminates VTL file system overhead, especially noticeable when backing up large files. In addition, SVTL removes the need to transfer all backups through a single client node, which disposes of network and bus overheads.
- Centralized D2D with Direct Backups to Disk Distributed Across Client Nodes. Instead of distributing multiple hardware across a network and attaching multiple VTLs to different clients, SVTL centralizes all the backups in a single VTL. The result is streamlined management and lowered costs.

**Diagram 10: SVTL in a SAN Environment**



*This diagram shows how a SVTL is shared between multiple heterogeneous clients across the network. The virtual "a rm" is owned by a single node and each virtual tape drive is directly accessed by a single node or simultaneous client nodes in a SAN environment .*

**Diagram 11: SVTL in an iSCSI Environment**



This diagram shows how a SVTL is shared between multiple heterogeneous clients across the network in an iSCSI environment.

### SVTL Performance Comparison

As the following performance comparison demonstrates, SVTL facilitates faster backup and restores over VTL and single-tape operations. In weighing performance, key parameters must be taken into consideration, including network, disk performance, system and software settings such as the total number of tape drives and the block size needed for write and read operations. SVTL also is faster than any other D2D solutions and tape library emulation software because it allows multiple clients to have access to multiple virtual tape drives directly and simultaneously. In doing so, NetVault: Backup's SVTL lets administrators meet specific performance requirements

In addition to speeding backups, BakBone's SVTL facilitates near-instantaneous restores on the same client node or alternate client node when compared to tape or VTL. SVTL also reduces hardware costs in most cases by enabling a common disk resource to be shared between multiple client nodes across the network instead of having multiple disks or partitions distributed across the network.

The following performance evaluation was conducted by NCR in January 2005: The test systems used included:

- Teradata system: Four-node NCR 5380 w/ dual 3.06GHz Intel P4 Xeon processors
- BAR Servers: NCR 4480 w/ dual 3.06GHz Intel P4 Xeon processors, 2GB RAM
- Disk array: 5884 array controller with SATA drives
- Gigabit Ethernet switch: SMC 8508T switches
- Gigabit Ethernet adapters - Intel PRO/1000MT Dual adapter, on-board Intel 82546EB adapter
- Fibre Channel host bus adapters: LSI Quad 2GB FC HBA LSI7004
- LSI 5885 controller: 512KB Segment size, Raid 5 6+1 Luns, 5x prefetch
- NetVault: Backup SVTL: raw disk, I/O 256KB

Diagnostic ARC	Write WCM(*)	Write No WCM(*)	Read
1 Stream	69.7 MB/sec	116.4 MB/sec	99.4 MB/sec
2 Stream	122.3 MB/sec	217.92 MB/sec	205.8 MB/sec
3 Stream			
4 Stream		256.6 MB/sec	243.03 MB/sec

(\*) Write Cache Memory

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## Comparing VTL and SVTL to standard tape libraries

### Reliability

NetVault: Backup customers that have taken advantage of VTL and others currently using SVTL all report improved performance and less incidents or technical support calls when compared to their traditional tape library deployments. In fact, customers across the board have reported increased reliability since embracing a D2D backup and recovery solution. VTL/SVTL backups are much more reliable than their tape counterparts, which can be complex and susceptible to a variety of media and drive challenges.

For instance, problems with physical tape drives and media often lead to higher instances of backup and restore failures. Although hardware vendors have increased the reliability of tapes, tape drives and robotics significantly, the complexity of integrating all the tape mechanics combined with SCSI-layer integration with the operating system restricts overall reliability of physical tape libraries. In addition, the use of RAID storage with VTL/SVTL makes read and write failures highly unlikely.

### Backup and Restore Performance

Substantial performance improvements over standard tape backup and recovery meet ever-increasing needs to complete backups in specific and often shrinking backup windows. On the tape front, the additional time required to mount, load and access data can slow backups considerably. In contrast, these same operations occur almost immediately with disk-based technology.

The following comparison highlights the average performance differences between disk and tape backup:

- **Average disk performance (test performed on MSA1000)**
  - o Capacity per disk: 72 GB of raw capacity
  - o Transfer time: 2.12 Gbps
  - o Seek time not specified but measured in nanoseconds
  - o Rotate time not specified but measured in nanoseconds
- **Average tape performance (test performed on MSL5026 tape library)**
  - o Capacity per tape: 200 GB
  - o Transfer time: 16 Mbps
  - o Cartridge swap time: 15 seconds
  - o Load time: 12 seconds
  - o Seek time: 70 seconds on average
- **Performance comparison between a VTL and SVTL based on tests performed by NCR in January 2005 with a LSI 5885 disk controller and SATA drives.**

512KB Segment size, RAID 5 6+1 Luns, 5x prefetch  
 NetVault: Backup VTL - NTFS file system - I/O limited to 64KB

Diagnostic ARC	Write – WCM	Write - No WCM	Read
1 Stream	53.9 MB/sec	75.3 MB/sec	34.1 MB/sec
2 Stream	91.6 MB/sec	126.8 MB/sec	63.7 MB/sec
3 Stream			

512KB Segment size, RAID 5 6+1 Luns, 5x prefetch  
 NetVault: Backup SVTL - Raw Disk - I/O 256KB

Diagnostic ARC	Write – WCM	Write - No WCM	Read
1 Stream	69.7 MB/sec	116.4 MB/sec	99.4 MB/sec
2 Stream	122.3 MB/sec	217.92 MB/sec	205.8 MB/sec
3 Stream			
4 Stream		256.6 MB/sec	243.03 MB/sec

In addition, restores are faster with VTL/SVTL solutions than using physical tape due to the random access nature of disks versus the sequential access method deployed by tape technology.

### Performance Considerations

There are several factors to take into consideration when measuring the performance differences between disk- and tape-based backup and recovery. While tape is slower inherently, there are ways to boost overall performance. For example, increasing the number of tape drives and controllers as well as changing network topology can improve performance.

It's difficult to make sweeping generalizations that disk is always faster than tape. While every case is dependent upon an organization's overall requirements, a combination of disk and tape maximizes overall performance typically and offers the most performance and management benefits. An integrated disk-to-disk-to-tape (D2D2T) approach delivers the most comprehensive data protection and advanced backup and recovery solution as described previously.

Other comparisons to take into consideration include:

- Advantages of disk over tape
  - o Increased durability with longer lifespan and ability to support more frequent data rewrites;
  - o Sealed cases are less susceptible to external environment issues (e.g., heat and humidity)
  - o 100 percent accuracy for restored data;
  - o Regular cleaning of "write" heads not required, which reduces TCO.
- Advantages of tape over disk
  - o Tape has been considered to be less expensive than disk storage for years. However, continuing disk-price erosion is changing this perception
  - o Removable media that can be put in a safe/off-site
  - o The ability to meet longer-term archiving compliance requirements.

### Disk Staging Vs. Tape Multiplexing

Distinct advantages of disk staging exist over typical tape multiplexing. Among these benefits is the ability to accommodate backing up multiple clients to a limited number of tape drives in a short backup window. NetVault: Backup addresses this challenge with disk staging instead of the more commonly used multiplexing method. With multiplexing, multiple streams of backup data can be directed to one tape device, which creates numerous drawbacks including:

- Increased need for multiple tapes per client backup, because the backup of any given client can span much more tape than actually required.
- Higher probability of failures since more media is used for any given backup.
- Restores take longer because more tapes need to be scanned for any given restore since data must be reconstructed from multiple data streams which is time consuming.
- CPU-intensive operations because data streams must be reorganized and packed into a multiplexed stream, which can cause severe performance degradation with high-speed tape devices.

To overcome these problems, NetVault: Backup first sends data to the VTL/SVTL, where it's copied or migrated to physical tape at maximum tape-drive throughput. Consequently, restoring from this tape is much faster than recovering data from a multiplexed tape backup.

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## Complementary D2D2T Solutions

Most data-intensive environments have requirements that are well suited for a complementary mix of both disk- and tape-based data protection. BakBone recognizes the benefits of an integrated D2D2T backup and recovery approach and provides the following deployment scenarios to demonstrate the effectiveness of both VTL and SVTL in blended backup implementations for maximizing performance, efficiency and TCO.

NetVault: Backup leverages the strengths of disk and tape technology to deliver robust yet easy-to-manage data protection. Unique functionality and embedded system intelligence combine the best of both technologies for unprecedented backup and recovery capabilities, including consolidated incremental backups, enhanced administrator productivity, increased automation as well as reduced backup vulnerabilities with the ability to retain multiple copies.

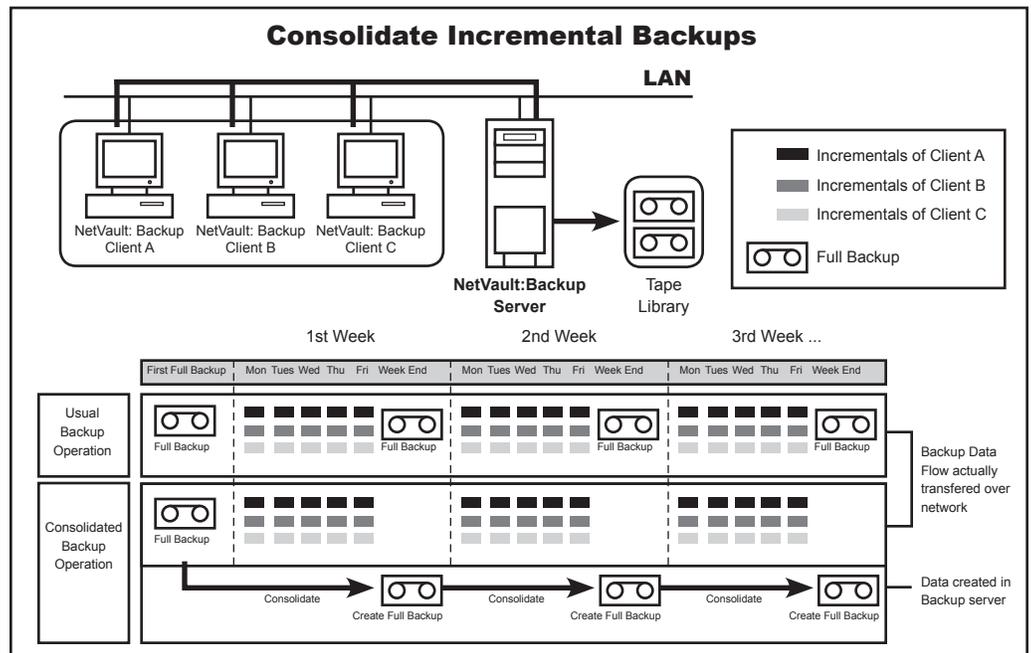
### Reduce Backup Windows with NetVault: Backup's Consolidated File System Feature

When used in conjunction with this innovative capability, VTL/SVTL deployments produce greater performance gains by enabling administrators to create a synthetic full backup without actually running a full backup each week. Initially, they need to run one full backup to serve as the base. Once the full backup has been created, administrators simply combine incremental or differential backups to maintain the full backup, which saves significant time and effort since all subsequent full backups are performed in background once an incremental backup is done.

Specific steps for optimizing consolidated file-system backup include:

- Create full-backup base and send to tape library as normal operation.
- Send nightly incremental backups to VTL/SVTL with a life-span of three days, which lets most common restore requirements be handled by the VTL/SVTL.
- After the incremental is completed, a consolidated full backup is created/updated from both the incremental and base-line full backup. Because disk technology is used to perform the incremental backup, consolidation time is reduced considerably.
- Once the consolidated full backup is complete, a copy of the incremental backup can be placed on tape optionally, giving the administrator further flexibility to retain multiple file versions.

**Diagram 12: Consolidated Incremental Backup Strategy**



*This diagram demonstrates how NetVault: Backup consolidates incremental backup functionality to better leverage D2D capabilities while yielding significantly faster backups.*

### **Improved Application Recovery**

NetVault: Backup offers improved data protection of mission-critical servers and applications by enabling administrators to separate backup and recovery of vital systems from standard daily backup operations. With this capability, it's no longer necessary to shut down crucial applications, databases or messaging systems in order to conduct regular backups. Instead, hot-line backups can be directed to a VTL/SVTL during the day to maximize speed and lessen total backup time. After hours, backups then can be migrated or duplicated to tape easily, without disrupting application servers. In return, space on the VTL/SVTL automatically is freed for the next day's regular backup. Under this scenario, restores are expedited as well since important data can be recovered quickly from the VTL/SVTL without needing to locate appropriate files on the tape archive.

### **NetVault: Backup's Unprecedented Flexibility with Third-Party VTL Support**

NetVault: Backup offers unprecedented flexibility with its ability to work seamlessly with other third-party hardware and software vendors to deliver best-of-class D2D backup alternatives. NetVault: Backup can be integrated easily with backup appliances that use inexpensive disk arrays as well as other backup solutions to simplify overall data protection while increasing backup and restore performance.

NetVault: Backup's SVTL is hardware and software independent, protecting investments in existing backup hardware and virtual tape library (VTL) software. NetVault: Backup offers advanced data protection and a compelling economic value proposition for meeting the growing backup and recovery demands of both medium-sized and largescale environments.

#### **What is a Third Party VTL?**

A virtual tape library (VTL) on disk typically is a dedicated computing appliance that emulates the drives of a physical tape library and stores backup images on disk. The difference between a VTL and NetVault: Backup's VTL/SVTL is that the emulation is provided by a third-party tool that is integrated with the disk array generally.

The paradigm for managing backups remains the same regardless of whether an organization uses tape or VTL/SVTL. The third party VTL allows an administrator to configure virtual tape drives and cartridges as well as specify cartridge capacity as NetVault: Backup VTL or SVTL. Unlike physical tape libraries, that require additional tape drives to be purchased and installed, virtual tape drives can be added to the third party VTL by changing the software configuration without incurring additional hardware costs.

NetVault: Backup currently supports third party VTLs from a variety of leading vendors as identified in the compatibility matrix that can be found on the company's website: [http://www.bakbone.com/docs/NetVault\\_Backup\\_Supported\\_Libraries.pdf](http://www.bakbone.com/docs/NetVault_Backup_Supported_Libraries.pdf)

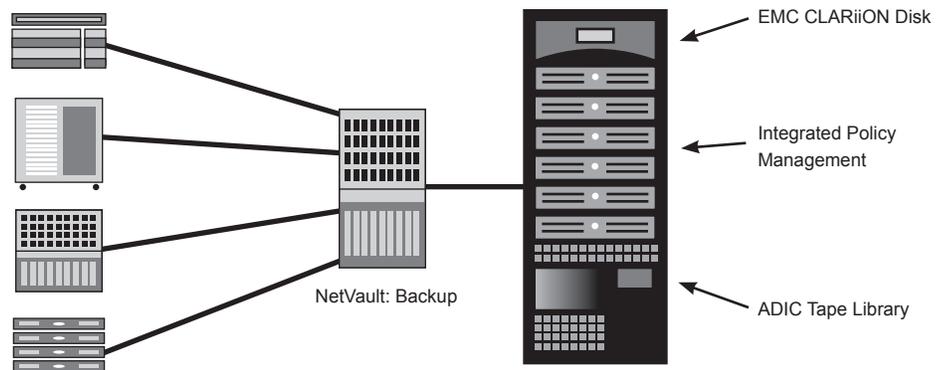
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**A synopsis of this third party VTL support follows in alphabetical order:**

### ADIC Pathlight VX

#### Features and Benefits

- Disk-based backup and restore using EMC CLARiiON disk
- Integrates capacity of tape with disk to provide scalable capacity from 3.8 to 2,823.2 TB
- Embedded data management policies let users balance service levels with value, and provide backup data life cycle management
- Integrated solution provides single point of management for lower total ownership costs
- Presents disk-based backup system as a virtual tape library, which preserves user's investment in existing backup processes
- Exports media under backup software control in native application format for secure data retention and flexible disaster recover

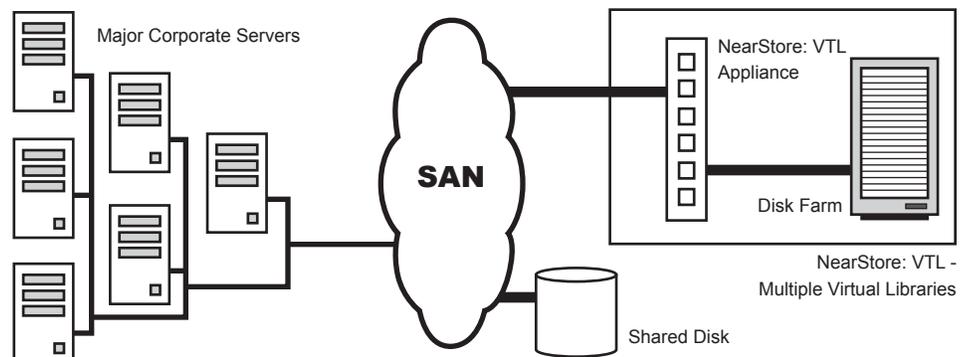


For more information please refer to ADIC's web site: <http://www.adic.com/diskbackup>

### NetApp NearStore: VTL Tape Library Emulation

#### Features and Benefits

- A single NearStore: VTL appliance can replace the shared tape library for a maximum backup throughput of 450 Mbps
- NearStore: VTL is configured into ten virtual libraries or one per server to allow simple and simultaneous backups
- No tuning or load balancing is required
- No degradation when data streams change speeds and no impact if servers run disparate backup applications
- Backups automatically occur at the fastest rate the server is able to deliver the data.
- If companies require off-site data-copies, they can connect a single SDLT-220 drive to the NearStore: VTL server and generate them automatically, post backup.



For more information please refer to the Network Appliance web site: <http://www.netapp.com/>

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## ATTO Diamond Storage Array VT-Class

### Features and Benefits

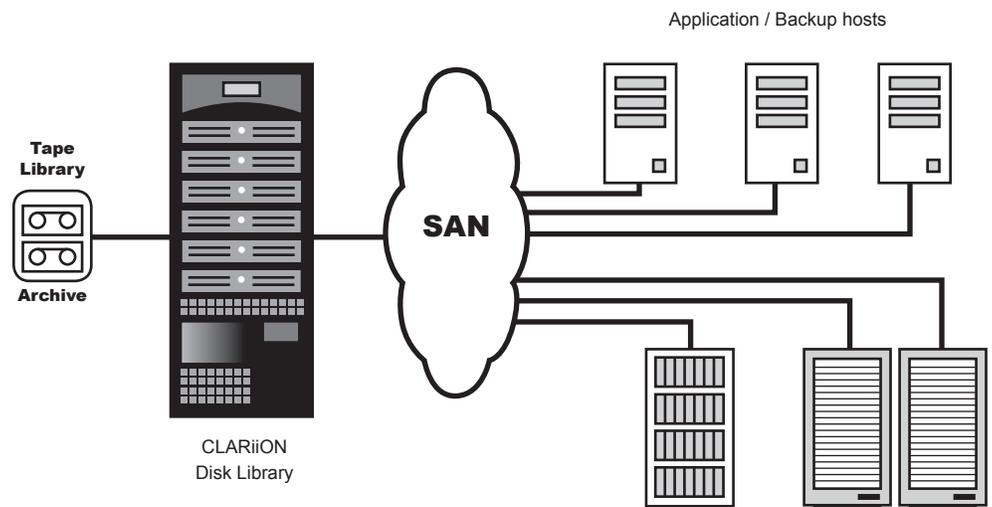
- Enterprise-class serial ATA-featured storage array with industry-leading density, reliability and performance
- Provides up to 7.2 TB of RAID-protected disk storage
- Aggregated Data Transfer Technology (ADXT™) aggregates the performance of individual ATA drives to achieve the high data-transfer rates
- Combines features and performance of Fibre Channel or SCSI storage arrays with the cost advantages of ATA disk technology

For more information please refer to ATTO's web site: <http://www.attotech.com>

## EMC Clariion Disk Library (CDL)

### Features and Benefits

- EMC Clariion Disk Library DL-Series are disk subsystems emulating virtual tape libraries with a variety of supported drive and media types
- Delivers single stream performance of up to 80 Mbps and sustained performance of up to 425 Mbps for a high-performance streaming bandwidth solution.
- In-band data compression of up to 3 to 1.



For more information please refer to EMC's web site:  
[http://www.emc.com/products/systems/clariion\\_disk/](http://www.emc.com/products/systems/clariion_disk/)

## EMC Celerra NDMP2D

### Features and Benefits

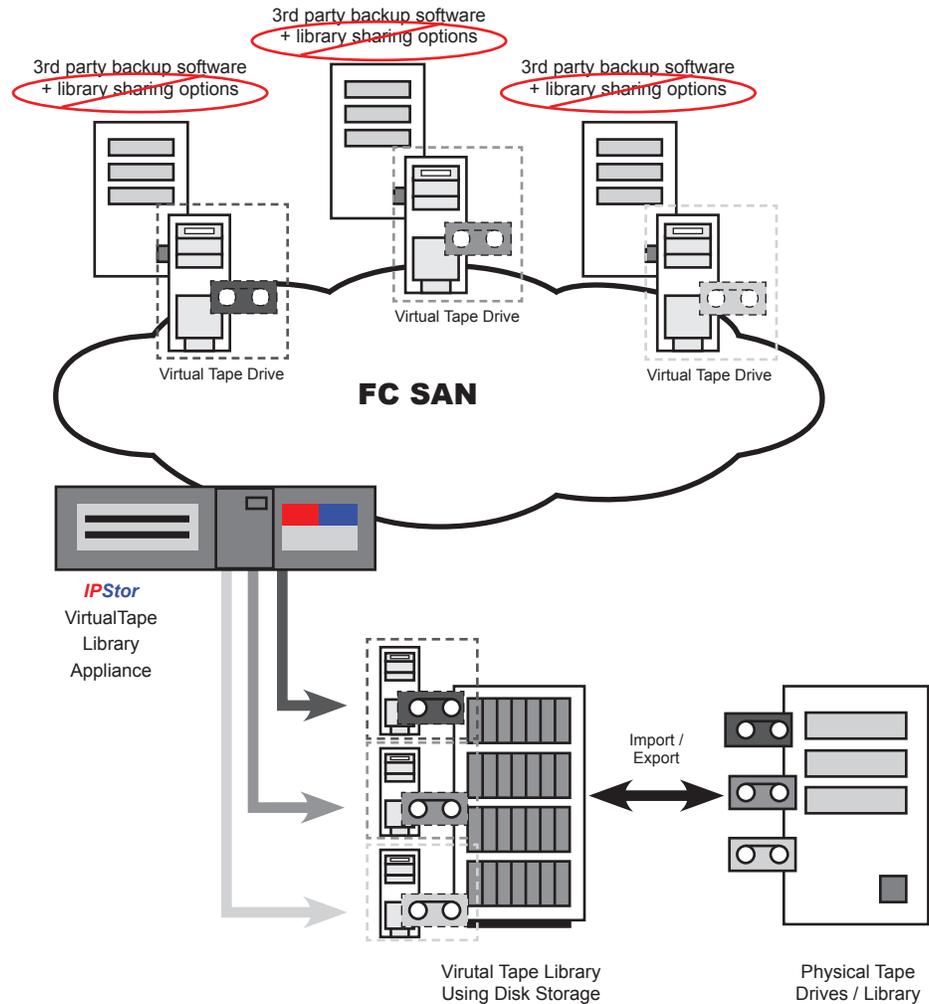
- EMC Celerra 5.3 SVTLU are disk subsystems emulating virtual tape libraries
- It provides NDMP capabilities that allow direct backups to inexpensive ATA disks

For more information please refer to EMC Web site: <http://www.emc.com>

## FalconStor IPStor Virtual Tape Library

### Features and Benefits

- IPStor Virtual Tape Library is a software product that emulates virtual tape libraries with a variety of supported drive and media types
- Provides centralized management and provisioning of backup resources
- Provisions disk-based, virtual tape drives/libraries to backup hosts over a FC SAN
- Eliminates the need to rely on library sharing option to coordinate access to a FC tape drive/library
- Performs tape import/export between virtual and physical tape drives/libraries based on policy



For more information please refer to FalconStor's web site: <http://www.falconstor.com/vtl.asp>

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## Overland Storage REO Series

### Features and Benefits

- Configurable as either a disk sub-system for a NetVault: Backup Virtual Tape Library and/or a virtual tape drive emulating HP LTO-2 devices
- Stores up to 9.6 TB of data
- Both iSCSI and Fibre Channel connections enable integration into existing SAN environments
- ProtectionPAC software allows the creation of virtual storage devices as needed to make the best use of total available capacity

For more information please refer to Overland's web site: <http://www.overlandstorage.com/>

## Quantum DX Series

### Features and Benefits

- Disk-based virtual tape library that offers hardware based compression with approximately 2:1 compression ratio (ratio depends on type of data), without decreasing the performance of the backup server or the DX processor
- Up to 64 TB of data
- Virtual tape-library partitioning
- Up to 24 virtual tape drives and 2,560 cartridges

For more information please refer to Quantum's Web site:  
<http://www.quantum.com/am/products/eb/default.htm>

## Leveraging the Power of NetVault: Backup VTL/SVTL

BakBone is committed to delivering flexible, modular data protection software that supports disk, tape or combined disk and tape deployments. By leveraging NetVault: Backup's unique VTL and SVTL capabilities, organizations of all sizes can safeguard critical data while lowering the costs and complexities of advanced backup and recovery.

VTL/SVTL delivers immediate benefits by enabling administrators to utilize both tape and disk storage much more effectively. For example, they can rely on cost-effective, easy-to-manage disk technology for handling daily back-ups and near-line storage requirements while maximizing more expensive tape solutions for longer-term data retention and archiving. Disk-based solutions also reduce ever-shrinking backup windows with fast disk transfer rates, concurrent backup as well as ability to consolidate operations while eliminating weekly, resource-intensive full backups. Faster transfer rates also fuel expedited restores, without the inherent drawbacks associated with tape multiplexing, which has higher probability of failure, requires more media and consumes greater CPU resources.

Today, nearly 70 percent of BakBone's customers blend the best of tape and disk technology to meet their increasingly critical data backup and recovery needs. In fact, at least a quarter of new NetVault: Backup customers have embraced a VTL or SVTL solution to bolster their backup and recovery environment while reaping the performance and economic advantages of virtual tape library deployment. In the long run, NetVault: Backup VTL and SVTL maximize the use of tape media while ensuring faster recovery of critical data, streamlined backups and increased operational efficiencies—all contributing factors to creating and sustaining a competitive business edge.