

Oracle9i™ for Windows® 2000: Integrating with a NetApp® Filer in a SAN Environment

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1. Purpose and Scope

This document describes the steps to install or migrate Oracle9i on Windows 2000 to a NetApp filer using the FC protocol. The specific issues covered will include:

- Installation of Oracle9i software on filer LUNs
- Creation of an Oracle® database on filer LUNs
- Resizing filer LUNs
- Migrating from data files over CIFS to RAW on filer LUNs
- Migrating from VLDs to LUNs

2. Assumptions

For the information contained in this report to be useful to the reader, several assumptions are made:

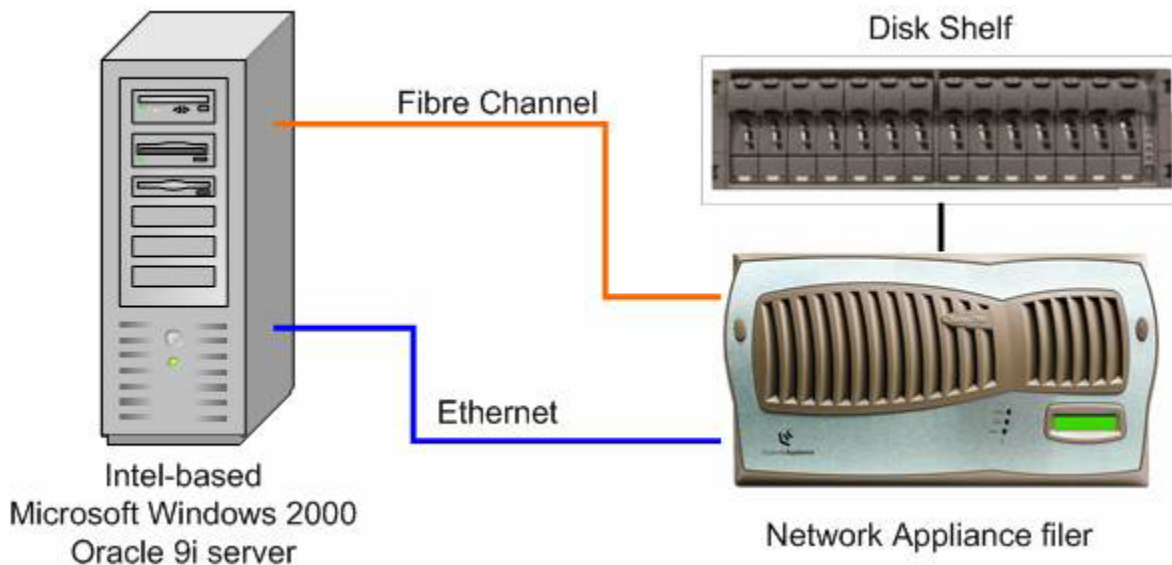
- The reader has at least intermediate Windows 2000 administration skills and has access to the administrator login or an account that is a member of the local or domain administrator's group.
- The reader has at least intermediate Oracle9i administration skills and has the Oracle9i installation media or has Oracle9i already installed on the target system.
- The reader has at least basic knowledge of Network Appliance™ filer administration, and has administrative access to the filer via the command-line interface as well as FilerView®.

- The filer and host have the required licenses necessary to perform the activities outlined in this document. For example, to convert from VLDs to LUNs will require both a VLD and FCP license on the filer.
- The target system must have the required protocol interconnects to perform the activities outlined in this document. At a minimum, both Ethernet and Fibre Channel interfaces should exist in the filer and the host, and connectivity should be established and verified.
- For the purposes of this report, filer administration is performed via telnet for clarity. FilerView may also be used.

3. Infrastructure

The following infrastructure is needed to setup Oracle9i over Fibre Channel to a NetApp filer:

- Intel-based server running Windows 2000 and Oracle9i
- Network Appliance Fibre Channel host attach kit
- Network Appliance filer supporting Fibre Channel interfaces
- IP-based Ethernet Network



3.1. Intel Server

An Intel processor-based server running Windows 2000 is required. Any member of the local or domain administrator's group can install Oracle9i. Verify that the server has sufficient memory and disk space to run the Oracle database. The server should be a member of the same domain or active directory (AD) tree as the filer. Licensing FCP or VLD on the filer will enable a subset of the CIFS protocol to allow joining the filer into the domain or AD. This is necessary to enable SnapDrive™ to perform commands on the filer via remote procedure call (RPC). Also, in cases where the data files are stored on a CIFS volume, the security credentials between the user running the Oracle process on the server must match with the file access control list (ACL) on the filer.

3.2. Fibre Channel Host Attach Kit

The Network Appliance Fibre Channel attach kit includes the Emulex LP9000L-F2 host bus adapter (HBA) in initiator mode, the Network Appliance Emulex HBA driver, and Network Appliance SnapDrive 2.0 software.

3.3. Fibre Channel Interfaces

The Network Appliance filer should be capable of Fibre Channel SAN connection via a host bus adapter card in target mode installed in the filer.

3.4. Ethernet Network

An IP-based Ethernet network is required for the host to communicate to the filer and perform administrative functions. Network connectivity should already exist in environments where VLDs or data files over CIFS are in use.

4. Oracle Home on a NetApp Filer LUN

Oracle Home is the location where the Oracle Universal Installer places all of the Oracle executables, libraries, and sample database creation scripts. On a normal Windows 2000 installation, this directory defaults to C:\oracle\ora90. There are some benefits and issues with installing the Oracle Home onto a NetApp filer LUN. If a CIFS license is available on the filer, the Oracle home can be installed on a filer volume and these advantages would still be available.

4.1. Advantages

One advantage to locating the Oracle Home on a NetApp LUN is the ability to make a Snapshot™ of the Oracle Home before applying patches or performing migrations. If the Oracle installation fails for any reason, the administrator can quickly restore the previous Snapshot and bring the database back online.

Another advantage is the expandability of the LUN. If the administrator chooses to install multiple versions of Oracle in the same LUN, they need not plan for this situation at the initial installation. The LUN size can be expanded as additional Oracle patches or versions are installed.

In the event of a complete loss of the host machine, the database server can be restored to full function without a complete reinstall of the Oracle software. The administrator need only reconnect the LUN to the rebuilt machine, perform basic setup tasks for the registry entries and services, and restart the database.

4.2. Issues

There are some issues to consider when installing the Oracle Home on a NetApp filer LUN.

One of the major issues is availability of the Oracle executables in the event of a filer outage. This can also include the alert logs and trace files, unless an alternate location is selected. Since the Oracle data files will most likely be placed on the filer, this is probably not a significant risk.

4.3. Installing Oracle Home on NetApp Filer LUN

Installation of the Oracle Home on a NetApp filer LUN does not differ significantly from an installation on a local disk drive. The LUN configuration is the only step that differs. Obviously, this needs to occur before the actual installation process can begin.

The system administrator should follow the basic steps outlined below to create the LUN.

1. Install the NetApp SnapDrive 2.0 software and Emulex HBA driver according to the installation instructions. See the SnapDrive 2.0 installation guide and documentation that came with the Network Appliance host attach kit.
2. Create volume(s) on the filer to store the LUNs in.
3. Join the filer to the Windows domain or AD using `cifs setup` or FilerView on the filer. This step will look something like the following:

```
data> cifs terminate
CIFS local server is shutting down...
Thu Jul 11 19:48:50 GMT [rc:info]: CIFS local server
has shut down...
data> cifs setup
Enable CIFS access to the filer by a Windows(tm) PC
Your filer is currently only visible to PCs on the
same net.
Do you wish to make the system visible via WINS? [no]:
This filer is currently configured as a Multiprotocol
filer.
Do you want to configure this filer as a NTFS-only
filer? [no]:
This filer is currently a member of the Windows
Workgroup 'WORKGROUP'
Do you want to delete the existing filer account
information? [no]: yes
The default name of this filer will be 'DATA'.
Do you want to modify this name? [no]:
CIFS supports three types of user authentication:
1. Windows Domain authentication.
2. Windows Workgroup authentication using the filer's
user accounts.
3. /etc/passwd and/or NIS based authentication.
```

What type of authentication will this filer use? [1]:

1

The filer will use Windows Domain authentication.

Enter the Windows Domain for the filer []:toby

TOBY.NETAPP.COM is a Windows 2000(tm) domain.

In order to create this filer's domain account, you must supply the

name and password of an administrator account with sufficient privilege

to add the filer to the TOBY.NETAPP.COM domain.

Please enter the Windows 2000 user

[Administrator@TOBY.NETAPP.COM]:

Password for Administrator:

CIFS - Logged in as administrator@TOBY.NETAPP.COM.

CIFS - Updating filer account

'cn=data,cn=computers,dc=toby,dc=netapp,dc=com'

CIFS - Connecting to domain controller.

Thu Jul 11 19:49:15 GMT [rc:info]: Connection with DC

\\KIM established

Welcome to the TOBY (TOBY.NETAPP.COM) Windows 2000(tm) domain.

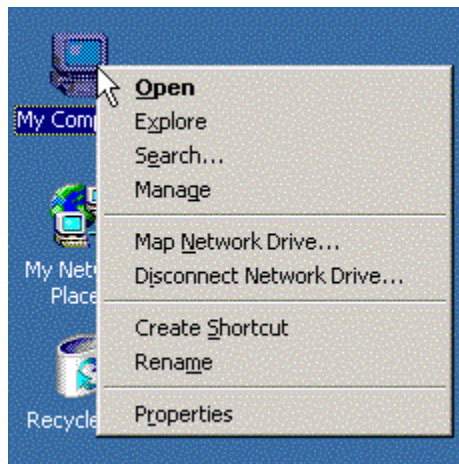
CIFS local server is running.

Note : The system clock between the client and the filer must be within five minutes of one another for this step to succeed.

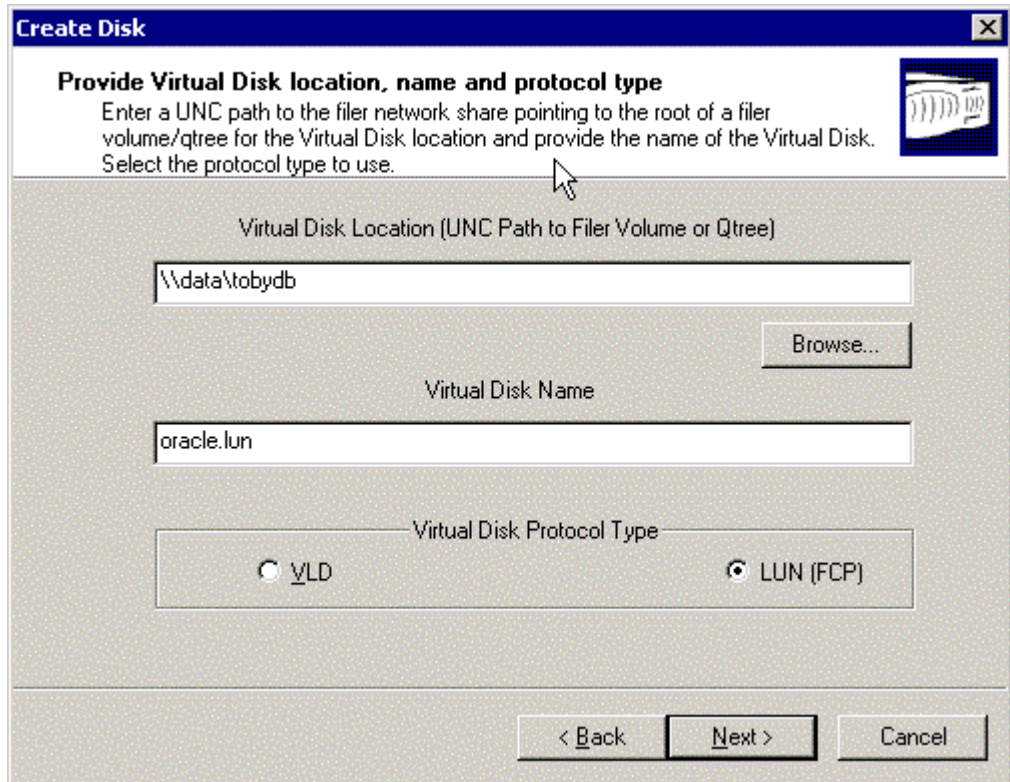
4. Share the volume for LUN storage with CIFS.

```
data> cifs shares -add /vol/tobydb tobydb
```

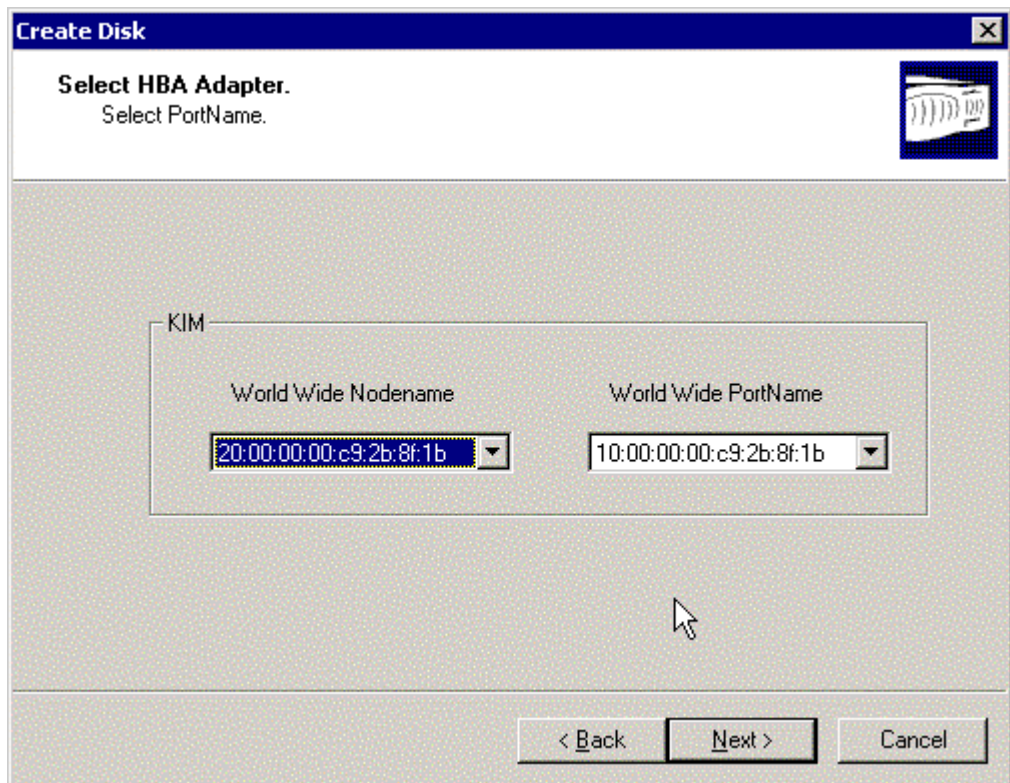
5. Right-click on the My Computer icon on the desktop and select the Manage... menu item, or select Start -> Run -> mmc.



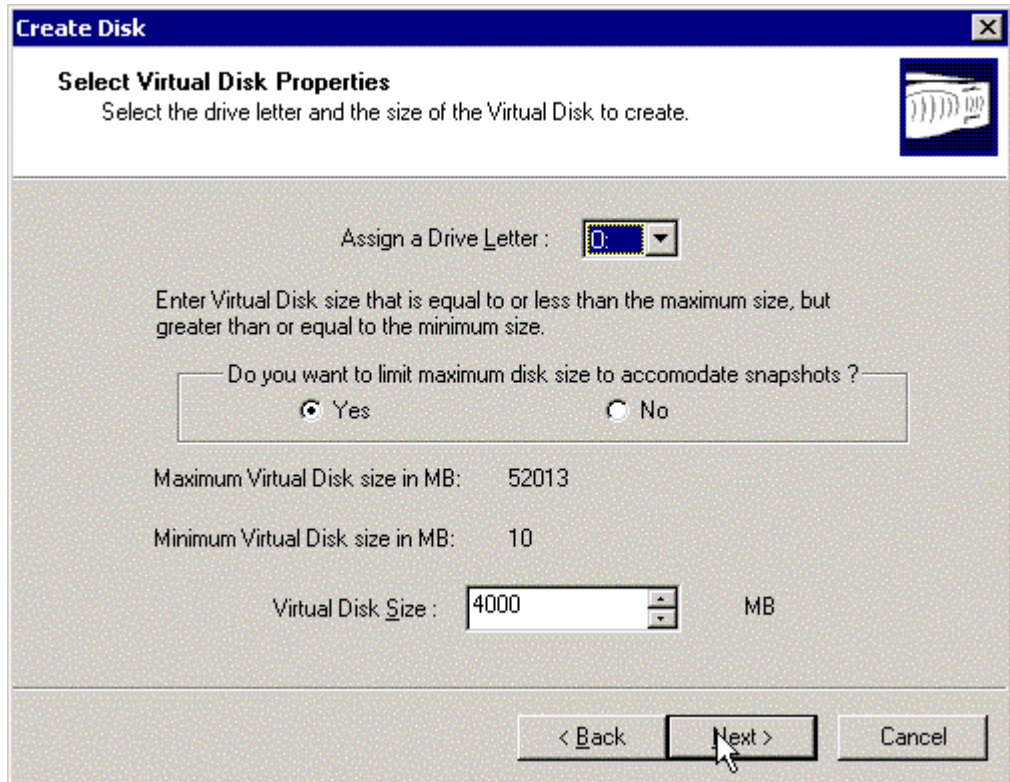
6. Select the SnapDrive tree on the left pane.
7. Right-click in the right pane and select Create Disk... from the menu.
8. At the Create Disk screen, enter the Virtual Disk Location as the UNC path that has been shared from the filer and the virtual disk name, and select the LUN(FCP) radio button. **Note**: LUNs can only be placed at the qtree root (the volume root is also a qtree root).



9. The wizard will present a dialog for selection of the HBA.



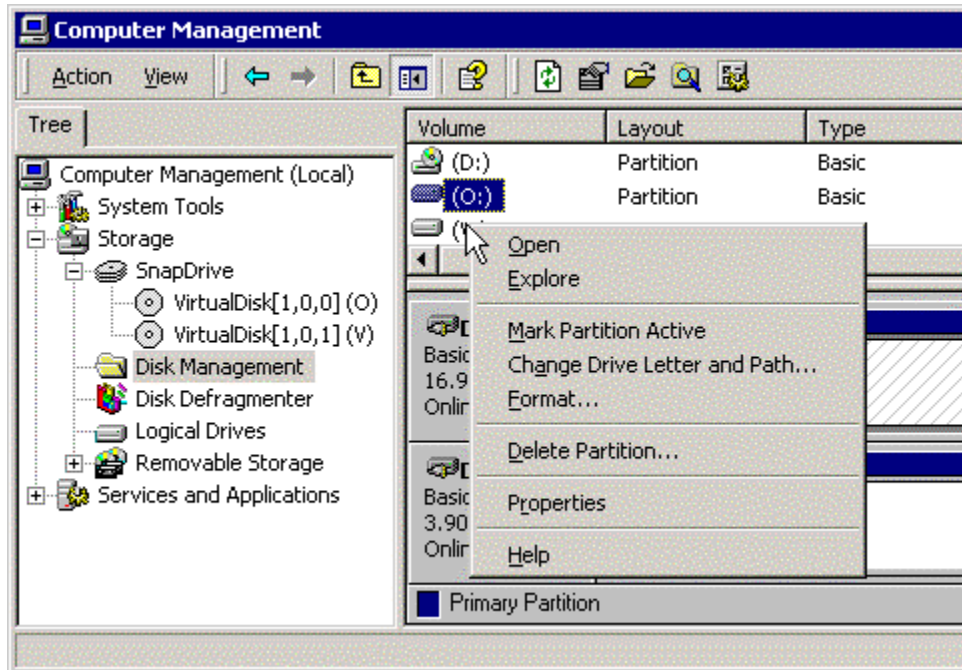
10. In the succeeding screens, the administrator will be asked to enter a volume size and drive letter.



11. Once the wizard screens have been completed, the disk will be displayed under SnapDrive in the Microsoft[®] Management Console (MMC).

Virtual Disk ID [Bus,Target,LUN] (Drive Letter)	Disk Location	File	File Path	Protocol Type
VirtualDisk[1,0,0] (D)	\\data\tobydb\oracle.lun	data	/vol/tobydb/oracle.lun	LUN (FCP)

12. Use the Disk Administrator to format the LUN with the NTFS file system.



For more information on these procedures, refer to the SnapDrive 2.0 documentation.

4.4. Migrating Oracle Home to a NetApp Filer LUN

Existing Oracle installations can be moved from their current location and placed on a NetApp filer LUN. This affords the administrator with the benefits listed previously.

When migrating from an installation on drives other than C:

1. Shut down the Oracle database and stop all associated services from the MMC.
2. Open an explorer window and drag and drop the contents of the Oracle Home to the filer LUN.
3. After the copy is complete, use the Disk Administrator to remove the drive letters from both disk devices (local and filer LUN) and invert their lettering.
4. Restart the Oracle services in the MMC and bring up the database.

If the original installation of Oracle is on the C: drive, the administrator will have to follow Oracle's recommended practice for moving the Oracle installation to the filer.

5. Creating Oracle Data Files on a NetApp Filer LUN

LUNs provided by Network Appliance appear to the operating system as a local disk. As such, Oracle can store data on them using one of two access methods: raw, where Oracle places its own data structures directly on the disk; or file system, in which Oracle places its data structures in files that reside in a file system.

The advantage of file system access is simply the manageability of files. Oracle data files in a file system are easier for system administrators to back up, move, and monitor.

The raw disk method often has a performance advantage over file system access because the database no longer has to go through the file system buffer cache and code to access data. This performance advantage can be as high as 10%.

However, the loss of manageability often deters database and system administrators from using raw disk access.

The Network Appliance filer solution offers the best of both worlds: the manageability of files with the performance of a raw disk interface. The use of file systems is recommended as SnapDrive provides more flexibility and functionality with file systems than with raw disk.

5.1. Using an NTFS File System

Using the file system access method is common in environments where manageability is more important than absolute performance. On the Microsoft Windows platform, only the NTFS file system should be used for storing Oracle data files. NetApp filer LUNs appear as physical disks, and can be formatted and managed through the Disk Administrator.

For Oracle servers that need more file systems than there are available drive letters on the host, Windows 2000 allows administrators to mount a file system under an existing file system path, much as they would with UNIX[®] operating systems. These options are specified at creation time, but can also be changed afterwards using the Disk Administrator.

Creation of tablespaces on data files within a file system allows additional flexibility, as files can be automatically resized by Oracle without manual intervention.

```
SQL> create tablespace customers datafile
'V:\oradata\toby\customers01.dbf' autoresize on;
```

5.2. Using Raw Disk Access

To use the raw disk access method with Oracle, the administrator need only make the disk available to the running system and partition it; it does not need to be formatted in any way. Specifically on the Microsoft Windows platform, the disk should be partitioned according to the needs of the database and optionally assigned a drive letter. These tasks are done through the Disk Administrator.

The naming convention for raw devices in Microsoft Windows is based on the physical drive number and an optional partition identifier. For example, Disk 2 in the Disk Administrator can be accessed by the file name `\\.\PhysicalDrive2`. Unless specified, the partition is assumed to be partition 0 on the disk. If the disk is partitioned, the second partition is referenced by `\\.\PhysicalDrive2\Partition1`. Partitions with drive letters assigned can also be accessed by the convention `\\.\{drive letter}`. If the disk is to be partitioned into more than four partitions, an extended partition with logical drives created in it should be used.

Using the DOSDEV.EXE utility from the Windows 2000 Resource kit, symbolic link names can be assigned to individual partitions. These names can be descriptive of the data that they contain. For example, `\\.\PhysicalDrive2\Partition1` can be assigned the name `\\.\customers`.

If there are to be more raw devices in use than available drive letters on the machine, using the drive letter to specify the device will not be possible, and one of the alternative naming methods should be employed.

Any of these three physical disk partition naming conventions can be substituted for file names in Oracle during a `create tablespace` or `alter tablespace add datafile` command.

```
SQL> create tablespace customers datafile '\\.\v:' size
190M;
```

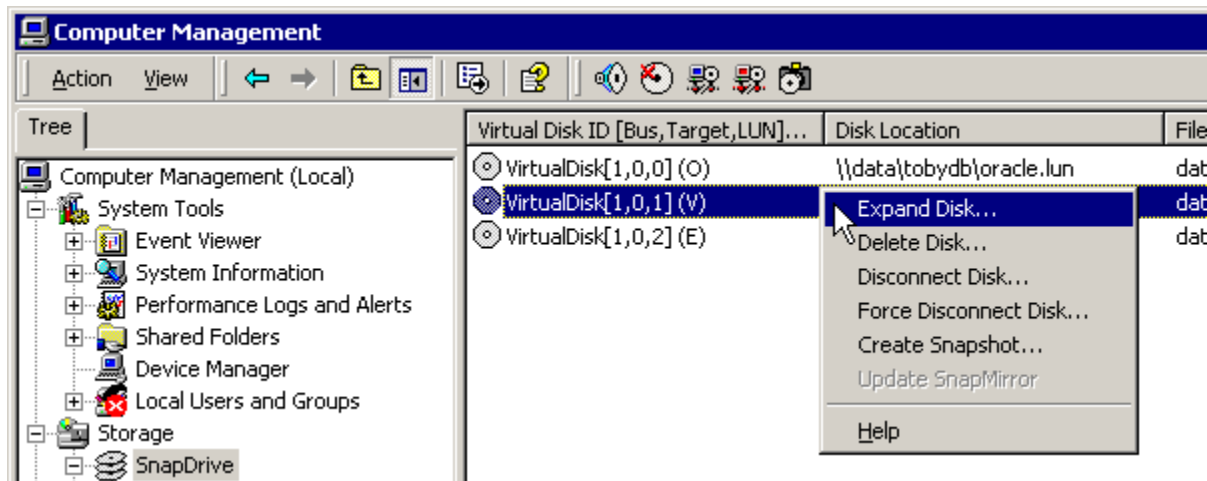
6. Resizing File LUNs Containing Oracle Data

The Network Appliance file's data virtualization engine makes it possible to easily resize a LUN. With other storage solutions, increasing the amount of space dedicated to a given LUN can be a lengthy and difficult process, possibly involving the backup and restore of the data set on the affected LUN. Intervention by several levels of both the software and hardware vendor's support personnel may also be needed.

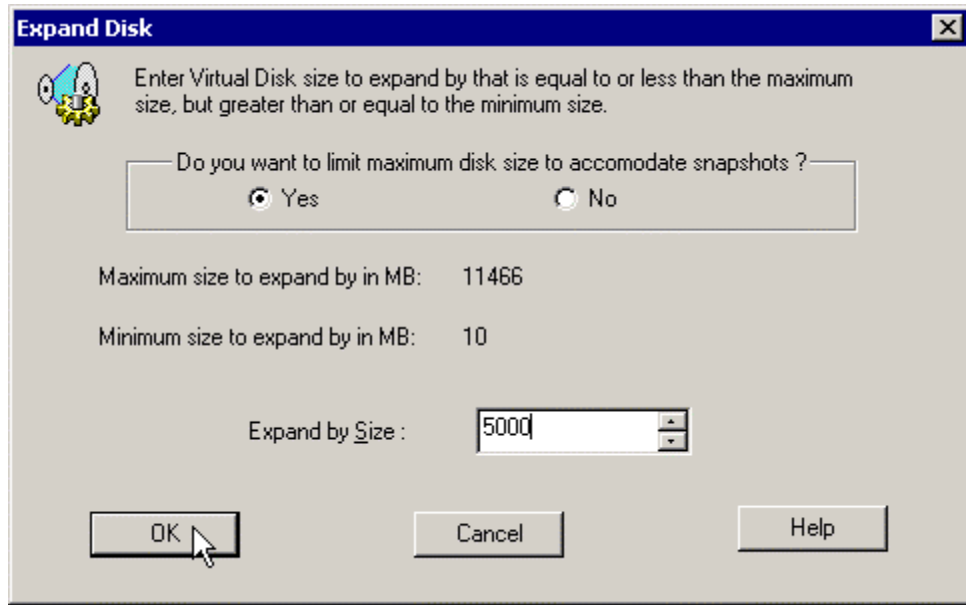
6.1. Resizing File Systems Containing Oracle Data Files

The process is accomplished according to the following steps:

1. Use the SnapDrive GUI to resize the file system.



2. Enter the size to add to the existing file system.



6.2. Resizing Raw Oracle Devices

Filer LUNs that are being accessed as raw storage cannot be expanded. The basic disk type does not allow for a change in disk size once the signature is written to the disk. The LUN can be expanded from the filer command line, but the additional space will be recognized as unallocated in the Disk Administrator. It must be partitioned and assigned a drive letter before use. There is no benefit to this method as opposed to adding an additional raw device to the tablespace to increase its size.

Dynamic disks can be resized; however, the use of dynamic disks is not supported because of other issues.

7. Oracle Data File Migration Scenarios

The first of these scenarios covers how to move Oracle data files from a CIFS volume to NTFS-formatted LUNs on the filer. This migration is straightforward and does not require any administrator intervention after storage provision. This preserves the file system interface that many administrators prefer.

The second of the scenarios will explain how to move Oracle data files from a CIFS volume to raw disk LUNs on the filer. Internally, the format of an Oracle raw partition and an Oracle data file are the same. This lack of differentiation between raw disk and file formats allows conversion directly from file system to raw disk access without performing a database-level data migration.

The third scenario shows how to convert VLD devices into FC LUNs. This process is the same whether the VLD is formatted with NTFS or not.

7.1. Migrating CIFS or NTFS Local Disk Data to NTFS on a NetApp Filer LUN

Migration from CIFS or NTFS file systems to NTFS file systems on a NetApp filer LUN is straightforward. Minor changes to the database are required.

1. Create LUN(s) as required and format them with the NTFS file system as outlined in the previous section.
2. Shut down the database.

```
SQL> shutdown
```

3. Using the Windows Explorer or another file management tool, copy the Oracle database files from their current location to the NTFS file system on the LUN. Make sure that the permissions for the files and directories get preserved. The scopy.exe and permcopy.exe utilities from the Windows 2000 Resource Kit can provide these functions at the command line.
4. Startup the database in mount mode and rename all the data files to the new NTFS file system.

```
SQL> startup mount
ORACLE instance started.
Total System Global Area      218918824 bytes
Fixed Size                     282536 bytes
```

```

Variable Size          159383552 bytes
Database Buffers      58720256 bytes
Redo Buffers          532480 bytes
Database mounted.
SQL> alter database rename file
'\\data\tobydb\oradata\toby\users01.dbf' to
'V:\oradata\toby\users01.dbf'
Database altered.

```

5. Start the database after all the data files have been renamed.

```
SQL> alter database open
```

7.2. Migrating CIFS Data to Raw Disk on a NetApp Filer LUN

In situations where limits have been reached using CIFS access, it is possible to migrate the data in the Oracle data files to LUNs accessed as raw disks over FCP. Raw disk access can provide a performance benefit of up to 10% by bypassing the file system code and communicating directly with the block device driver. No data migration or reorganization is required to accomplish this.

If the additional performance benefit is not needed, it may be more beneficial to migrate to data files on filer LUNs as detailed in the previous section. This preserves the manageability of files for the administrator and simplifies the conversion process while providing the additional benefits of the Fibre Channel interconnect.

The system administrator and database administrator should follow the basic steps outlined below:

1. Make sure that all data files to be converted have autoextend turned off. The autoextend feature is fundamentally incompatible with the raw disk access method.

```

SQL> select file_name, increment_by from
dba_data_files;
FILE_NAME                                INCREMEN
T_BY
-----
-----
\\DATA\TOBYDB\ORADATA\TOBY\SYSTEM01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\UNDOTBS01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\CWMLITE01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\DRSYS01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\INDX01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\TOOLS01.DBF
0
\\DATA\TOBYDB\ORADATA\TOBY\USERS01.DBF
1

```

Data files with a nonzero increment_by have autoextend turned on. Turn off autoextend on each data file by using the `alter database` command as shown below:

```

SQL> alter database datafile
'\\data\tobydb\oradata\toby\users01.dbf' autoextend
off;
Database altered.

```

2. Shut down the database:

```
SQL> shutdown
```

3. Convert each data file to a LUN by executing commands on the filer:

```
data> lun create -f
/vol/tobydb/oradata/toby/USERS01.DBF -t windows
/vol/tobydb/users01.lun
data> igroup show
viaRPC.10:00:00:00:c9:2b:8f:1b (FCP) (ostype:
windows):
10:00:00:00:c9:2b:8f:1b
data> lun map /vol/tobydb/users01.lun
viaRPC.10:00:00:00:c9:2b:8f:1b
lun map: auto-assigned
viaRPC.10:00:00:00:c9:2b:8f:1b=1
```

Note: This example assumes that SnapDrive has already created the igroup with the appropriate format for its use. If the igroup does not already exist, create a small LUN so that SnapDrive will create the igroup for later use.

4. In the Disk Administrator, connect the disk to a drive letter, but do not format it. In this example, the LUN above was connected to drive **U:**.
5. Start up the database in mount mode.

```
SQL> startup mount
ORACLE instance started.
Total System Global Area      218918824 bytes
Fixed Size                    282536 bytes
Variable Size                 159383552 bytes
Database Buffers              58720256 bytes
Redo Buffers                   532480 bytes
Database mounted.
```

6. Rename the database file in Oracle to reflect the new location and start the database when complete.

```
SQL> alter database toby rename file
'\\data\tobydb\oradata\toby\users01.dbf' to '\\.\u: ';
Database altered.
SQL> alter database open;
Database opened.
```

7.3. Migrating NTFS/VLD Data to NTFS on a NetApp Filer LUN

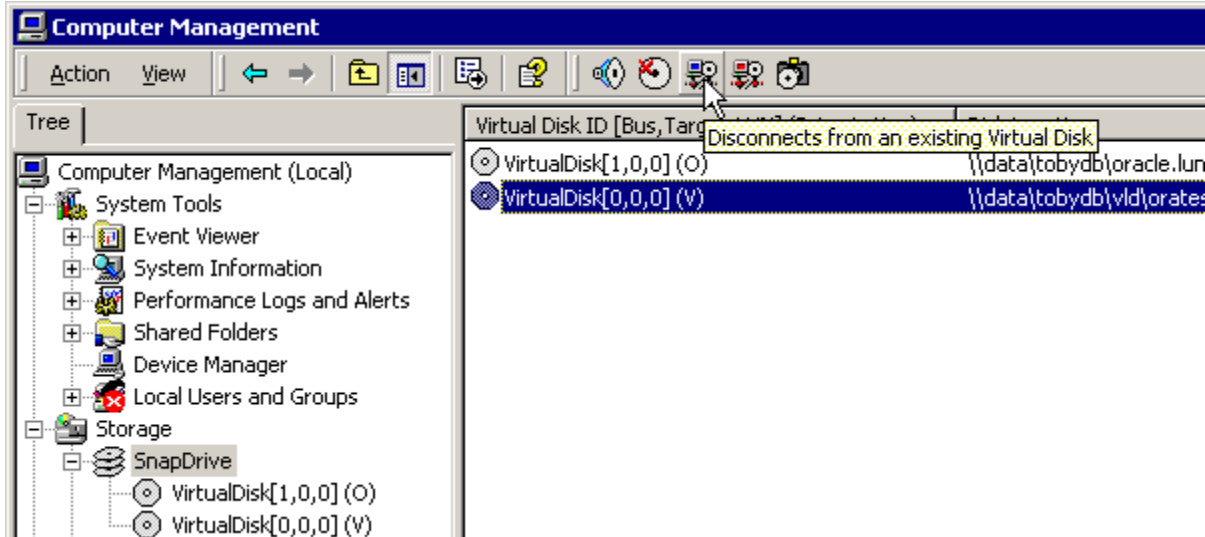
Prior to the introduction of Fibre Channel, virtual logical disks (VLDs) were the only block-access mechanisms available to a NetApp filer. There is a migration path from VLDs to LUNs, but it is one direction only; once converted to LUNs, the data streams on the filer are changed in a way that does not allow conversion back to VLDs.

The SnapDrive software has a simple method for converting VLDs to LUNs.

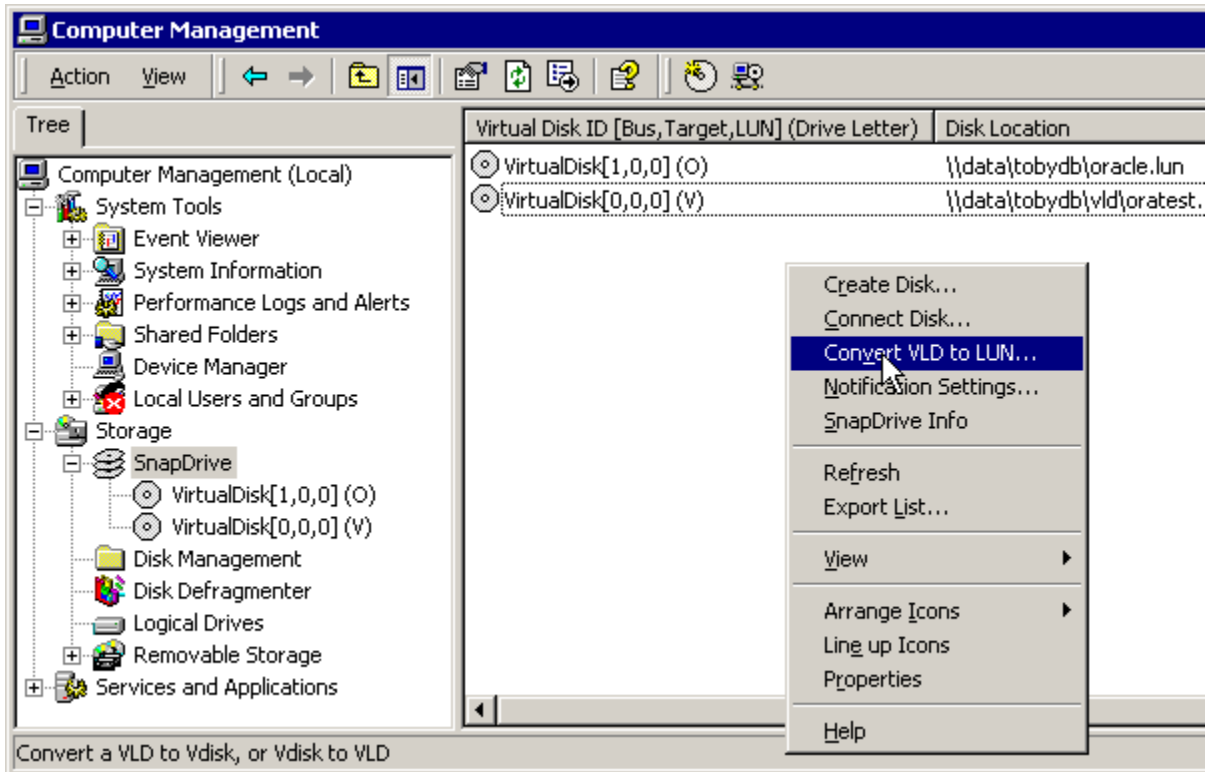
1. Shut down the Oracle database.

```
SQL> shutdown
```

2. Start the MMC and select the SnapDrive tree.
3. Select the VLD to convert. Click the disconnect button or select Disconnect Disk... from the right-click menu.

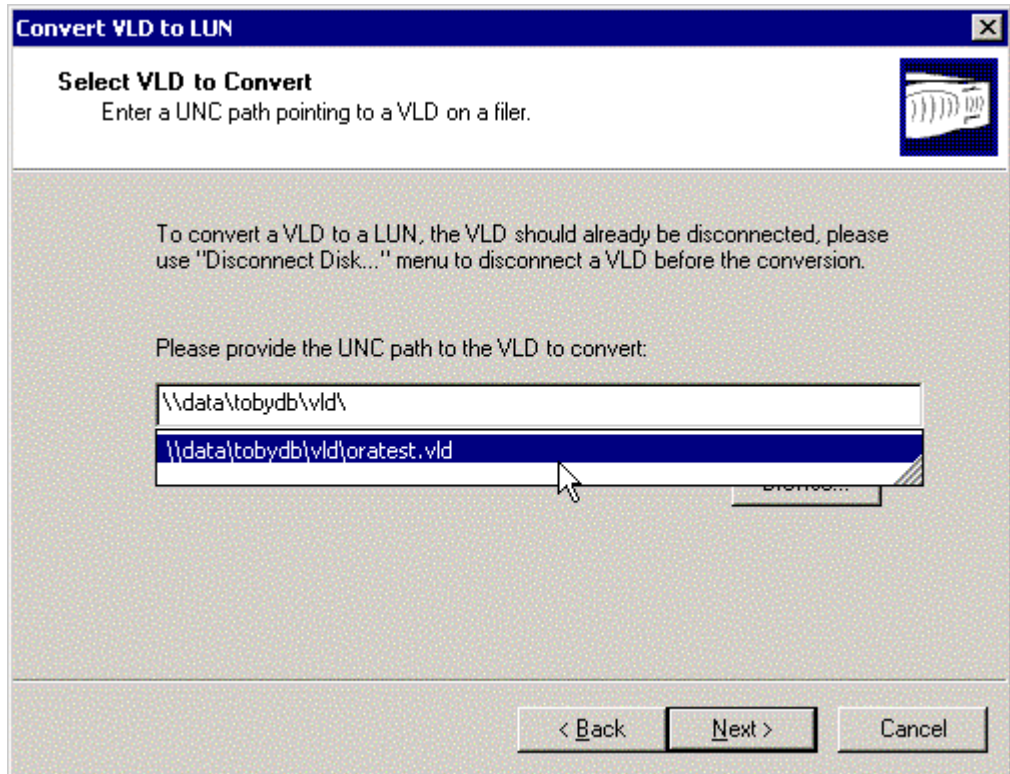


4. Select the Convert VLD to LUN... menu item.

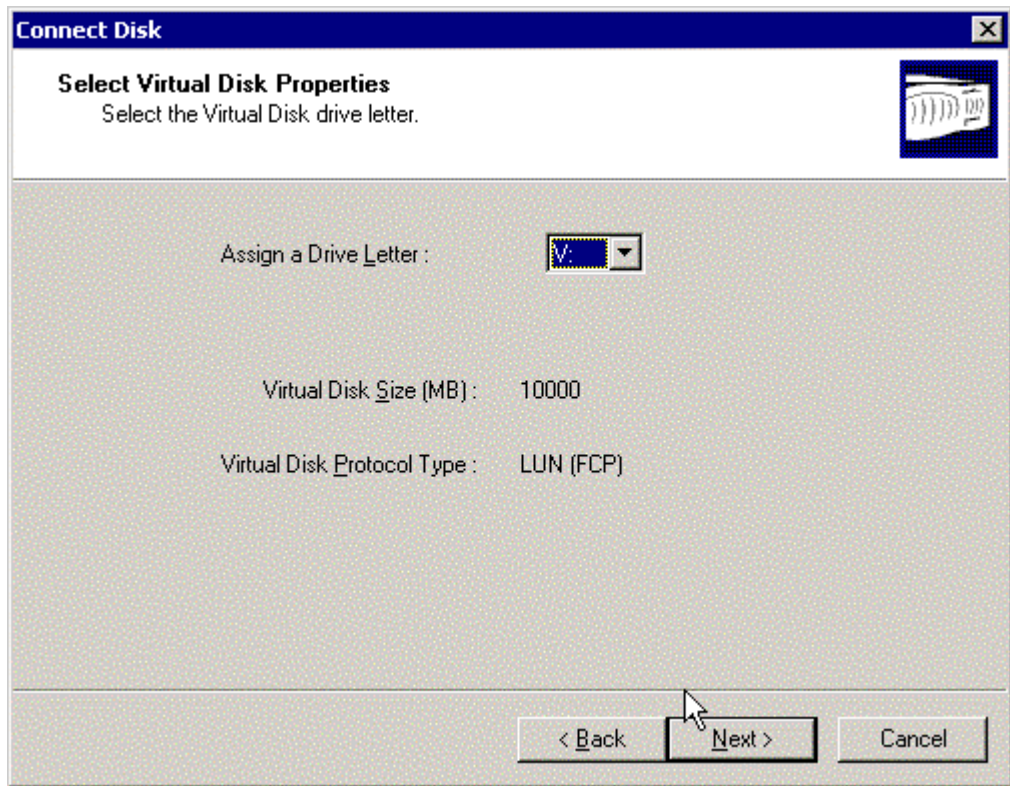


5. The conversion wizard will start and proceed through the necessary steps. Select the disk that was disconnected in the previous step.

Note: This conversion is not reversible.



6. Reconnect the disk using the Connect Disk button or menu item. The wizard will complete the necessary steps, including mapping the LUN to the host.



7. Start the Oracle instance.


```
SQL> startup
```

8. Best Practices with Oracle Data Stored on a NetApp Filer LUN

8.1. Recommendations for Operation and Layout

- It is recommended that the system administrator use the SnapDrive MMC snap-in for all LUN management from the beginning with the NetApp filer Fibre Channel solution. The naming convention used for the initiator groups (igroups) is based on the RPCs from the SnapDrive management, and will not be compatible with user-selected names.
- Per Oracle's recommendations, control files should be spread across file systems. If the node is not part of a failover cluster, one of these locations can be the local disk.
- The nvfail volume option should be turned on for all volumes that contain LUNs with Oracle data. In the event of an NVRAM failure, the filer will panic. All LUNs served from the affected filer will be set to an offline state until the administrator manually intervenes.

To set this option, use the `vol options` command set on the filer console to change the setting for all volumes containing Oracle LUNs.

```
data> vol options tobydb nvfail on
```

8.2. Snapshot Considerations with Oracle Data Stored on a NetApp Filer LUN

There are numerous best-practice considerations that affect decisions about the layout and operation of Oracle on a NetApp filer LUN.

- LUNs containing archive and redo logs should be placed on a separate volume from the LUNs containing the rest of the Oracle data files. This provides maximum flexibility in designing a backup strategy using filer Snapshots and will ensure that the latest transactions are not lost during a recovery.
- The use of dynamic disk types in the Disk Administrator is not supported. Dynamic disks use a different signature and layout to provide additional features, and may not perform as intended with Snapshot.
- The use of Snapshot technology with the Network Appliance Fibre Channel solution will be covered in depth in another technical report. Additional details concerning backup and restore scenarios with LUNs will be explained in that paper.

8.3. Separation of NAS and SAN Workloads

There are configurations in which it is advantageous to use an FC-enabled filer to share files via NAS protocols like NFS and CIFS also. There are certain practices that should be followed to avoid potential problems.

- NAS and SAN workloads should be separated at the volume level. Host synchronization is required to get consistent, usable Snapshots of filer LUNs. Because of this, the Snapshot schedules will most likely differ for NAS and SAN volumes.
- Block interconnects such as Fibre Channel can be more sensitive to storage latency. If heavy NAS workloads are anticipated, the system should be sized and designed to prevent over subscription of the storage.

9. Conclusions

A Network Appliance filer offers the Oracle database administrator compelling advantages in terms of integration in a Fibre Channel environment. The filer can simplify migration of data across many protocols and platforms, consolidate the storage of Oracle binaries, and allow a variety of data access, including raw disk and NTFS. In addition, the filer is a robust, high-performance storage device for Oracle data on Windows 2000.

10. Caveats

For more information regarding use of Network Appliance filers with Oracle, see: [Oracle9i for Windows 2000: Backup and Recovery Using a NetApp Filer in a SAN Environment](#) by Toby Creek. You can also find support on [Oracle's Web site](#) for NetApp filers. However, NetApp has not tested this procedure with all of the combinations of hardware and software options available on Microsoft Windows. There may be significant differences in your configuration that will alter the

procedures necessary to accomplish the objectives outlined in this paper. If you find that any of these procedures do not work in your environment, please contact [the author](#) immediately.

11. Related Technical Reports

The following technical reports are related to this one. See these technical reports for more information.

Report	Author
Oracle9i for Windows 2000 - Backup and Recovery Using a NetApp Filer in a SAN Environment	Toby Creek
Oracle9i for UNIX - Integrating with a NetApp Filer in a SAN Environment	Brian Casper
Oracle9i for UNIX - Backup and Recovery Using a NetApp Filer in a SAN Environment	Brian Casper
Microsoft SQL Server 2000 - Integrating with a NetApp Filer in a SAN Environment	Toby Creek
SQL Server 2000 for Windows 2000 - Backup and Recovery Using a NetApp Filer in a SAN Environment	Toby Creek

12. Revision History

Date	Author	Description
7/23/2002	Toby Creek	Creation



Network Appliance, Inc.
495 East Java Drive
Sunnyvale, CA 94089
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