D2D2T Data Backup

A report and review on the BAKStor 2000 iSCSI backup appliance from Tandberg Data

Network storage is experiencing unprecedented growth but regardless of this data explosion companies still have a clear legal responsibility to protect business critical data. Effective data management is the key to not only protecting data but ensuring it is available at all times and a coherent, achievable strategy is an essential part of this equation. Backup has a large role to play but as demands increase many administrators are finding traditional tape based systems unable to provide them with a large enough backup window to allow data to be secured without impacting on normal business operations.

The concept of D2D2T (disk-to-disk-tape) has risen in response to this crisis as it allows administrators to use a multi-tiered approach to backup. It calls for the use of hard disks as a primary stage for securing server data followed by a secondary phase where the data is then copied to tape for essential off-site storage. This type of strategy opens up new windows of opportunity as securing data to high-speed disk-based storage first allows server backups to fit in better with day-to-day business operations. Furthermore, backup to tape can now be run as and when required as the first stage is used as the source so the task will have no impact on server availability.

At the SMB level iSCSI is proving to be the ideal infrastructure for implementing a D2D2T strategy. Fibre channel (FC) may be the best choice for SANs (storage area networks) but its high price makes it best suited to the enterprise. iSCSI is a far better alternative for SMBs as it can be implemented over standard Ethernet networks to create an IP SAN without the need for costly fibre channel switching equipment, storage arrays and cabling.

Despite the growing number of iSCSI storage on the market few offer a true D2D2T solution as they only offer iSCSI disk targets. This allows them to deliver first line network storage to servers but they do not address the secondary phase. Tandberg Data's response to this clear demand is the BAKStor range of appliances and this report will take an in depth look at the BAKStor 2000 appliance. It will report on its capabilities as a D2D2T solution and run a full performance test in order to determine how it compares with standard tape based backup. The report will focus on and review the BAKStor's installation procedures, manageability and general features of the product.

The BAKStor concept

A key aim of the BAKStor product family is to bridge the performance gap between traditional tape and disk-to-disk data backup solutions by providing fast near-line storage. They function not as a replacement to tape but as a complete D2D2T solution that allows data to be backed up first to hard disk and then migrated to tape. With an extra SCSI controller card in the appliance it can accept physical tape drives and libraries allowing them to be used to backup data on the appliance to removable media. Consequently, the BAKStor supports backup strategies combining virtual disk, virtual tape and physical tape stages.

The BAKStor fits in to a wide range of backup scenarios as presenting iSCSI virtual hard disks allows storage to be removed from the server's themselves and placed elsewhere on the network. The iSCSI tape target emulates a Hewlett Packard Ultrium LTO-2 tape drive which is currently one of the most popular models on the market so it will work with any network backup software that supports this hardware. Consequently, using common backup software allows administrators to secure data on virtual disks to virtual tapes within a single appliance. Alternatively, data maintained locally on servers and workstations can be secured directly to a virtual tape from a system running the backup software.

A critical requirement when evaluating a backup system is also restoration speeds. It's all well and good if a system provides fast backup capabilities but if lost or deleted data cannot be restored in a timely manner then this will have an impact on productivity. Restoring data from tape drives is always a relatively slow process as the tape containing the correct file version needs to be located and then loaded. When the restore process starts the backup software has to search sequentially down the tape to find the required file. The BAKStor implements a virtual tape structure that includes a look up table which allows the backup software to go straight to a specific file mark. The upshot of this feature is it reduces file restoration times and, as our performance tests show, by a substantial amount.

The final piece of the backup puzzle is solved by using locally attached tape devices on the appliance. Control of these is implemented within the appliance's operating system and it allows backup tasks to be created that will secure the contents of a virtual tape to a physical tape. Furthermore, a restore function also allows data on physical tapes to be reloaded on the appliance as a virtual tape.

Our testers found installation was a swift affair and agreed with Tandberg's claim that the BAKStor can be up and running within ten minutes. The appliance has a pair of Gigabit Ethernet ports both with default IP addresses on different subnets. Just point a web browser at either and you will be presented with the management interface. Initially, we felt that this was very basic but a bonus of this is that it does make each feature easily accessible.

The system provides a good range of fault tolerant features as along with support for software managed RAID-0, -1 and -5 arrays the appliance itself is equipped with a pair of redundant hot-plug power supplies. The network ports can also be placed in a team to provide a load balanced or fault tolerant virtual network connection with a single IP address. The system supplied for review came with eight 250GB SATA drives preconfigured in two, quad drive RAID-5 arrays. However, it's easy enough to delete these and opt for RAID-0 stripes or RAID-1 mirrors if required. After selecting the RAID type and drives to be included you create the array and then assign it to the appliance. The next process is to create partitions on each array or 'storage slices'. The slice can be either an iSCSI virtual disk or tape and requires a name and a maximum size.

Implement a sensible naming convention as this is appended to the iSCSI IQN and identifies it to the initiator so you need to know whether the target is a virtual disk or tape. Tape slices are created initially with a 10GB capacity and are designed to grow dynamically in 10GB increments as data is stored on them. When they reach the specified maximum size the appliance issues an 'end of tape' command to the backup software. This is a valuable feature as it avoids wasting storage space on the appliance. However, if you don't enter a maximum size then the slice will be allowed to grow until it has used all available space.

Snapshots provide a local backup facility and you can decide what percentage of the source slice size they should use as their own storage space. Mirroring is possible if you select a snapshot size of 100 per cent. As soon as a snapshot is created it appears as an iSCSI target so you can log on and use it to restore data back to the original slice or any other for that matter. The AiiR (automated internal intelligent replication) feature takes this a stage further by offering an automated file versioning system that takes snapshots at scheduled intervals and retains older ones according to your rotation settings.
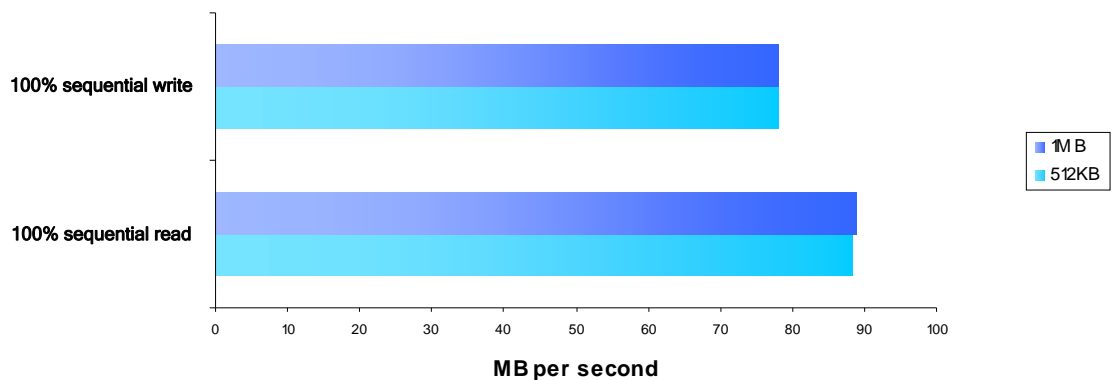
For performance testing the BAKStor was introduced into the lab's resident Gigabit Ethernet network. The appliance used a single Gigabit connection to avoid any overheads adapter teaming may introduce. We also reconfigured the appliance with two, four-drive RAID-0 stripes for maximum performance.

A Supermicro dual 2.4GHz Xeon rack system running Windows Server 2003 was selected as a host server and for backup software we chose Computer Associates BrightStor ARCserve r11.5 which we have found offers particularly good performance for tape based backup. To compare the speed of the virtual LTO-2 tape target we installed a Hewlett Packard StorageWorks Ultrium 460e tape drive and connected it to a dedicated LSI Logic Ultra320 SCSI controller card. This tape drive was also used on the appliance to test tape slice backup and restoration performance.
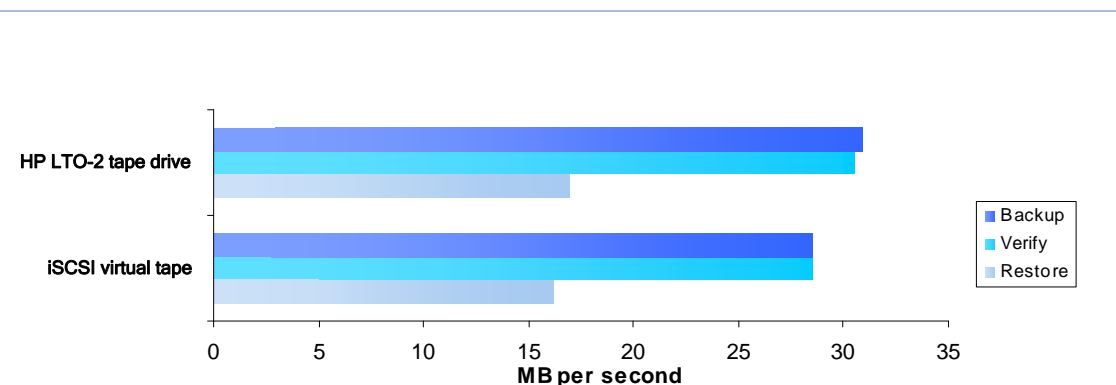
For iSCSI virtual disk performance we used the open source Iometer utility configured with two disk workers. We took two readings with Iometer configured with 512KB and 1MB transfer request sizes and set to use 100 per cent sequential reads and sequential writes. Virtual tapes were tested using a 7.3GB mixture of data on the host system to represent the average departmental server. This consisted of a variety of Word documents, Excel spreadsheets, Access databases and PowerPoint presentations along with HTML files, video clips, bitmaps, sound files and Acrobat .PDF files. Using ARCserve we backed up the test data, ran a full tape to disk verification and then restored all the data back to its original location. For comparison purposes we then reran the same tests but with the LTO-2 tape drive locally attached to the test server.

To test general restoration performance we selected a single file and also a 480MB directory of graphics files known to be near the end of the tape backup and asked ARCserve to restore them from the virtual tape and also from the LTO-2 drive as well. Lastly, we ran a timed backup of the virtual tape slice to the LTO-2 tape drive attached directly to the appliance and then restored it back to the original slice.
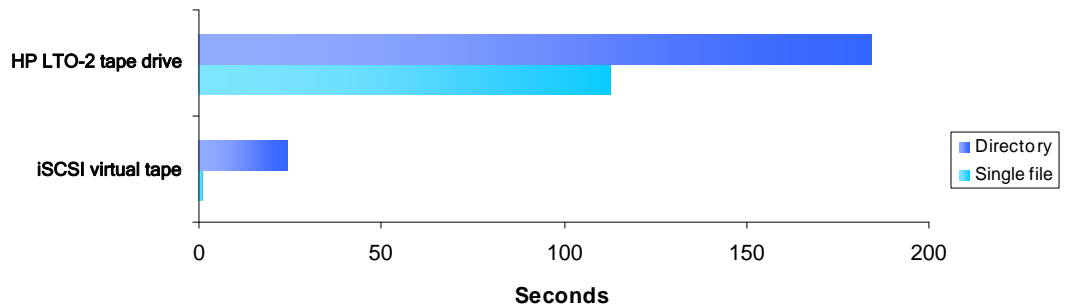
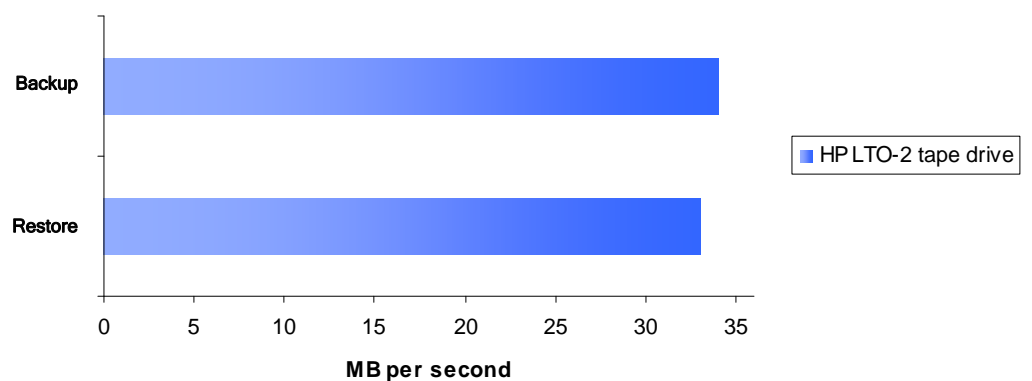**iSCSI virtual disk performance**

iSCSI virtual tape performance

File and directory restore performance

Local appliance backup and restore performance

Overall, we were very impressed with the BAKStor's performance results from all the tests. For the iSCSI virtual disk test Iometer returned a high raw throughput for both 100 per cent read and write operations. We have seen higher figures than this from other iSCSI systems but these employ hardware controlled RAID arrays. On the BAKStor all RAID functions are managed in software which does generally incur processing overheads but this clearly had a relatively low impact on overall operations.

A straight comparison between the BAKStor's virtual LTO-2 tape drive and the equivalent physical tape drive shows there is little between the two for general data transfer rates. In all cases the virtual drive was slightly slower but for backup operations the difference was a modest seven per cent which reduced to only four per cent when restoring the entire set of test data back to the server.

The BAKStor's virtual tape drives scored heavily in the single file and directory restore tests. It was able to return the single file so quickly that ARCserve actually reported zero seconds for this process - the same task using a physical tape took 113 seconds. ARCserve is actually a little sneaky here as its reporting facility doesn't start the timer until the required file has been located on the tape. We set our timer from the moment each job was started and stopped it when ARCserve advised that the job had been completed. The differences in speeds were also highlighted clearly for the directory restore as the BAKStor was nearly eight times faster.

Securing and restoring a tape slice to a drive connected to the BAKStor also returned very good speeds. It's important to note that a backup job copies every block in the slice irrespective of whether they contain data. Consequently, our test calculations were made on copying and restoring 10GB of data.

iSCSI technology may have taken a while to develop and mature but its profile has grown exponentially over the past year as it clearly represents a far more cost-effective choice than fibre channel in the SMB network storage market. In fact, the majority of storage vendors are now unable to ignore its appeal with many incorporating iSCSI virtual disk capabilities into their existing NAS appliance ranges. The BAKStor is a versatile storage appliance as combining virtual disk and tape with support for locally attached physical tape drives and libraries allows it to fit in with a wide range of backup scenarios.

We found the appliance very simple to install and configure and the simplicity of its management interface can actually be of benefit as it provides easy access to most features. In terms of data protection facilities the BAKStor delivers an impressive range of features that includes snapshots, Tandberg's AiiR file versioning and scheduled backup to tape. One area where the BAKStor does well on is cost as the few competing D2D2T products currently available are aimed more at the mid-range storage market and are not so well suited to SMBs on a tight budget.

We found performance to be particularly good with the iSCSI virtual disk delivering comparatively high read and write speeds. The appliance's virtual tape targets also presented a close match to the equivalent physical tape drive for backup, verification and restore data transfer rates. However, where the BAKStor's virtual tapes scored highest was for tasks involving individual file and directory restoration as they outperformed physical tape drives by a huge margin.

There's no denying that demand for a D2D2T backup solution is being driven by an exponential increase in network storage and those vendors fail to address this will be missing out on a lucrative opportunity. The BAKStor lays claim to being one of the first products on the market to provide an integrated D2D2T solution for the SMB market and as such sets a high standard for the rest to follow.