# Disk-to-Disk-to-Tape (D2D2T)

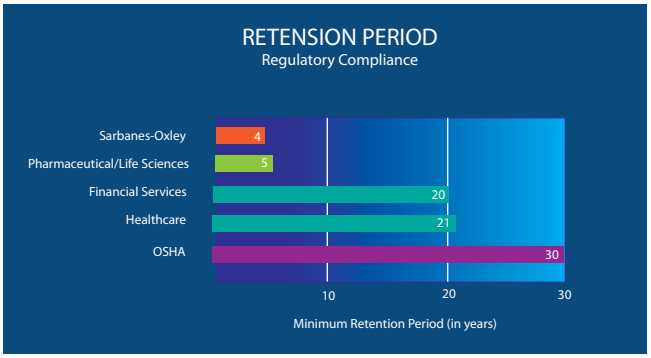
Where Disk Fits into Backup

**Tape originated in the 1950's as the primary storage device for computers. It was one of the first ways to store data beyond the memory of a computer, which at the time was dominated by large mainframes. The evolution of computers led to the need for faster access times, which was met with the development of the disk drive. Disk drives were also able to store data beyond the memory of the computer, but they could do it much quicker than tape.**

The downside to disk was the increase in cost and the potential for hardware failures. Generally, if a disk crashed the data was lost. The solution was to use tape as a secondary storage device focused on backup and archive. Since tape cost so much less than disk, it was a natural fit to use for backup. Plus, tape was also the most cost effective, most dense and most reliable method for long term archival.

While backup and archive are extremely important, they are each fundamentally different. Backup is a copy of data in case the original is damaged whereas archive is data stored for historical purposes. Typically, each full set of data is kept on-site for immediate recovery and another copy off-site in case of a data loss event.

Data loss can come from many different sources, including hardware failures, fire, theft/sabotage, natural disasters, power surges, viruses, or human error. This is why data protection has always been a concern. A good backup strategy provides the ability to restore data to the most recent state possible. It's a short-term solution to keep users productive. Archive, on the other hand, is focused on the long term. It's a method to retrieve data from the past. Many businesses need to have the ability to retrieve historical records. Whether accounting records, HR records, medical information or audio/video data, companies need to have the option to view records upon request without tying up valuable disk space. New rules and regulations are requiring retention of data for years to come. Also, archived data would be a way to gain access to critical files that were accidentally deleted months earlier or roll back an application upgrade that was not successful.




*Source: Enterprise Storage Group, May 2003*

## Disk-to-Tape (D2T)

Disk-to-Tape backup is done several ways. One of the most common ways is to have a tape device attached to each server that needs to be backed up. Each server is programmed to copy all critical data to the dedicated tape device during off hours. Initially, this is easier to setup and configure, but individual tape devices require additional management and manual intervention by the system administrator to rotate tapes and maintain the tape device.

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Another popular method is to add a backup server to the company network with a tape device directly attached. The backup server is programmed to copy critical data from the other servers across the LAN to the attached tape backup device. This method consolidates the backup operation to one manageable location. Once backups are complete, tapes are rotated off-site for storage in a secure location. Sets of tapes are periodically pulled out of the rotation and archived. Tape's ability to do both backup and archive at low cost makes tape a good choice for storing data. .

Tape data storage continues to be a popular choice for several key reasons: Cost, Capacity, and Portability. First, tape is less than half the cost of disk in dollars-per-gigabyte.

| Recording Method | Cost per GB | Data Density GB/in$^3$ |
|---|---|---|
| Blue Ray | $2.58 | 2.4 |
| DVD | $0.98 | 5.4 |
| Hard Disk | $0.64 | 8.4 |
| Tape | $0.27 | 9.0 |

Since the value of data decreases over time, it makes sense to store it on the most cost effective medium possible. Second, only the recording media needs to be archived and not the recording mechanism.

Tape cartridges do not contain any electromechanical parts that can fail during long-term archive, giving tape the longest shelf life of any removable media and making it more durable for daily handling. Plus, most tape technologies provide read compatibility with future generation tape drives. This way the tape technology can evolve and the data stored with older tape drives is still accessible with newer tape drive technology. Another benefit is that the cartridge takes up less physical space per gigabyte, making it easier to store. Finally, tape is the most portable storage medium that can match the capacity of disk, making off-site backup and archive easy.

### Advantages of tape data storage

- Single solution for backup and archive
- Most cost effective option for long-term storage (archiving)
- Superior portability of tape provides security against fire, theft, and natural disaster
- Tape is immune to viruses and worms
- Established standard (proven method for archiving)
- Tape is supported by a wide range of backup applications
- It is easier to recover data from a failed tape than it is to recover from a failed disk drive
- Data is not as accessible as disk


## Disk-to-Disk (D2D)

For years people have predicted disk would replace tape as the backup and archive device. One reason is because disk can read and write much faster than most tape drives. This reduces the time needed for backup. Secondly, disk takes less time to access data. Disk is a random device, which is much faster than the sequential method used by tape. This makes the restore process much quicker and reduces downtime.

There are a number of environments that the speed of disk is absolutely critical for backup and recovery. Banks, financial institutions, the telecom industry, security systems, and transaction processing are

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a few examples. The data is changing by the second, and in massive quantities. These are 24-hour operations with backup windows in minutes instead of hours and down time is not an option. To meet these requirements a Disk-to-Disk backup strategy works best. Disk drives are used to store the backup copy in place of tape drives. Data is copied to the secondary disk drive as if it was tape. The backup disks can be located on the corporate LAN as (Network Attached Storage), on a separate network (Storage Area Network). With the data on disk, restores can be completed much quicker, decreasing downtime. The downside to disk backup is its portability. Without off-site backups the data is still susceptible to fire, theft, virus, and natural disasters. This disk strategy still doesn't provide for archiving data.

Hard drives have several mechanical parts (heads, bearings, motor and actuator arm) that can fail during archive, which puts a question mark on their shelf life. If the disk solution is a RAID device, then all the disks and supporting hardware in the RAID will need to be archived to ensure the data can be restored. Another concern during archival is the disk interface. It is inevitable that interfaces are going to change, so to be compatible down the road, it might be necessary to store the proper interface hardware with the off-site disks. Disk's speed is impressive, but its mobility makes it difficult to use for off-site backup and archive.

It is possible to setup high-speed network service line and replicate the data at two separate locations. Each T1 line supports a transfer rate of 1.54 MB/sec and costs around $1,000 per month. The number of lines needed is dependent on how much data needs to be transferred per day. Once the connection is established, disk and network solutions need to be purchased for both sites. Mirrored sites provide a good answer to fire, theft, hardware failures, and natural disasters, but they are still susceptible to virus and human error. If one location is infected with a virus it can easily spread it to the other location. The same is true for human error. If an employee deleted an important file several months earlier, it most likely has been deleted at the mirrored site. The problem with this disk strategy is that the data is at risk of being lost..

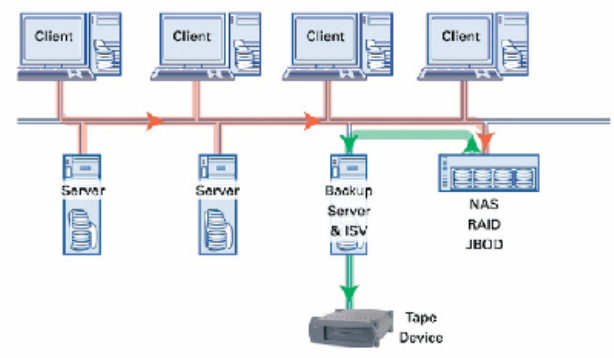
### Advantages of Disk

- Fast backups
- Quicker restores
- Random access of data instead of sequentially reading through a tape
- Easy to consolidated storage

### Disadvantages of Disk

- Not a complete backup solution
- Very difficult to archive (physically & reliably
- High Cost

**Disk-to-Disk-to-Tape over the Network**




## Disk-to-Disk-to-Tape (D2D2T)

The best answer for customers who require fast backups and restores is to add disk into their backup and archive strategy. Disk-to-Disk-to-Tape (D2D2T) is the combination of Disk-to-Disk and Disk-to-Tape. In essence it takes the best from both worlds. D2D2T is an approach to computer storage backup where data is first copied to a disk storage system and then copied again to a tape backup system. It provides a way to expedite backup by first copying data directly from one tier of disks to another, then enabling tape backup as a separate operation.

The data will reside on the second tier disk until it is ready for long-term archive, which allows it to serve both as a staging area for the tape backup and a holding area that is available for quick restores. The idea is to back up from the production disk to a backup disk as quickly as possible.

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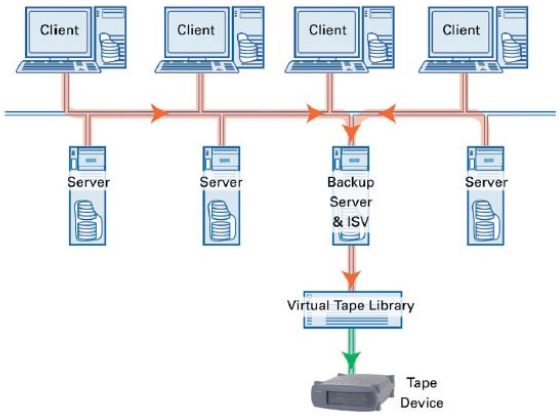
Once the D2D portion has finished, files can be backed up to tape at a more comfortable pace without impacting the performance of the primary storage space. The additional disk stage will add cost, but for some customers the speed is vital.

Most disk solutions can be used in D2D environments, including NAS Boxes, RAID Systems, Appliance Servers, File Servers, and Virtual Tape Libraries. The disk can be implemented as direct attach storage, but the most common method is to use it as a target on the network.

While the price tag is less, so is the reliability and performance. The MTBF for hard drives may be higher than tape drives, but the difference is that a failed hard drive results in lost data whereas a failed tape drive does not since the data resides on the tape media. In fact the more hard disks that are added to the storage pool the higher chance of failure, where the opposite is true for tape. Since the data is stored on the cartridge, adding tape drives actually reduces the chance of data loss, especially when they are combined with a solid tape rotation scheme.

**Disk-to-Disk-to-Tape using VTL**




Once a second tier of disk has been implemented, a third party backup application is used to copy the data from the production servers to the second tier disk where it is available for restore. Then, when it is time for off-site backup and archive, the software copies the data to tape.

Some disk solutions offer the ability to connect a tape device directly to the disk solution. Data can then be migrated directly to tape without impacting the network. The D2T transfer requires additional intelligence, which is usually included with the disk solution. The first piece is a slimmed down operating system, which is usually Linux or Windows, but can also be a proprietary OS. The operating system works with a built-in processor (CPU) and memory (RAM) to handle the transfer of data to the tape device. Finally, a third party backup application or native OS utility is used to manage the data on the backup device. Without the added intelligence the data would need to be pulled back across the network to the backup server and then archived to tape.

Most third party backup applications were originally designed and optimized to write to tape. As the applications, evolved support was added for disk, but the performance increase was marginal. To solve this problem, virtual tape library (VTL) software can also be added to the mix. VTL software presents the second tier disk as though it was tape, often done by emulating the tape device. In most cases VTL software can transfer data faster than typical backup applications, but it's also another application to purchase, integrate, and maintain.

As organizations become more global, the time available to perform backups (backup window) continues to shrink, but D2D2T is well suited to address this challenge. With more and more pressure on IT departments to protect data and make it readily accessible, companies are looking for more complete solutions to traditional tape backup and restore. With a properly designed D2D2T solution, IT

departments can spend their time working on other critical issues. Tapes will be ready for off-site storage and restores can be done quickly during the day, which allows business to continue uninterrupted.

### Advantages of D2D2T

- Quick backups and restores will reduce network bandwidth issues
- Reduced backup window concerns
- Consolidated storage
- Portability of tape provides security against fire, theft, viruses and natural disaster
- Tape provides a cost-effective solution for long term archive

### Disadvantages of D2D2T

- More complicated to setup
- Additional cost
- More points of failure

## Summary

Tape has been the preferred backup method for almost 50 years because of its ability to backup and archive. Tape cartridges are inherently cheaper than disk and tape has always been more portable, making it easy to store the data away from the computer system. This provides protection against fire, theft, viruses, sabotage, and natural disasters. Tape is also the most reliable medium for long-term archiving.

D2D backup does solve several data storage issues, but it is not a complete backup and archive solution, and leaves critical corporate data at risk. If the speed of disk backup is required, the only complete solution is D2D2T. Tape provides low cost archiving while disk provides increased performance and accessibility. In most environments, disk backup is a “nice to have” while tape backup is a “must have”.

| | Low Cost | On-site Backup | Off-site Backup | Off-site Archive | Quick Backups and Restores | High Capacity | Backup App Compatibility | Easy to Set up |
|---|---|---|---|---|---|---|---|---|
| Tape | Yes | Yes | Yes | Yes | No | Yes | Most | Yes |
| Disk | Yes | Yes | Yes/No | No | Yes | Yes | Limited | Yes |
| D2D2T | Yes | Yes | Yes | Yes | Yes | Yes | Limited | No |

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## FURTHER INFORMATION

If our whitepaper on "Where Disk Fits into Backup" has not answered all your questions about your backup challenges, Tandberg Data storage specialists are available globally to offer you help in finding the best solution for your business.

Tandberg Data is a leading global supplier of backup and archiving technologies. Tandberg Data offers of a complete range of tape libraries, tape autoloaders and tape drives (based on the LTO™, SLR™, and VXA® technology platforms), storage software, data media and disk-based storage such as the RDX® QuikStor, designed to meet storage requirements of small and medium-sized businesses.

**Please contact Tandberg Data on 00 800 TANDBERG (00 800 8263 2374) (EMEA) or 800 392 2983 (US) or contact your regional office directly.**

**You can also visit Tandberg Data online at www.tandbergdata.com.**

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