NetBackup Best Practice

AdvancedDisk Configuration

This paper looks at best practices around deploying and using the AdvancedDisk feature in NetBackup.

If you have any feedback or questions about this document please email them to IMG-TPM-Requests@symantec.com stating the document title.

This document applies to the following versions of NetBackup: 6.5.x, 7.x
Document Control

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Revision History

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Related Documents

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**Introduction**

The ability to back up to disk storage has always existed in NetBackup but, prior to the 6.5 release, was limited to backing up to single mount points or folders on a single media server. This “traditional” type of disk storage is now referred to as BasicDisk storage. BasicDisk can be used as “staging” storage where backups are initially written prior to be duplicated to long term, high capacity storage such as tape. Using disk storage in this way reduces the wear and tear on tape devices caused by slow backup streams that cause the tape device to operate in a stop/start mode (sometimes referred to as “shoe shining”). However BasicDisk has limited capabilities as it cannot be shared, only uses a single mount point for each storage unit and, when used in staging mode, operates on a strictly “first in first out” mode.

AdvancedDisk, introduced in NetBackup 6.5, increases the utilization and performance of disk storage by combining disk resources together as a single pool rather than treating them as smaller, separate islands of disk. AdvancedDisk also extends the capability of BasicDisk through the Enterprise Disk Foundation features such as Media Server Load Balancing and Storage Lifecycle Policies which increase Media Server utilization and availability while improving backup success rates and performance. Instead of creating Storage Units from single disk volumes, AdvancedDisk allows you create Storage Units containing multiple disk volumes defined within a disk pool.

AdvancedDisk, does not require any specialized hardware and can be used with any disk array. It works at the file system level so disks must be formatted in a way that the media servers can use them.

**Disk Pool Fundamentals**

Disk pools form one of the key concepts underlying AdvancedDisk. It significantly changes the way in which available disk space is used. A disk pool groups a set of disks together to form a single block of storage that can be shared among multiple Storage Units and, in some cases, multiple Media Servers.

With AdvancedDisk the disk pool provides a pool of storage for use by the Storage Units, replacing the more conventional one-to-one mapping between disk and Storage Unit provided by the BasicDisk model. With the AdvancedDisk, the Storage Units can access all the disks in a disk pool and the disk used for a particular backup is selected based on the amount of space available. In effect the entire disk pool appears as a single disk to reach Storage Units.

Figure 1 shows the difference between a Media Server with access to BasicDisk Storage Units and a Media Server with access to an AdvancedDisk disk pool.

![Figure 1 - BasicDisk vs. AdvancedDisk](image-url)
In the BasicDisk configuration the three disks act as separated Storage Units and the backups are written to specific disks. Backup jobs do not use all three disks unless they are configured to form a Storage Unit Group and there is no guarantee that the disk space is used efficiently among the three independent disks.

AdvancedDisk utilizes space more efficiently than BasicDisk. In the AdvancedDisk configuration the three disks form a single pool and backups may be written to any of the disks. When a backup runs, Intelligent Disk Capacity Management will automatically estimate the size of the backup and select the disk with the greatest amount of free space and will reserve space to match the estimated size of the backup image so that other backup jobs do not over commit beyond the disk’s available space. Note how the different colored backup images reside on different disks in the BasicDisk configuration but are distributed across all of the disks in the AdvancedDisk disk pool.

Table 1 summarizes the advantages of using disk pools over BasicDisk volumes.

<table>
<thead>
<tr>
<th>Feature</th>
<th>BasicDisk</th>
<th>AdvancedDisk</th>
<th>Benefit of AdvancedDisk</th>
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<tr>
<td>Storage sharing</td>
<td>Fixed capacity based on a single disk. Multiple Storage Units can be created on a Single Media Server but each one requires a dedicated disk.</td>
<td>Multiple Storage Units on the same Media Server can share a disk pool. Space is allocated dynamically as required.</td>
<td>Automatic space allocation reduces the risk of backup failure.</td>
</tr>
<tr>
<td>Intelligent capacity management</td>
<td>No checks on available space before backup starts</td>
<td>“Will Fit” selection selects the Storage Unit based on ‘available’ space.</td>
<td>Pre-selection of storage ensures efficient backup operation.</td>
</tr>
<tr>
<td>Simplified growth</td>
<td>No ability to increase the size of individual Storage Units when disks fill up</td>
<td>Disk pool capacity is increased by adding additional disk volumes into the pool.</td>
<td>Minimal reconfiguration required as environment grows. Improved utilization of disk.</td>
</tr>
<tr>
<td>Media Server load balancing</td>
<td>Does not support load balancing in Storage Unit Groups</td>
<td>Supports load balancing – directing the backup to the least busy Media Server</td>
<td>Eliminates Media Server bottlenecks to increase the performance and success of backup jobs.</td>
</tr>
<tr>
<td>Storage Lifecycle Policies</td>
<td>Staging achieved using individual Storage Units with staging schedules</td>
<td>Data can be classified and managed differently throughout its life based on the importance of the data. After it has been duplicated, data can be selectively expired based on the relative importance to the business.</td>
<td>‘Important’ backups are available for rapid restore for longer periods, thereby improving RTOs.</td>
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Table 1 - AdvancedDisk vs. BasicDisk

Storage Units that use AdvancedDisk disk pools on different Media Servers can be configured to form ‘load balanced’ Storage Unit Groups. When a backup is run using the Storage Unit Group, the Storage Unit on the least busy Media Server is automatically selected and a suitable disk within the AdvancedDisk disk pool on that Media Server is used for the backup.
Configuring Storage Servers

In order to create Disk Pools the Media Server must first also be configured as a Disk Storage Server. In NetBackup 6.5.x this is done using the command line function `nbdevconfig -creatests`. This command takes four additional qualifiers:

- `-storage_server` – this is the name of the Storage Server and, for AdvancedDisk is always the same as the Media Server
- `-stype` – this is the Storage Server type, for AdvancedDisk the valid value is AdvancedDisk.
- `-media_server` – this is the name of the Media Server
- `-st` – this is the storage type and for AdvancedDisk the value is always 5.

In the following examples the Media Server WSTMED01 is configured as an AdvancedDisk Storage Server:

```
nbdevconfig -creatests -storage_server WSTMED01 -stype AdvancedDisk -media_server WSTMED01 -st 5
```

Using the Storage Server and Disk Pool Wizards

In NetBackup 7.x it is also possible to configure a disk storage server using the Disk Storage Server wizard in the administration GUI as shown in Figure 2.

![Disk Storage Server Wizard](image)

Figure 2 - Disk Storage Server Wizard

The wizard allows you to select the type of storage server and the media server to create it on as shown in Figure 3.
Configuring Disk Pools

Once the Storage Server has been established the Disk Pools can be created using the Disk Pool Configuration Wizard. Note that before a Disk Pool can be configured the disks in the Disk Pool must be formatted. For AdvancedDisk the formatting must be done before the disks are mounted and the disks must be mounted before they can be added to the Disk Pool. First select the type of Disk Pool you are creating as shown in Figure 4.

Figure 3 - AdvancedDisk Storage Server Creation

Figure 4: Pool Type Selection
Then select the Storage Server you want to create the Disk Pool on as shown in Figure 5.

![Figure 5: Media Server Selection](image)

The wizard will display the list mount points that can be used (Figure 6):

![Figure 6 - Disk selection](image)

When the disks are selected it is possible to set high and low water mark attributes and I/O streams limit for the Disk Pool as shown in Figure 7. These values are applied to each disk within the Disk Pool.
individually.

![Figure 7: Disk Pool Properties](image)

Note the setting of Limit I/O streams (circled in red in Figure 7) – this setting is discussed in more detail later in this document in the section headed “Use “Maximum I/O streams” with Disk Pools”.

It is also possible to create a Disk Pool using the command line, for example you can create a list of the disks that the Storage Server can see using the command:

```
nbdevconfig -previewdv -storage_servers <storage server name> -stype AdvancedDisk -dvlist <file name>
```

and then use that list to create a Disk Pool using the command:

```
nbdevconfig -createdp -dp <disk pool name> -stype AdvancedDisk -storage_servers <storage server name> -dvlist <file name>
```

### AdvancedDisk sharing

The concept of AdvancedDisk sharing was introduced in NetBackup 6.5.2 and allows storage that can be mounted against the same mount point on multiple Media Servers such as storage presented over NFS or CIFS or clustered file systems such as Veritas Cluster File System, Lustre or CXFS, to be placed into disk pools and shared between those Media Servers. Storage presented this way is accessible to all the Media Servers at the same time and remains mounted at all times while server is up.

### File System Restrictions

For some file system types, notably NFS and ZFS, the lack of full posix compliance of the file system means that full file system conditions cannot be detected correctly, leading to problems when spanning volumes. To avoid problems where these file systems are used, each disk pool should be comprised of only one volume so that no spanning occurs.
Configuring AdvancedDisk sharing with CIFS

Support for AdvancedDisk sharing on Windows using CIFS was not introduced until NetBackup 7.0.1 and requires some specific additional configuration steps before the disk pool can be configured which are detailed here:

1. Configure the Windows disk shares in the normal way remembering to select “reconnect on login” when presenting the share to remote media servers.

2. On all the media servers that will have access to the shared volume modify the Log On properties of the services “NetBackup Client Service” and “NetBackup Remote Manager and Monitor Service” to use an account that has full access to the shared disk and restart the services.

3. On the master server run the following command for all the media servers that have access to the share.

   \nbdevconfig \-createdv \-stype AdvancedDisk \-storage_server <media server> \-dv <mount point>

   Where the mount point is expressed as \hostname\share not the mapped drive on the media server. Note that

Once these steps have been completed it should be possible to configure a disk pool.

Creating a Disk Pool using a Shared Volume

The process for creating a Disk Pool with a shared volume is essentially the same as for a regular volume. The principle difference is that you select multiple storage servers at once as shown in Figure 8.

![Figure 8 - Creating a Disk Pool with Multiple Storage Servers](image)

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With the storage servers selected advance to the volume selection screen and select the shared volume as shown in Figure 9. Note that, as well as any shared volumes, this screen will display any volumes that are common to all the storage servers selected so in this case disks C: and E: which exist locally on all three servers are also displayed. Make sure that you only selected the shared volumes.

![Disk Pool Configuration Wizard](image)

**Figure 9 - Selecting the Shared Volume**

It is also possible to add storage servers to a shared disk pool retrospectively by selecting the option to change the disk pool in the administration GUI.

### Storage Unit configurations

Storage Units that are used with AdvancedDisk are based on the Disk Pool rather than individual disks. The high and low water marks are applied at the disk pool level and thus do not need to be applied to individual Storage Units as they are in BasicDisk configurations.

Once the Disk Pool is created it is possible to configure a storage unit using some or all of the Media Servers associated with the Disk Pool:
Multiple Storage Units sharing the same Disk Pool

A single AdvancedDisk Disk Pool can support multiple Storage Units. There is no relationship between Storage Units and disk volumes in a configuration of this kind, any Storage Unit will use any disk volume within the Disk Pool depending on the available space. This means that there is generally little benefit in creating multiple Storage Units that use the same Disk Pool.

Shared Disk Pool Storage Units

One key change from the 'traditional' model of Storage Units that occurs when AdvancedDisk is used is that for Disk Pools that are shared between multiple Storage Servers a single Storage Unit can be associated with a number of Media Servers. Where a Storage Unit is configured with multiple Media Servers load balancing across the Media Servers (based on CPU utilization) will occur automatically and a backup job will always be directed to the 'least busy' Media Server. By default the storage unit is available to all the media servers that share the disk pool (as shown in Figure 11) but it is possible to limit the storage unit to use a subset of these media servers.

Figure 10: Storage Unit Creation
Storage Unit Groups and Media Server Load Balancing

Storage Units that used AdvancedDisk Disk Pools that are associated with a single node (i.e. do not include shared mount points) can be configured into Storage Unit Groups. When a Storage Unit Group is defined Media Server load balancing can be enabled by simply selecting the Load Balance option or, if the `bpstuadd` command is being used from the CLI, just specifying the qualifier `-sm 4`. 
This Load Balance option is not available for BasicDisk Storage Units. Within a Disk Pool load balancing between the disks occurs automatically with backups always being directed to the disk with the most available space expressed as a percentage of the total space.

**Performance Considerations**

It should be noted that the entire data path between client and storage including both hardware and software stacks determines the overall performance of the backup and restore process. It is therefore essential that the performance of the disk storage is not considered independently of entire data path and effect of infrastructure when seeking to resolve overall performance issues.

The AdvancedDisk storage implementation relates mounted file systems within the operating system of the Media Server to disk volumes within NetBackup Disk Pools. The normal rules and guidelines related to file system configuration on the host apply and advanced file systems such as VxFS, XFS and ZFS can be used on Media Servers that support them.

The AdvancedDisk storage implementation enforces the fact that an AdvancedDisk disk volume is a mounted file system on the Storage Server. However, NetBackup does not manage the mounting and dismounting of AdvancedDisk disk volumes. Instead, mounting and dismounting is managed by the administrator and the operating system of the host.

**Recommendation:** File systems that are used as AdvancedDisk disk volumes in NetBackup should be configured in such way that they are automatically mounted upon startup of the operating system of the hosting Media Server.
Considerations for Disk Volume Sizes in AdvancedDisk

In an AdvancedDisk configuration the disk volumes can be created from individual LUNs using a logical volume manager such as VxVM to create volumes of any size. When creating disk volumes for use in an AdvancedDisk Disk Pool there are two factors to consider for optimal performance:

1. To avoid backups spanning multiple volumes the size of each disk volume should be larger than the largest backup that will be written to it.
2. To avoid write contention between backup jobs the number of volumes in the disk group should be equal to or greater than the total number of maximum concurrent jobs allowed in all the Storage Units using the Disk Pool.

Exclusive use of disk volumes

Once a file system is imported as a disk volume into a NetBackup Disk Pool, NetBackup assumes that no third party applications utilize this file system. However, NetBackup has no mechanism in place to enforce this. Failure to ensure sole use / ownership of a disk volume by NetBackup may and will cause incorrect behavior of the capacity management components in NetBackup resulting in premature image expiration. For example in a Disk Pool containing one disk volume with a high water mark set to 90% and a low water mark set to 70%, if 50% of the available space used by applications other than NetBackup only 40% will be available to NetBackup. When the high water mark is reached 50% of all the backups held on the disk volume will be removed rather than 20% if the disk volume is exclusively available to NetBackup.

Recommendation: Disks used as AdvancedDisk volumes in NetBackup should not be used for any other purpose.

Disk volumes with different characteristics

NetBackup allows multiple disk volumes to reside within a single Disk Pool. Load balancing strategies are applied across all disk volumes within the Disk Pool during media and device selection (MDS). In other words, NetBackup assumes that all disk volumes within a Disk Pool are somewhat similar. This includes the areas of size and performance characteristics. While asymmetric configuration will not cause backups to fail, it is likely to result in unpredictable performance.

Example 1: Assume a Disk Pool with two disk volumes, one is 800 GB and the other is 80 GB. When NetBackup selects a disk volume to be used for a backup job, this selection is essentially driven by the size (free space) of the disk volume. Because of the size difference in this case, the larger disk volume will initially receive a larger share of the backup traffic. While this is quite correct from the point of view of available space, it will limit the system wide performance as the bulk of the I/O traffic will be directed to the one disk.

Example 2: Assume a Disk Pool with two disk volumes of the same size, one has a transfer rate of 100 MB/sec and the other has a transfer rate of 25 MB/sec. Once again load balancing will select a disk volume based on available free space. As a result both disk volumes will see the same amount of traffic but backups and restores will run much faster to one disk volume than the other.

Recommendation: All disk volumes within a NetBackup Disk Pool should be of similar size and should have similar performance characteristics. When dealing with disk volumes that are have significantly different characteristics they should be grouped into multiple disk pools, each containing disk volumes with similar characteristics, rather than all being placed in one pool.

Disk Pools and Volume Managers

Logical volume managers such Veritas Volume Manager (VxVM) allow abstractions to be created between the underlying disks/spindles and the volume on which a file system resides. Multiple small volumes can be created on a single disk and multiple disks can be combined to form a single large volume. Volume Managers can improve the resilience and data integrity for backups written to disk volumes used in Disk Pools by allowing mirroring and RAID configurations.
The AdvancedDisk storage implementation presents all mounted file systems as disk volumes to NetBackup. AdvancedDisk operates naturally with volume managers that work below the level of a mounted file system because it has no visibility of them and thus is not concerned with the underlying geometry of the storage.

Network file system considerations

The AdvancedDisk storage implementation presents all mounted file systems as disk volumes to NetBackup. This includes network file systems (such as NFS and CIFS). Like different types of SCSI and SAN presented disk volumes, network file system disk volumes should be placed in dedicated Disk Pools based on size as well as performance. Disk Pools should not contain a mixture of locally presented and network presented disk volumes.

When using network file systems the following should be observed:

- Manual mount points must be used. Automatic mounting and dismounting can change mount points, which may cause disk resources to be unavailable.
- The server that exports the mount points must be configured to allow root access to the file systems from the Storage Servers.

Although a network file system can be visible across many Media Servers, NetBackup 6.5 is not aware of this capability and network file systems should not be presented to multiple Storage Servers running NetBackup 6.5 or 6.5.1.

NetBackup 6.5.2 and subsequent versions are aware of the ability to present network file systems to multiple servers and allows the configuration of multiple Storage Servers within an AdvancedDisk Disk Pool. However NetBackup does not validate the mount points so if the NFS volumes are presented to more than one Storage Server, the following must apply for the file systems of the disk volumes:

- Each Media Server must mount the file systems of all the disk volumes within a disk pool.
- The mount points must be valid.
- The mount points must be the same on each Media Server.

Some network file systems, such as NFS, implement a file system behavior that makes them unsafe for use in spanning situations.

Recommendation: Network file systems such as NFS should be configured to disable spanning. For NetBackup 6.5 this is done by limiting the number of disk volumes in a Disk Pool to one.

Use “Maximum I/O streams” with Disk Pools

The “Maximum Concurrent Jobs” setting on the Storage Units limits the number of backup or write jobs using each Storage Unit but does not limit the number of restore or read activities that may be going on concurrently with the write activity. This can give rise to unexpected I/O contention on the disk pool. By setting the Maximum I/O streams option on the Disk Pool, you can limit the total number of jobs that access the disk pool concurrently, regardless of the job type. While the disk pool is maxed out with backup jobs that are writing images to the device, no duplication jobs are allowed to start reading from the device. (The one exception to this rule is that restore jobs are allowed to read from the Disk Pool even if the maximum configured number of input and output streams is already being utilized.)

When you enable the Maximum I/O streams option on the Disk Pool the default number of streams is 2. Although the optimal number of streams per volume will vary depending on the disk type a general guide line to minimize contention would be to divide the maximum concurrent jobs count for all the storage units using the disk pool by the number of volumes in the disk pool.

State Changes in AdvancedDisk

If the mount status of a configured disk volume changes, the state of the disk volume within NetBackup will follow (with a delay of about a minute). The current state of a disk volume can be checked by issuing
the command `nbdevquery -liststs -stype AdvancedDisk -U` as this example from a Windows server shows:

```
Storage Server      : wstmas02
Storage Server Type : AdvancedDisk
Storage Type        : Formatted Disk, Direct Attached
State               : UP
Flag                : OpenStorage
Flag                : AdminUp
Flag                : InternalUp
Flag                : SpanImages
Flag                : LifeCycle
Flag                : CapacityMgmt
Flag                : FragmentImages
Flag                : Cpr
Flag                : RandomWrites
Flag                : FT-Transfer
```

The mount status is indicated by the `InternalUp` flag. If `InternalUp` is not show, the disk volume is marked as 'DOWN' in the output of the command `nbdevquery -listdp -U` as shown here:

```
Disk Pool Name   : DPtest
Disk Pool Id     : DPtest
Disk Type        : AdvancedDisk
Status           : DOWN
Flag             : Patchwork
Flag             : Visible
Flag             : OpenStorage
Flag             : SingleStorageServer
Flag             : AdminDown
Flag             : InternalUp
Flag             : SpanImages
Flag             : LifeCycle
Flag             : CapacityMgmt
Flag             : FragmentImages
Flag             : Cpr
Flag             : RandomWrites
Flag             : FT-Transfer
Raw Size (GB)    : 4.00
Usable Size (GB) : 4.00
Num Volumes      : 1
High Watermark   : 98
Low Watermark    : 80
Comment          :
Storage Server   : wstmas02
```

The administrator can reset the state of the disk volume by issuing the command:

```
bdevconfig -changestate -stype AdvancedDisk -dp <disk pool> -dv <disk volume> -state RESET
```

### Capacity Management with AdvancedDisk

#### Intelligent Capacity Management and Load Balancing within Disk Pools

The Intelligent Capacity Management feature, introduced with Storage Lifecycle Policies (SLPs) and AdvancedDisk in NetBackup 6.5, optimizes the process of 'staging' backups to disk before duplicating them to tape under SLP control. It does this by checking not only the actual free space in a disk pool but
also the potential free space if images stored under capacity managed retention are removed and the
amount of space that may be required by other backups running at the time a particular backup starts.
This mechanism ensures a high success rate of backups to disk by reducing the risk that a disk within
the pool will run out of space while the backup is in progress.

How is available space calculated in AdvancedDisk disk pools?
The variables used to calculate the amount of available space in the disk pool and their associated values
in bytes are displayed by the nbdevquery -listdv -D command as follows:

```
  total_capacity : xxxxxxx
  total_phys_capacity : xxxxxxx
  free_space : xxxxxxx
  free_phys_space : xxxxxxx
  potential_free_space: xxxxxxx
  committed_space : xxxxxxx
  precommitted_space : xxxxxxx
```

Five of these variables (total_capacity, free_space, potential_freespace, committed_space and
precommitted_space) are used to calculate available space in AdvancedDisk disk pools. Two other
variables (total_phys_capacity and free_phys_space) are currently unused by NetBackup and are
reserved for future feature development for deduplicating disk storage pools.

Total_capacity is the total size of the disk and free_space is the amount of free space on the disk. These
values are derived from the file system and are updated at one minute intervals. For the purposes of
AdvancedDisk, total_capacity and total_phys_capacity should have the same values and free_space and
free_phys_space should have the same values.

Potential_free_space is the sum of the sizes of all fragments on the disk that are in EligibleForExpiration
(EFE) state. This information is obtained from the SLP information held in the EMM database and only
applies when capacity managed retention is used.

A fragment enters EFE state when the copy it belongs to uses the Capacity Managed retention type and
has been successfully duplicated by the SLP duplication manager. It leaves EFE state when the copy it
belongs to has expired, at which point the fragment moves to ToBeDeleted state.

There are two points in NetBackup processing when the potential_free_space value will be computed.
Successful duplications will add EFE fragments so the SLP duplication manager will compute the value
for each disk at the end of each duplication session. Successful expirations will remove EFE fragments
so the SLP expiration manager will compute the value for each disk at the end of each expiration session.

The algorithm to compute the value simply accumulates the sum of the sizes of all the EFE fragments on
the disk. The potential_free_space value for the disk can become stale and may be incorrect by small
amounts between computations due to manual expirations, etc. but it is self-correcting. The next time the
computation is done, the correct value will be reestablished.

Committed_space is the amount of data NetBackup has estimated as being written to the disk and is the
sum of all estimated ‘in progress’ backup sizes based on either ‘last backup + 20%’ for full and
incremental backups or ‘total_capacity – high water mark’ for user backups.

Precommitted_space is a helper value for committed_space and is decremented as a backup job
proceeds. Each time the capacity and free space information is updated the value of committed_space
is also updated to the current value of precommitted_space. This ensures that all capacity related values
are updated at the same time to give the most accurate description of the state of the disk.

NetBackup uses free_space, potential_free_space and committed_space to determine how much space
is available on a disk according to the formula:

\[
\text{available space} = \text{free_space} + \text{potential_free_space} - \text{committed_space}
\]
When a backup starts NetBackup first compares the estimated size of the job against the available space on all disks within the disk pool (including any disks that are marked down) to determine if there is sufficient space for the backup. It then selects the disk within the pool with the most available space and starts writing the backup to that disk until the disk reaches its high water mark or the backup completes.

When a disk reaches its high water mark potential_free_space is released by expiring images in accordance with the capacity managed retention rules. Once those images are expired and removed from the disk potential_free_space for that disk is recalculated. If high water mark is reached and there are no images eligible for expiration on the disk, the backup will continue. Should the disk run out of space before the backup completes, it will then span to another disk within the disk pool. The choice of disk to span to is again based on the most available space.

Intelligent Capacity Management is used to select the disk volume within a Disk Pool that a given backup will be written to. The disk volume selected will have the most available free space as determined by NetBackup. This does not necessarily mean the most available free space at that point in time. NetBackup calculates the free space on a volume based on two additional factors:

**Pre-allocated space** – when a backup is started the amount of space it will occupy is estimated from previous backups of the same type (same policy, type and client). The estimated amount of space is then ‘pre-allocated’ on the target volume within NetBackup. Thus a disk volume with a backup in progress may appear to have 200 Gbytes free but, because the backup has an estimated size of 100 Gbytes, NetBackup will only consider it to have 100 Gbytes free.

**Potential free space** – NetBackup also take account of space that could be released by removing existing backup images that have expired. Thus a disk volume may appear to have 200 Gbytes free but, because it contains 100 Gbytes of expired backup data, NetBackup will consider it to have 300 Gbytes free.

**How does NetBackup calculate how much space to pre-allocate?**

For backup jobs that have run previously the amount of space that is pre-allocated is based on the size of the last backup of the same type made by the same policy on the same client and an overhead of 20% is added. Backup jobs with no previous history the capacity of the disk volume above the high watermark is used (e.g. for a 2TByte volume with a 98% high water mark, 40Gbytes is pre-allocated).

For duplication jobs the size of the source image is known and the pre-allocation uses that value.

Jobs will never fail due to estimated size. If no disk volume has sufficient free space the volume with the most available space is used.

**Water Marks and Capacity Based Retention**

High and low water marks are set on the Disk Pool but apply to each disk volume within the Disk Pool. The water marks are expressed as a percentage of the space on the disk volume.

As the disk volumes within a Disk Pool fill up checks are made that the high water mark is not being exceeded. These checks are made at one minute intervals and also whenever a backup job is initiated.

The Storage Lifecycle Policies feature in NetBackup allows AdvancedDisk storage to be used with Capacity Manager Retention. Under Capacity Managed Retention a target value is set for how long the backup images should remain on disk if there is sufficient space available. The backups remain on disk until the disk volume high water mark is reached and are then removed until the low water mark is reached. The oldest images that have been successfully duplicated to another location are automatically removed according to the following rules:

1) Images that are past their ‘try to keep’ time (the desired cache period specified in the Storage Destination) are expired based on data classification with the images belonging to the lowest data classification being expired first.

2) A check is made after image is removed to see if the disk volume low water mark has been reached.
3) Image expiration continues until either the disk volume low water mark is reached or there are no remaining images that have passed their try to keep time.

4) If the low water mark is not reached after removing all the images that have passed their 'try to keep' date then the expiration process will continue to remove images that have not yet reached their 'try to keep' date. However this will only happen if the total Disk Pool is still above the high water mark.

If an image being removed spans two or more disk volumes within the Disk Pool all fragments of the image on all disk volumes are removed.

Increasing and decreasing the size of disk pools

If a logical volume manager such as VxVM is used the size of the disk volumes in the disk pool can be changed by using the logical volume manager to add LUNs. If no logical volume manager is available the amount of space in a disk pool can be increased or decreased simply by adding or removing disks.

Adding disks to a disk pool

To add disks to an existing disk pool first create a new disk pool including the disks you want to add to the existing pool and then merge the two pools using the command `nbdevconfig -mergedps`. This command can only be executed when both disk pools are off-line so the following command must be used to set the state of both pools to DOWN before they are merged:

```
nbdevconfig -changestate -stype AdvancedDisk -dp <disk pool> -dv <volume> -state DOWN
```

When both disk pools are down run the command:

```
nbdevconfig -mergedps -stype AdvancedDisk -primarydp <existing_disk_pool> -secondarydp <new_disk_pool>
```

This command merges the new disk pool into the existing disk pool. Once the merge is complete set the state of the resulting pool to UP with the command:

```
nbdevconfig -changestate -stype AdvancedDisk -dp <disk pool> -dv <volume> -state UP
```

Removing disks from a disk pool

Disks can be removed from a disk pool using the `nbdevconfig -deletedv` command. Both the disk pool and disk volume must be off-line at the time so the `nbdevconfig -changestate` command must be used to mark both the pool and disk as DOWN and the disk itself must be empty when it is deleted from the pool.

Note: Any backup data on the disk when it is removed from the pool will be lost so ensure the disk is empty before issuing this command.

Temporary disk maintenance

If there ever is a need to mount a SAN LUN that forms part of a disk volume outside of NetBackup (troubleshooting, file system maintenance, etc.), the related disk volume must first be marked as ‘DOWN’ within NetBackup the command:

```
nbdevconfig -changestate -stype AdvancedDisk -dp <disk pool> -dv <volume> -state DOWN
```

Once the SAN LUN is dismounted, the disk volume should be marked as ‘UP’ in order for NetBackup to resume operations on that disk volume.
APPENDIX A – Glossary

The following terms are used throughout this document:

**Storage Server** – A Storage Server is a logical abstraction of the entity that owns (serves) physical storage. It needs to be implemented on a real system. In the context of this paper a Storage Server is always implemented on a Media Server.

**Disk, disk volume or volume** – in the context of this document the term disk does not refer to a single physical spindle or LUN but is stead refers to a disk volume presenting a file system that can be written to by NetBackup. In an AdvancedDisk implementation this equates to a mount point with a file system which could either be a single physical disk (spindle), a LUN comprised of multiple spindles at the hardware layer or a volume created using a logical volume manager such as VxVM.

**Disk Pool** – A collection of Disks Volumes (usually in the same disk array) which provides a target storage area for Storage Units.

**BasicDisk** – this is the term used in NetBackup 6.5 to describe the simple mounted file system disk storage unit that has been available in NetBackup releases for some time. BasicDisk storage units are limited to a single mount point or path and cannot make use of many of the new features introduced in NetBackup 6.5 such as Media Server Load Balancing and Storage Lifecycle Policies.

**AdvancedDisk** – one of the two types of disk covered by the Flexible Disk Option. AdvancedDisk can make use of any locally presented or network presented disk storage. In the initial implementation AdvancedDisk volumes were dedicated to a single media server but from NetBackup 6.5.2 onward volumes such as NFS volumes that can be presented to multiple servers simultaneously can be ‘shared’ by multiple Media Servers.

**LUN or SAN LUN** – a LUN or volume presented from a disk array that can be used as a disk volume. This may not correspond directly to a physical disk within the array as hardware Raid and mirroring may be used below the LUN level.

**Capacity management** – NetBackup’s Storage Lifecycle Policy system can be used with the Flexible Disk Option to ‘stage’ data destined for long term storage, providing a faster restore time for recently created backups. The capacity management feature ensures the disks do not fill up by removing older and less important backups when capacity thresholds are reached. Capacity management also ensures that data is distributed evenly across the volumes in a disk pool.

**Load balancing** – works in conjunction with capacity management to ensure that backups are directed to the most appropriate volumes using the least heavily loaded Media Server that has access to the Disk Pool.

**High and low water marks** – these threshold figures are use to control the capacity management feature of the AdvancedDisk. They set on a Disk Pool and applied to all the volumes within a pool.

**nbdevconfig** – the NetBackup command used to create, import, preview and inventory disk pools.

**nbdevquery** – the NetBackup command used to display the characteristics of disk pools and their associated components.

**VxVM** – Veritas Volume Manager, a logical volume manager that forms part of the Symantec Storage Foundation product.

**VxFS** – Veritas File System, an advanced file system that forms part of the Symantec Storage Foundation product on UNIX and Linux servers.
APPENDIX B – Related Documents
The following documents provide more background on the subjects discussed in this paper:

- The NetBackup Hardware Compatibility List (http://support.veritas.com/docs/284599)
- NetBackup 6.5.2 Documentation updates (http://support.veritas.com/docs/302438)
- Upgrading BasicDisk Storage Units to AdvancedDisk Storage Units (http://support.veritas.com/docs/301168)
About Symantec:

Symantec is a global leader in providing storage, security and systems management solutions to help consumers and organizations secure and manage their information-driven world.

Our software and services protect against more risks at more points, more completely and efficiently, enabling confidence wherever information is used or stored.