

Deploying Oracle over dNFS with the Dell FS8600 Scale-out File System

Dell Engineering
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Revisions

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Table of contents

| | |
|---|----|
| Revisions..... | 2 |
| Acknowledgements..... | 2 |
| Executive summary..... | 5 |
| 1 Introduction..... | 6 |
| 1.1 Audience..... | 6 |
| 1.2 Prerequisites..... | 6 |
| 2 FS8600 introduction..... | 7 |
| 2.1 FS8600 LAN/client network..... | 7 |
| 3 Oracle file management..... | 8 |
| 3.1 Oracle Disk Manager (ODM)..... | 8 |
| 3.2 Oracle Direct NFS (dNFS)..... | 8 |
| 4 Configuring FS8600..... | 10 |
| 4.1 FS8600 internal network..... | 11 |
| 4.1.1 Enable jumbo frames from FS8600 CLI..... | 12 |
| 4.1.2 Enable jumbo frames using the FS8600 GUI..... | 13 |
| 5 Network switch..... | 14 |
| 5.1 Server network interface cards (NICs)..... | 14 |
| 6 Architecture..... | 15 |
| 7 Database server SAN boot..... | 16 |
| 8 Installing Oracle Unbreakable Linux 6.4 (UEK6U4)..... | 20 |
| 8.1 Identify the SAN boot during UEK6U4 installation..... | 20 |
| 8.2 Configuring NICs for public and dNFS networks..... | 22 |
| 8.3 Selecting UEK6U4 package groups..... | 27 |
| 8.4 Post UEK6U4 installation..... | 29 |
| 8.4.1 Relax Red Hat 6 network routing filters..... | 29 |
| 8.4.2 Disabling Network Manager service..... | 30 |
| 8.4.3 Preparing the server for Oracle..... | 33 |
| 8.4.4 Preparing storage for Oracle and dNFS..... | 33 |
| 9 Configuring NFS..... | 34 |
| 10 Deploying Oracle 11gR2 dNFS with FS8600..... | 35 |
| 10.1 Configure dNFS..... | 35 |
| 10.2 Enable dNFS..... | 41 |

| | | |
|------|--|----|
| 11 | Cloning an Oracle database | 44 |
| 11.1 | Database cloning with FS8600 snapshots | 44 |
| 11.2 | Database cloning using Oracle dNFS CloneDB | 44 |
| 12 | Tracking dNFS and FS8600 issues | 45 |
| 12.1 | Enabling persistent Oracle events | 45 |
| 12.2 | Disabling persistent Oracle events | 45 |
| 12.3 | Enabling dNFS events for an active session | 46 |
| 12.4 | Disabling dNFS events for an active session | 46 |
| 12.5 | Issue from enabling FS8600 secure port on Oracle NFS storage | 46 |
| 13 | Conclusion | 48 |
| A | FS86000 CLI examples | 49 |
| B | Technical support and resources | 51 |
| B.1 | Related resources | 51 |

Executive summary

This document reviews the deployment and key considerations of using Oracle® 11gR2, Oracle Unbreakable Enterprise Linux Kernel 6.4 (x86-64) (UEK6U4), Dell™ servers and the Dell FS8600 network-attached storage (NAS) appliance. This document should not be considered an installation guide, but it provides enough information to successfully deploy a working environment that is based on the information provided in documents [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#) and [How to deploy Oracle 11g Release 2 on RHEL6/Oracle Linux 6](#) which are located on [Dell TechCenter](#). This document also does not discuss performance tuning of any component of the infrastructure (operating system (OS), transmission control protocol (TCP) network, network file system (NFS) stack or Oracle software and database), which is dependent on the overall architecture and business requirements.

For detailed information on Dell Storage SC Series arrays or FS8600 storage, refer to the information provided on [Dell TechCenter](#), and [Knowledge Center](#) (login required). For detailed information on any part of Oracle, use the information provided at [My Oracle Support](#). Additional resources are listed in Appendix B.

1 Introduction

NAS has been around since the mid-80s and has become more conventional as a storage solution in data centers. The pervasive usage of NAS is in part due to a number of its operating characteristics when compared to storage area networks (SANs). NAS tends to be simpler to provision, more agile, easier to maintain and is less expensive.

NFS-Ethernet provides the ability to access file systems on a NAS server through the native NFS kernel driver on the client, and is one key driver of NAS performance. With Oracle 11g Direct NFS (dNFS), Oracle has tightly integrated the NFS client within the Oracle kernel, resulting in optimizing the I/O access path to the NFS server.

Several use cases for Oracle dNFS with Dell FS8600 are listed below:

- Cloning a database without using the Oracle CloneDB feature.
- Cloning a database using CloneDB
- Using dNFS for Oracle RAC deployments that use FS8600 for back-end clustered storage
- Using dNFS for an Oracle standalone deployment that use FS8600 for back-end shared storage
- Using NFS with ASM
- Using NFS with non-ASM

The deployment method for Oracle dNFS in this document is for a generic installation. For specific deployments of dNFS or for further information on a given dNFS topic, refer to Oracle documentation, or [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#) located at [Dell TechCenter](#)

1.1 Audience

This document is intended for information technology professionals interested in deploying an Oracle 11gR2 environment using dNFS with UEK6U4 residing on Dell servers and a Dell FS8600 network attached storage (NAS) appliance. General understanding and management of Linux, Oracle and NFS are required to fully understand the included instructions and information.

1.2 Prerequisites

Readers should have prior experience with or training in:

- General understanding of Ethernet networks, DNS, and managing network switches
- Fabric zoning and management of fabric switches
- General understanding of SAN and NAS administration
- QLogic® and Fast!UTIL
- Oracle UEK6U4
- Oracle 11gR2 single instance databases
- General understanding of Dell FS8600, and SC Series storage
- General understanding and management of NFS
- OS platform architecture and administration

2 FS8600 introduction

FS8600 scale-out NAS consists of one to four FS8600 appliances configured as a FluidFS cluster. Each NAS appliance is a rack-mounted 2U chassis that contains two hot-swappable NAS controllers in an active-active configuration. In a NAS appliance, the second NAS controller that has one paired NAS controller is called the peer controller. FS8600 scale-out NAS supports expansion; NAS appliances can be added to the FluidFS cluster as needed to increase performance.

The FS8600 shares a back-end infrastructure with the Storage Center. The SAN network connects the FS8600 to the Storage Center and carries the block level traffic. The FS8600 communicates with the Storage Center using either the internet small computer system interface (iSCSI) or Fibre Channel protocol, depending on the NAS appliance configuration purchased.

2.1 FS8600 LAN/client network

The LAN/client network is used for client access to the common internet file system (CIFS) shares and NFS exports. It is also used by the storage administrator to manage the FluidFS cluster. The client network is assigned one or more virtual IP (VIP) addresses that allow clients to access the FluidFS cluster as a single entity. The client VIP also enables load balancing between NAS controllers, and ensures failover in the event of a NAS controller failure.

If client access to the FluidFS cluster is not through a router (in other words, a flat network), define one client VIP per NAS controller. If clients access the FluidFS cluster through a router, define a client VIP for each client interface port per NAS controller.

3 Oracle file management

This section introduces two components of Oracle file management:

- Oracle Disk Manager (ODM)
- Oracle Direct NFS

3.1 Oracle Disk Manager (ODM)

Oracle I/O and its file management infrastructure are managed by the Oracle standard ODM library. ODM provides a new approach in how I/O activity interfaces with and is managed by Oracle. ODM can manage NFS devices without using the native Linux® NFS kernel (kNFS) client, providing the standard ODM library is replaced with the ODM library with the embedded Oracle NFS client. When ODM manages NFS devices with the Oracle embedded NFS client, the environment is said to be using the Oracle Direct NFS (dNFS) client, otherwise the environment will process NFS calls with the kNFS client.

Four new dynamic views are available in Oracle 11g to monitor NFS storage devices. A full description of the dynamic tables can be found in the Oracle Database Reference 11gR2 guide at

http://docs.oracle.com/cd/E18283_01/server.112/e17110.pdf.

Table 1 dNFS dynamic performance views used by ODM

| Dynamic view | Description |
|-------------------|---|
| v\$d nfs_channels | Displays open network paths/channels to servers for which dNFS is providing files |
| v\$d nfs_files | Displays files currently open using dNFS |
| v\$d nfs_servers | Displays servers accessed using dNFS |
| v\$d nfs_stats | Displays performance statistics for dNFS |

dNFS does not adversely affect kernel performance. On the contrary, performance improves from its usage as it manages and standardizes NFS configurations and options that can be tuned, load balances all available dNFS network paths, provides greater stability, scalability and manageability of NFS operations.

3.2 Oracle Direct NFS (dNFS)

dNFS is an optimized NFS client from Oracle for database I/O and resides in the ODM library as a part of the Oracle database kernel. dNFS improves stability, reliability, faster access to NFS storage devices over TCP/IP than does the native OS NFS driver (kNFS). dNFS in 11gR2 can be configured to access NFS version 3 filers, bypassing the kNFS I/O stack and improving performance.

The advantage of using Oracle dNFS lies within the fact that it's part of Oracle's database kernel and all I/O to NFS storage devices are serviced by the Oracle dNFS client rather than by the kNFS client. This process gives Oracle the ability to manage the best possible configuration, automatically tune itself and take advantage of the Oracle buffer cache and use of available resources for optimal NFS I/O.

One to four network paths between the NFS server and NFS client can be defined for each NFS mount point used by dNFS. For kNFS devices, only one network path can be used. If multiple NFS paths are defined with dNFS, when a path fails, dNFS reissues requests over any remaining path. The multiple paths also provide Oracle the ability to control the I/O paths to the NFS storage devices, thereby avoiding the need to manually tune NFS network performance at the system level.

To enable dNFS on a device, the device must be mounted and available over kNFS. If dNFS cannot access a NFS storage device, dNFS silently reverts to using the kNFS client. However, to ensure this reversion occurs, kNFS client mount options rsize and wsize must be defined.

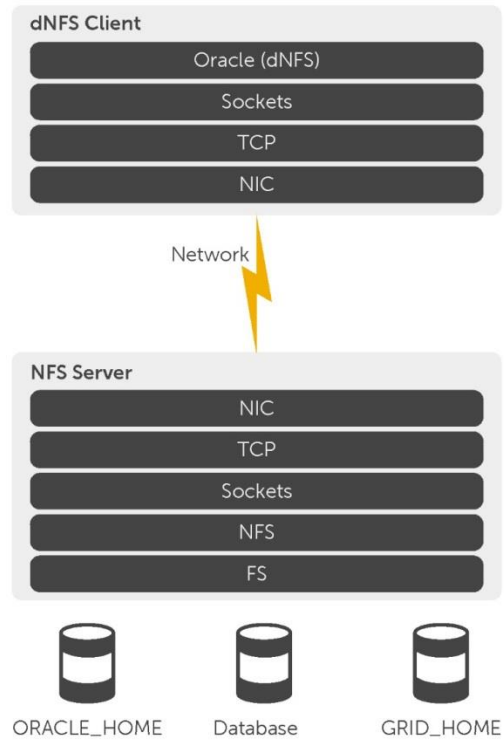


Figure 1 Oracle Direct NFS stack

4 Configuring FS8600

Log in to the FS8600 that will host the volumes for Oracle and create the volumes. The number, size and purpose of the volumes for Oracle are dependent on the business and infrastructure needs. In the below example, the vol3 volume was created to host an Oracle database. Oracle binaries were installed on a standard ext3 file system (but could exist on a NAS volume as well). Unlike an SC Series array, the FS8600 does not have the ability to snap multiple volumes in a consistent replay group. Therefore, all files for a given database must reside on the same volume if FS8600 snapshots are going to be used to clone a database.

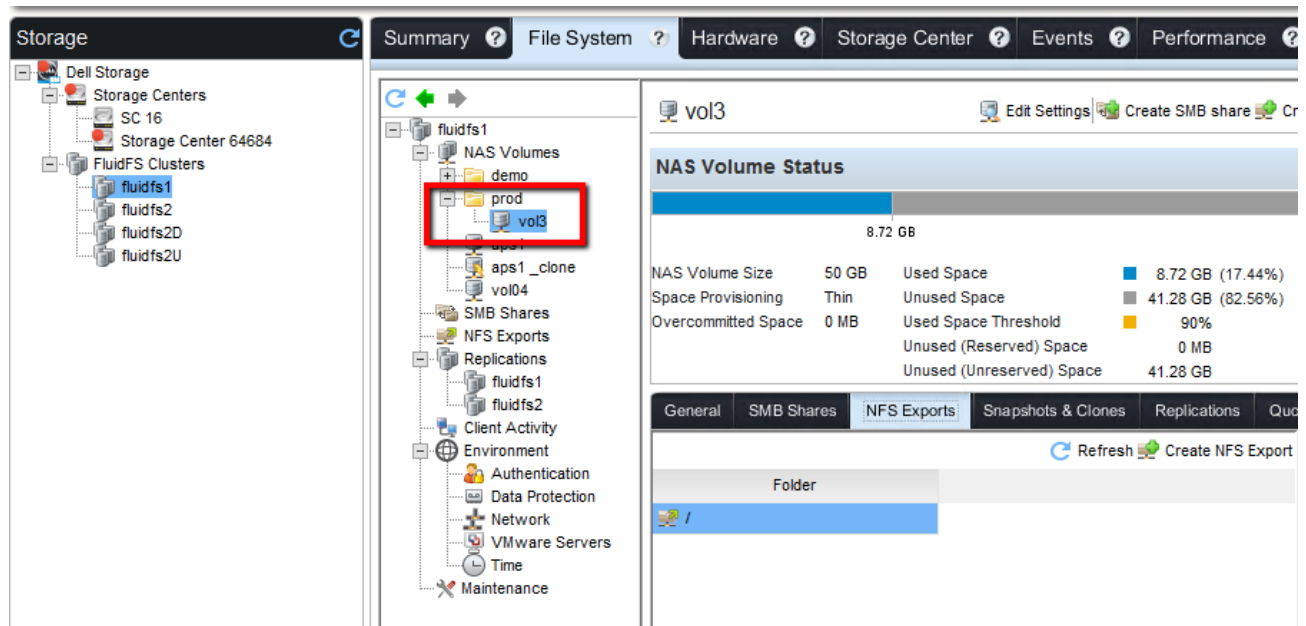


Figure 2 FS8600 Oracle volume

If using dNFS with the FS8600, reserved port checking cannot be used. Reserved port checking prohibits dNFS from functioning correctly and causes errors to be written to the Oracle alter log. See document [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#) located at [Dell TechCenter](#) for more information. When configuring FS8600 volumes for Oracle on NFS, uncheck option **Require Secure Port**, and set **Authentication Methods** to **UNIX Style**.

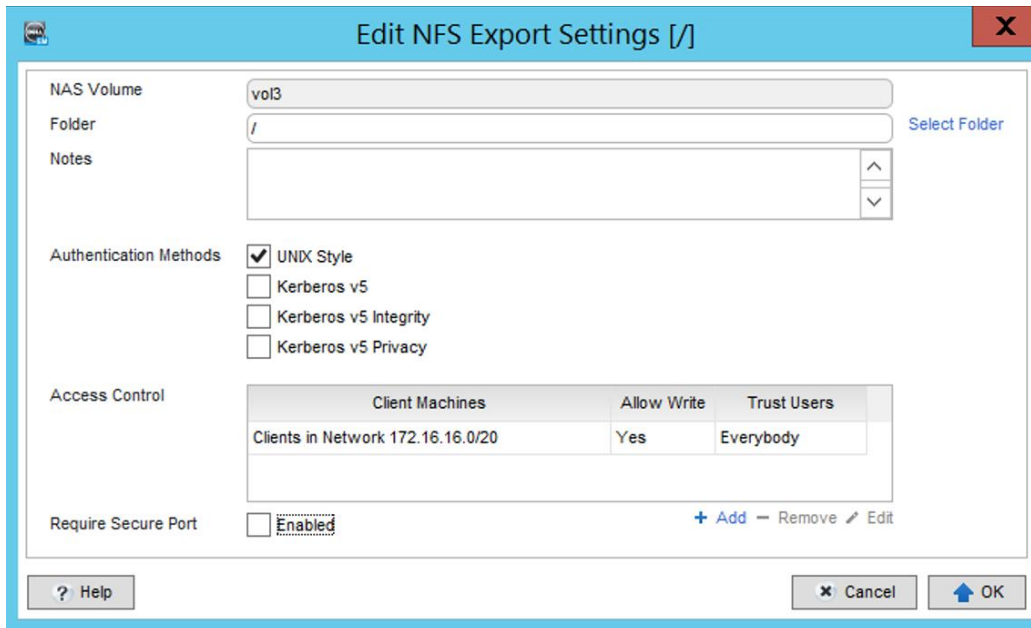


Figure 3 Edit FS8600 volume settings

If **Require Secure Port** is not selected, the FS8600 volume will be mounted with an **insecure** mount option. A value of **Everybody** in the **Trust Users** column of the **Access Details** table is required and specifies the mount option as **no_root_squash**. In the **Read/Write** column, **Yes** is required because this value is translated into mount option **rw**. Mount option **no_root_squash** is required if using NFS for either the Grid home or Oracle home. The settings shown in Figure 3 provide the following mount options in Red Hat® Enterprise Linux®.

(rw, no_root_squash, insecure)

For additional NFS mount options that must be used for NAS volumes in an Oracle environment, refer to bulletin number 359515.1 at support.oracle.com.

4.1 FS8600 internal network

An internal network is used for communication between NAS controllers. Each NAS controller in the FluidFS cluster must have access to all other NAS controllers in the FluidFS cluster to achieve the following goals:

- Provide connectivity for FluidFS cluster creation
- Act as a heartbeat mechanism to maintain high availability
- Enable internal data transfer between NAS controllers
- Enable cache mirroring between NAS controllers
- Enable balanced client distribution among NAS controllers

The entire end-to-end storage stack (FS8600, network switches, database server) should be jumbo frame enabled when deploying Oracle dNFS. Oracle makes this recommendation in document 1496040.1 at support.oracle.com. The document covers some frequently asked questions related to Direct NFS.

Two methods can be used to enable jumbo frames in the FS8600 and are shown in the following sections. Enabling jumbo frames on the database server and on the network switch are discussed in later sections.

4.1.1 Enable jumbo frames from FS8600 CLI

To access jumbo frames in the FS8600, use ssh to access the FluidFS management IP/DNS name.

```
[root@Linux1 ~]# ssh cli@172.16.26.39
Last login: Wed Oct  1 13:38:23 from 172.16.26.236
Welcome to "fluidfs1" (3.0.8290)
Installed on Mon Jul 29 10:45:07 CDT 2013
```

Provide the password for the username **Administrator**.

```
login as: Administrator
Administrator's password: *****
```

Execute the following command:

```
CLI> networking client-network-interface edit -MTU 9000
```

4.1.2 Enable jumbo frames using the FS8600 GUI

To enable jumbo frames in Dell Storage Manager (DSM), right click on the FluidFS name and click **Network**.

Next, click **Edit Settings** and change the MTU setting to 9000.

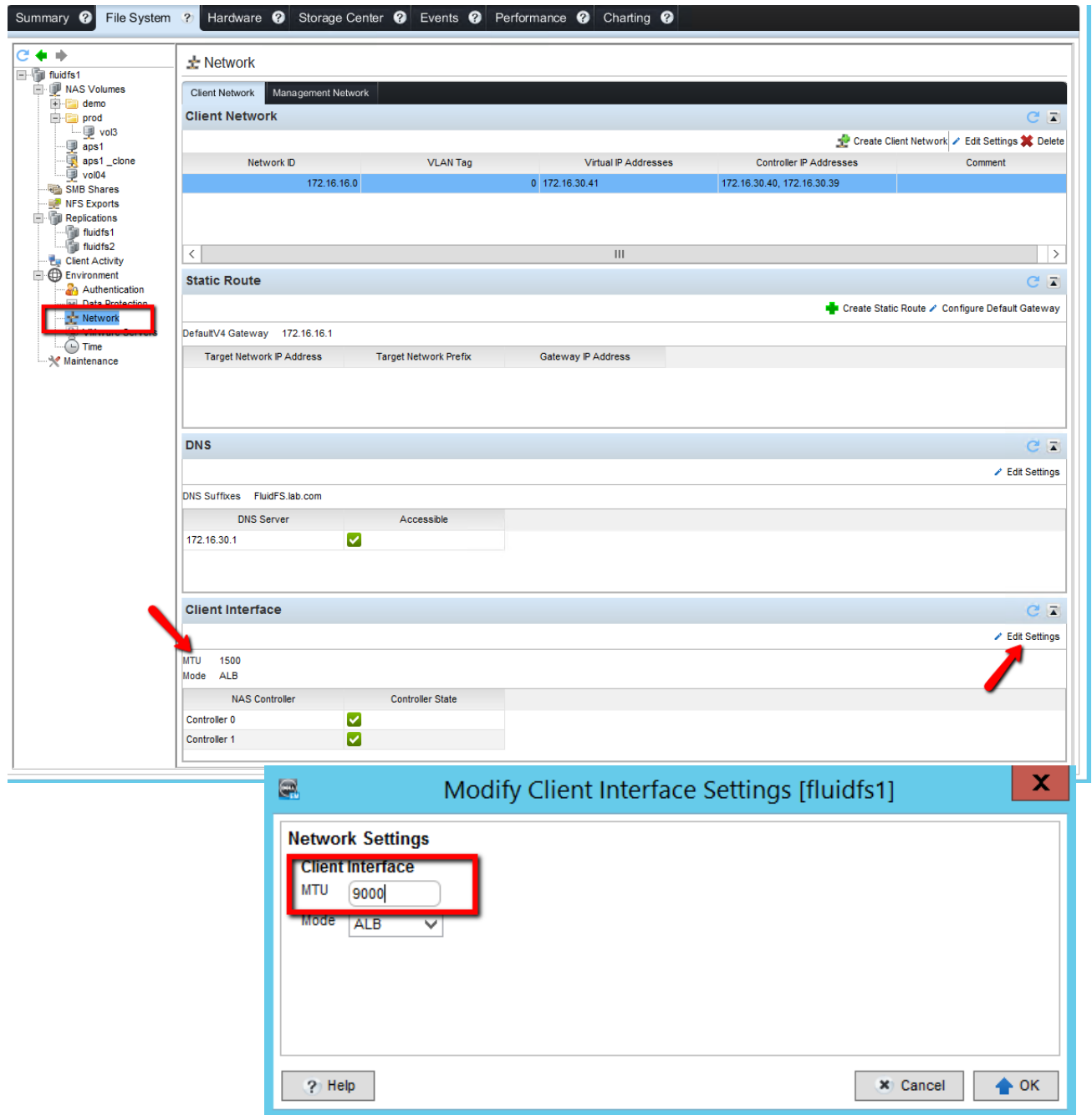


Figure 4 Enable jumbo frames

5 Network switch

A Dell Networking N2000 series switch, with 48 x 10/100/1000 + 2 x 10 Gbps SFP+ ports, was used for this deployment. Depending on the expected network traffic and infrastructure requirements, a Dell Networking S Series switch may be required.

Document number 1496040.1 at support.oracle.com recommends using jumbo frames with Direct NFS. An example of configuring jumbo frames on a N2000 series switch is show below:

```
s60>enable
s60#configure
s60 (conf) #interface range gigabitethernet 0/0 - 47
s60 (conf-if-range-gi-0/0-47) #mtu 9216
s60 (conf-if-range-gi-0/0-47) #no shutdown
s60 (conf-if-range-gi-0/0-47) #exit
s60 (conf) #exit
s60#wr
s60#reload
```

To configure jumbo frames on the FS8600, see section 4.1, “FS8600 internal network”.

5.1 Server network interface cards (NICs)

Depending on expected network traffic and infrastructure requirements, a single network card with four interfaces may be sufficient. However, under heavy loads a second network card might be needed, or Dell Networking S Series network cards could be used. The deployment discussed in this paper uses a single PCI Express compliant Broadcom 10/100/1000Base-T GbE BCM5720 quad-port NIC card. One NIC is dedicated to public traffic, and three are dedicated for NAS storage for Direct NFS.

6 Architecture

The following diagram is an example of an FS8600 and Oracle deployment; use it as a guide to designing a solution.

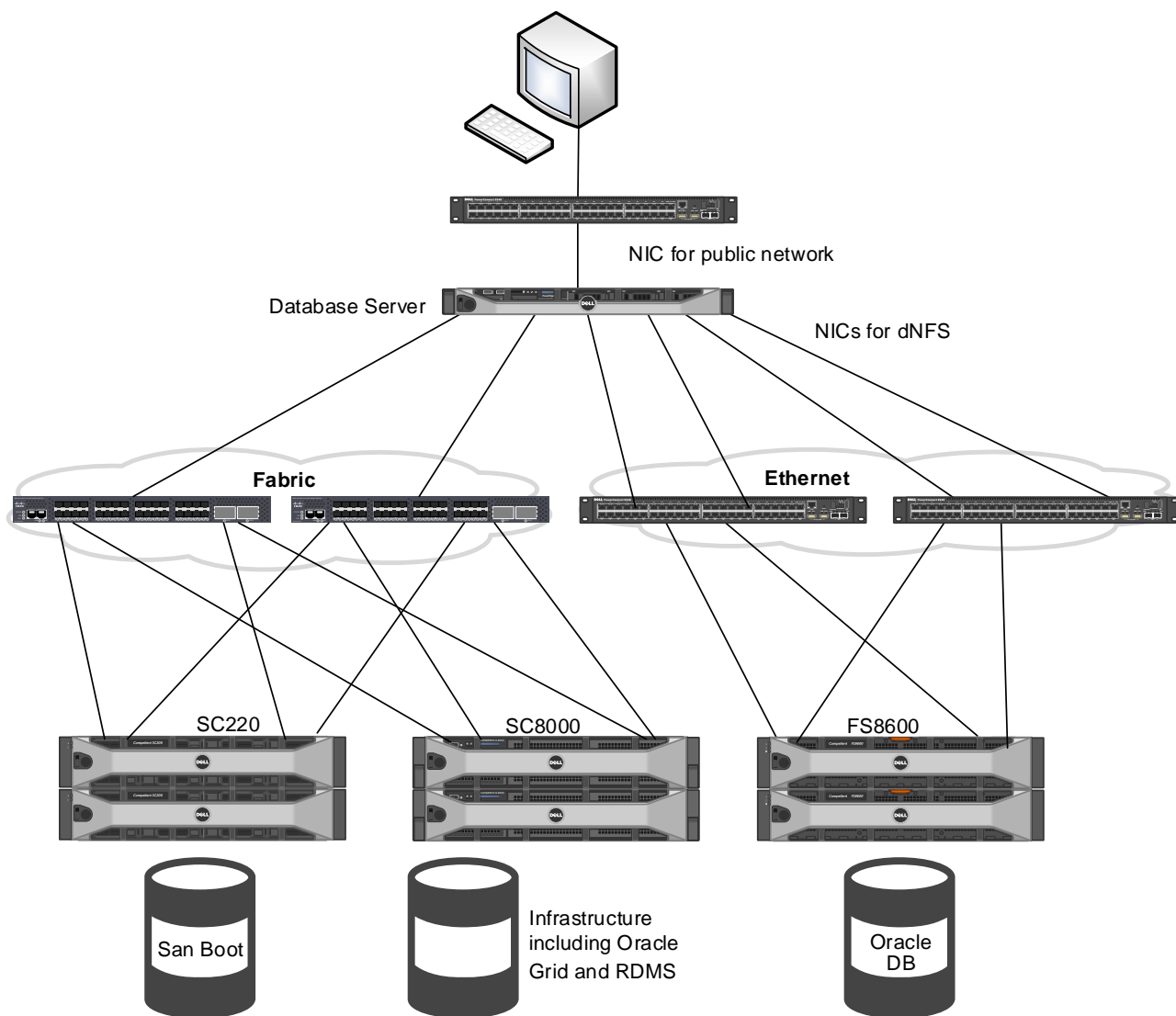


Figure 5 Architecture of infrastructure stack

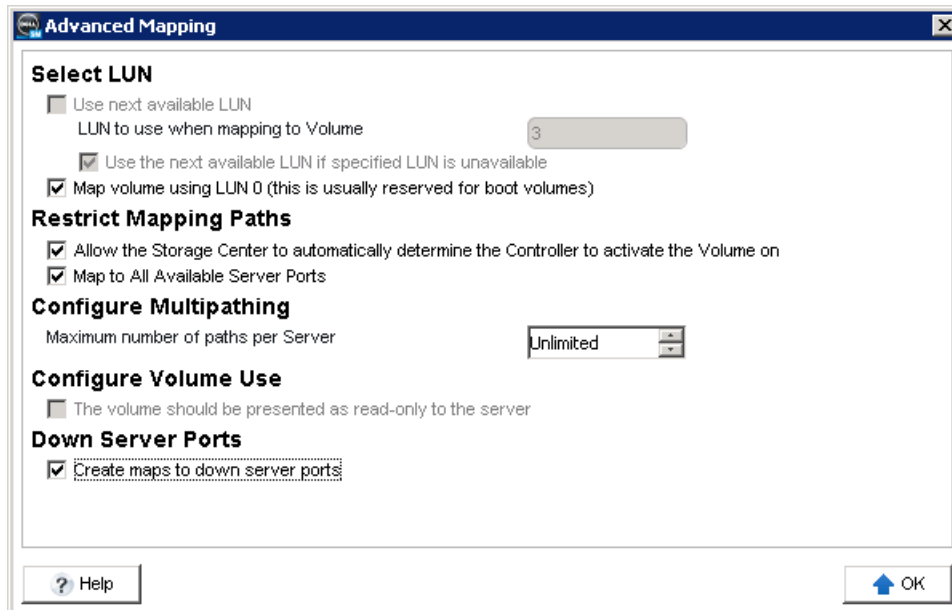
7

Database server SAN boot

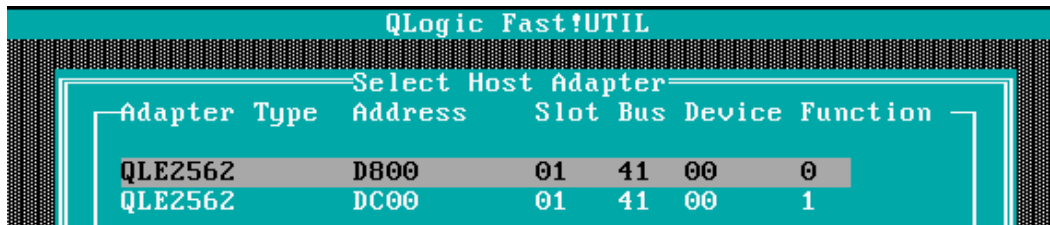
Although SAN boot is not a requirement for database servers, there are many advantages for using it, and the Dell recommendation is to deploy SAN boot where applicable.

Prior to installing Linux, make sure all fabric zoning is complete, and an SC Series volume is created and mapped to the database server object as LUN id 0 for SAN boot. QLogic must be configured appropriately to boot from this volume. Instructions for performing these steps can be found in [Red Hat Enterprise Linux \(RHEL 6.x Best Practices\)](#) at [Dell TechCenter](#).

1. While the database server was powered down, a 100GB boot volume was created in DSM and mapped to the database server as LUN ID 0. The below image shows this process. The **Restrict Mapping Paths** and **Configure Multipathing** selections below show no restrictions on the use of multiple paths to the boot volume. This provides redundancy to the boot volume in case the device paths fail.



2. After the volume is created and mapped, power up the server. Enter the QLogic Fast!UTIL to configure the volume as the boot LUN. In Fast!UTIL, select each one of the HBAs and configure it for the SAN boot.



3. Select **Configuration Settings** and in the **Adapter Settings** record the HBA port name. Configure it using the settings below.

```

Adapter Settings
BIOS Address:          CF800
BIOS Revision:         3.00
Adapter Serial Number: BFD1238D96510
Interrupt Level:       15
Adapter Port Name:     21000024FF4F7726
Host Adapter BIOS:     Enabled
Frame Size:            2048
Loop Reset Delay:      5
Adapter Hard Loop ID:   Disabled
Hard Loop ID:          0
Spinup Delay:          Disabled
Connection Options:    1
Fibre Channel Tape Support: Enabled
Data Rate:             2
  
```

4. Configure the advanced adapter settings, by selecting **Configuration Settings** and **Advanced Adapter Settings** from the main menu

```

Advanced Adapter Settings
Execution Throttle:     65535
Luns per Target:        256
Enable LIP Reset:       No
Enable LIP Full Login:  Yes
Enable Target Reset:    Yes
Login Retry Count:      60
Port Down Retry Count:  60
Link Down Timeout:      30
Operation Mode:         0
Interrupt Delay Timer:  0
Enable Interrupt:       No
EV Controller Order:    Disabled
  
```

5. Set the boot options for the adapter, by selecting **Configuration Settings** and **Selectable Boot Settings** from the main menu. Set **Selectable Boot** to **Enabled** and select the top-most **Boot Port Name, LUN** value.

```

Selectable Boot Settings
Selectable Boot:         Enabled
(Primary) Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0
      Boot Port Name, Lun: 0000000000000000, 0

Press "C" to clear a Boot Port Name entry
  
```

- Press **[Enter]** to generate a list of candidate volumes to be used for LUN 0 for the current HBA.

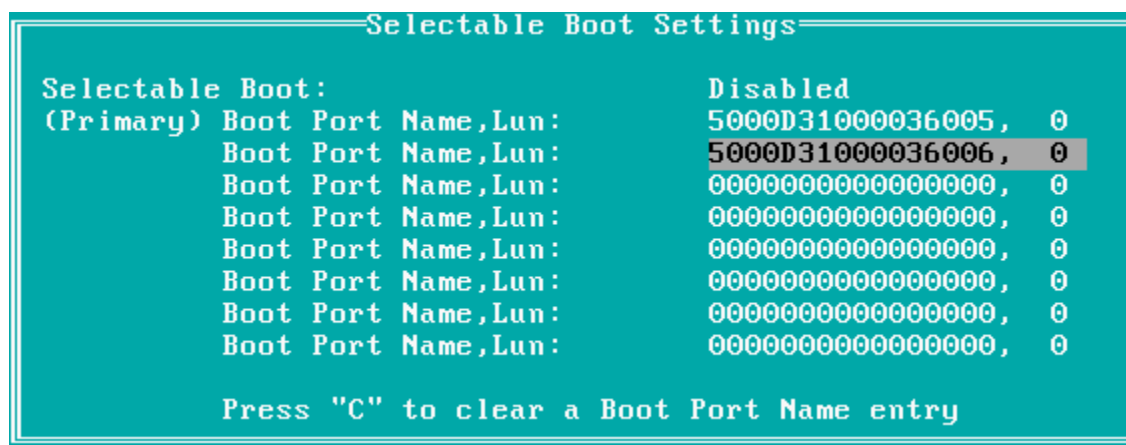
| Select Fibre Channel Device | | | | | | |
|--|-------------------|-----------------|------|------------------|---------|--|
| ID | Vendor | Product | Rev | Port Name | Port ID | |
| 0 | COMPELN | TCompellent Vol | 0605 | 5000D31000036006 | C61E01 | |
| 1 | COMPELN | TCompellent Vol | 0605 | 5000D31000036005 | C61F01 | |
| 2 | No device present | | | | | |
| 3 | No device present | | | | | |
| 4 | No device present | | | | | |
| 5 | No device present | | | | | |
| 6 | No device present | | | | | |
| 7 | No device present | | | | | |
| 8 | No device present | | | | | |
| 9 | No device present | | | | | |
| 10 | COMPELN | TCompellent Vol | 0603 | 5000D3100002B914 | E60201 | |
| 11 | COMPELN | TCompellent Vol | 0603 | 5000D3100002B909 | E60301 | |
| 12 | No device present | | | | | |
| 13 | COMPELN | TCompellent Vol | 0603 | 5000D3100002B913 | E60501 | |
| 14 | COMPELN | TCompellent Vol | 0603 | 5000D3100002B90A | E60601 | |
| 15 | No device present | | | | | |
| Use <PageUp/PageDown> keys to display more devices | | | | | | |

After a period of time, the status of the Server Port and Controller Port in SC Series array will change to **Up** to identify the zoned paths from the array presenting the boot LUN and the Server HBA Fast!UTIL is currently configuring.

| Mapping Details: | | | | | |
|------------------|------|------------------|------------------|-----|-----------|
| Status | Type | Server Port | Controller Port | LUN | Read Only |
| Up | FC | 21000024FF4F7727 | 5000D31000036005 | 0 | No |
| Up | FC | 21000024FF4F7727 | 5000D31000036006 | 0 | No |
| Down | FC | 21000024FF4F7727 | 5000D310000360DC | 0 | No |
| Down | FC | 21000024FF4F7727 | 5000D310000360DD | 0 | No |
| Down | FC | 21000024FF4F7727 | 5000D310000360DE | 0 | No |
| Down | FC | 21000024FF4F7727 | 5000D310000360DF | 0 | No |

- Make note of the controller ports in the array with an **Up** status and create a **Boot Port Name, LUN** mapping in Fast!UTIL.

8. In the **Select Fibre Channel Device** window, select the devices with the corresponding **Port Name** values that appear on.
After the **Boot Port Names**, LUN mappings are defined; window **Selectable Boot Settings** will display all multiple paths for SAN boot.



9. Save the settings in Fast!Util and reboot the server.
10. When the server restarts, enter iDRAC to configure BIOS to boot from the device that will present the OS install media, and then reboot the server.

8 Installing Oracle Unbreakable Linux 6.4 (UEK6U4)

Once the database server (NFS client) has been identified, install Oracle Unbreakable Linux 6.4 (UEK6U4) x86_64 using the instructions documented in [How to deploy Oracle 11g Release 2 on RHEL6/Oracle Linux 6 on Dell TechCenter](#). Components of the UEK6U4 installation that pertain to dNFS, or are noteworthy, are shown in this section. The content is presented only as a guide and is not intended to be used as an installation guide. Complete installation instructions for UEK6U4 can be found using the above link or at support.oracle.com.

8.1 Identify the SAN boot during UEK6U4 installation

It is recommended to unmap all LUNs to the database server except for LUN 0 prior to installing UEK6U4. If additional LUNs cannot be unmapped prior to installing UEK6U4, the following information will help in determining which LUN should be used as LUN 0 for installing UEK6U4. Caution should be exercised if multiple devices are mapped when installing the OS because the install will destroy all data existing on the target SAN boot volume.

If there are multiple LUNs mapped to the database server prior to installing UEK6U4, the installer requires identifying the SAN boot volume to ensure the OS is installed on the correct LUN. Assuming the SC Series array has multiple controllers, the database server has multiple HBAs, and if multipathing and HBAs were not restricted in the array, LUN 0 appears in a UEK6U4 installation window (**Multipath Devices** tab) that prompts the device to be used for the OS installation.

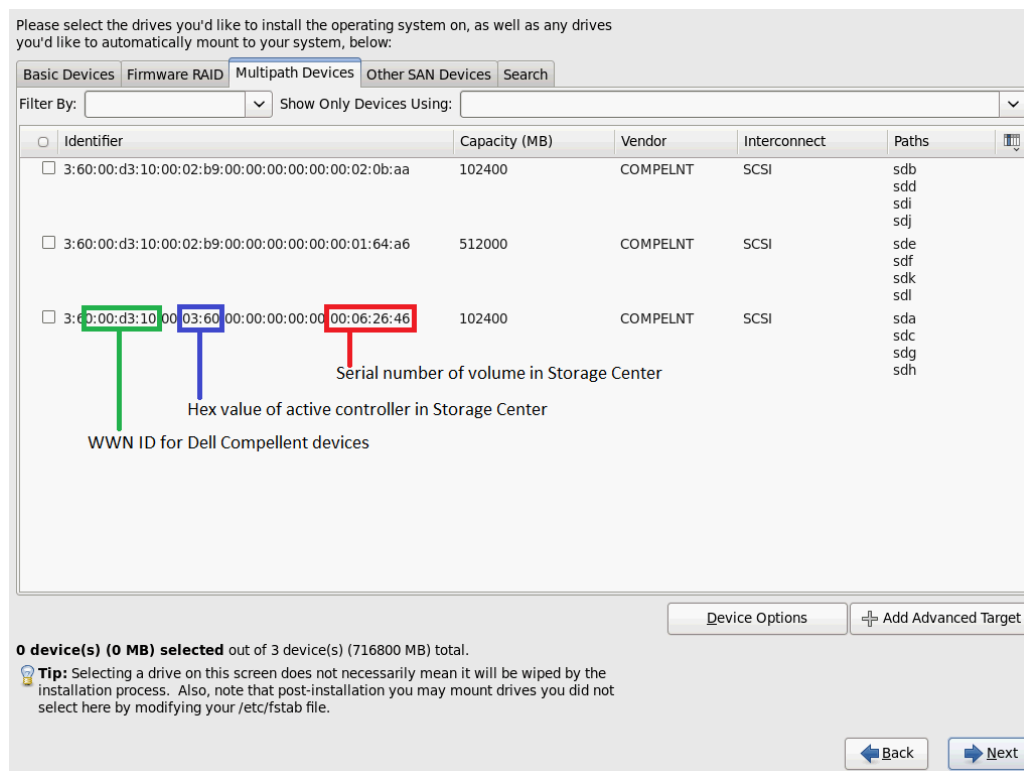


Figure 6 Selecting the LUN for SAN boot

1. To identify which device should be used for the OS, match the serial number of the SC Series LUN 0 to the appropriate identifier in the OS installer screen. When matching the values, disregard colons from the identifier in the OS installer GUI.

oradev3-boot-UEK6U4-mstr

Index 306 Volume has not us
 Configured Size 100 GB
 Volume Folder oradev3

Summary Mappings Historical Usage Sta

General
 Serial Number 00000360-00062646

2. When the correct device has been identified in the installer, select the check box associated with it.

Please select the drives you'd like to install the operating system on, as well as any drives you'd like to automatically mount to your system, below:

Basic Devices Firmware RAID Multipath Devices Other SAN Devices Search

Filter By: Show Only Devices Using:

| Identifier | Capacity (MB) | Vendor | Interconnect | Paths |
|--|---------------|----------|--------------|--------------------------|
| <input type="checkbox"/> 3:60:00:d3:10:00:02:b9:00:00:00:00:00:02:0b:aa | 102400 | COMPELNT | SCSI | sdb sdd sdi sdj |
| <input type="checkbox"/> 3:60:00:d3:10:00:02:b9:00:00:00:00:00:01:64:a6 | 512000 | COMPELNT | SCSI | sde sdf sdk sdl |
| <input checked="" type="checkbox"/> 3:60:00:d3:10:00:03:60:00:00:00:00:00:06:26:46 | 102400 | COMPELNT | SCSI | sda sdc sdg sdh |

1 device(s) (102400 MB) selected out of 3 device(s) (716800 MB) total.

Tip: Selecting a drive on this screen does not necessarily mean it will be wiped by the installation process. Also, note that post-installation you may mount drives you did not select here by modifying your /etc/fstab file.

Device Options Add Advanced Target

Back Next

3. Select **Next**, and verify the serial number for LUN 0 from Storage Center is the right-most part of the WWID.



4. If the serial number matches, unselect Apply my choice to all devices with undetected partitions or filesystems and select Yes, discard any data.
Proceed with the installation according to business and infrastructure requirements.

8.2 Configuring NICs for public and dNFS networks

Depending on expected network traffic, using at least one NIC for public traffic and at least one other NIC for dNFS traffic is recommended. Sharing the same NIC for both the public and dNFS networks is possible, but it may cause network performance issues under heavy loads as the server will not perform network load balancing, and a single NIC may not be able to satisfy the performance requirements of the system. If network traffic is expected to benefit from multiple NICs, configure multiple NICs and assign a dedicated network and a valid routable IP address to at least the public NIC and dNFS NICs. Additional performance gains may be realized by assigning a dedicated network and a valid routable IP address to each of the dNFS NICs. The infrastructure used for this paper was configured with one NIC for public traffic, and three NICs for dNFS traffic. The remainder of this section demonstrates how the NICs were configured.

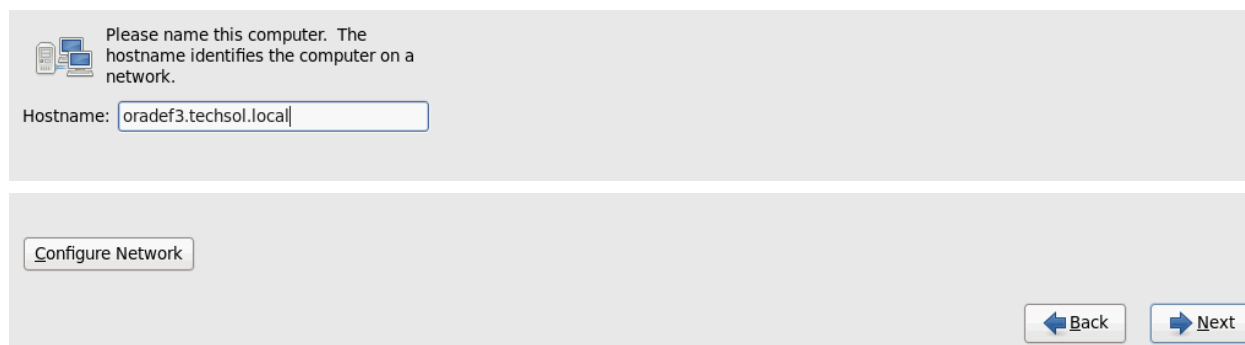
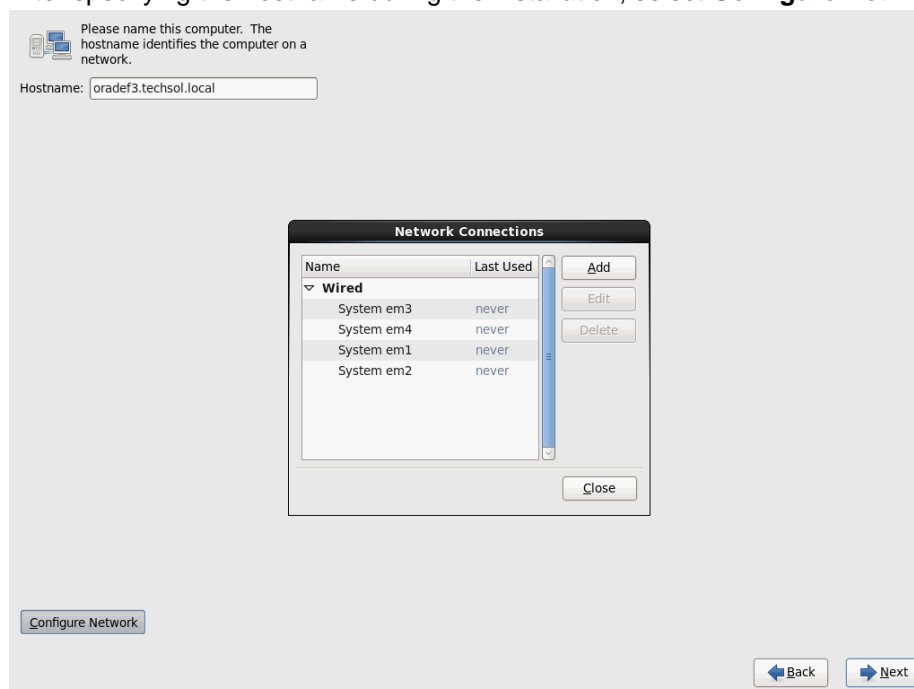
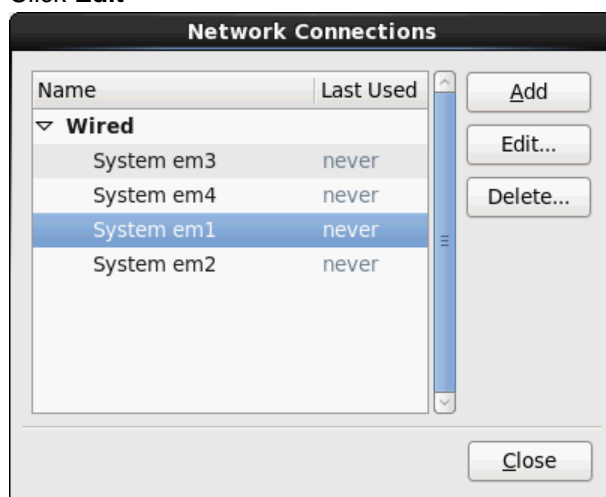


Figure 7 Define network interface during UEK6U4 installation

1. After specifying the hostname during the installation, select **Configure Network**.



2. Select the network interface associated with the NIC chosen for the public network. In this case **System em1** was chosen.
3. Click **Edit**



4. Compare the Device MAC address reported by the installer with that of NIC 1 Port 1 reported by iDRAC.

Editing System em1

Connection name: System em1

☐ Connect automatically

☒ Available to all users

Wired 802.1x Security IPv4 Settings IPv6 Settings

Device MAC address: 90:B1:1C:1D:BD:85

Cloned MAC address:

MTU: automatic bytes

- a. If they are not the same, cancel the edit and select another **em<n>** adapter until the one with the same MAC address as the one in iDRAC NIC1 Port 1 is located.

System Setup

Device Settings

[Integrated RAID Controller 1: Dell PERC <PERC H310 Mini> Configuration Utility](#)

[Integrated NIC 1 Port 1: Broadcom Gigabit Ethernet BCM5720 - 90:B1:1C:1D:BD:85](#)

[Integrated NIC 1 Port 2: Broadcom Gigabit Ethernet BCM5720 - 90:B1:1C:1D:BD:86](#)

[Integrated NIC 1 Port 3: Broadcom Gigabit Ethernet BCM5720 - 90:B1:1C:1D:BD:87](#)

[Integrated NIC 1 Port 4: Broadcom Gigabit Ethernet BCM5720 - 90:B1:1C:1D:BD:88](#)

[Fibre Channel in Slot 1: QLogic QLE7562 8Gb Fibre Channel Adapter - 21000024EE4E7726](#)

- b. If they are the same, select **Connect automatically**.

Editing System em1

Connection name: System em1

☒ Connect automatically

☒ Available to all users

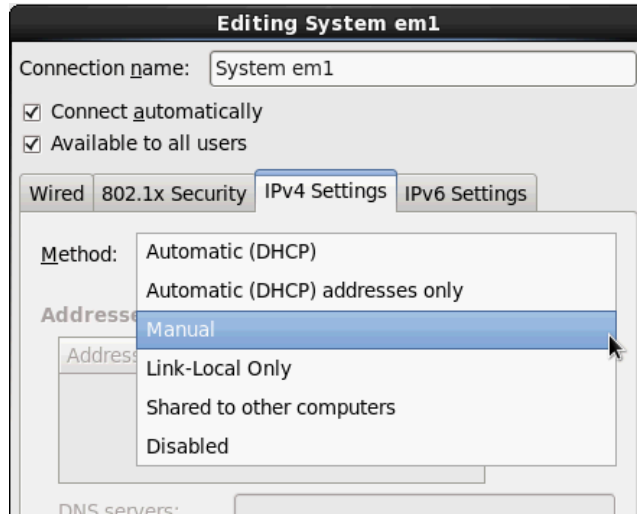
Wired 802.1x Security IPv4 Settings IPv6 Settings

Device MAC address: 90:B1:1C:1D:BD:85

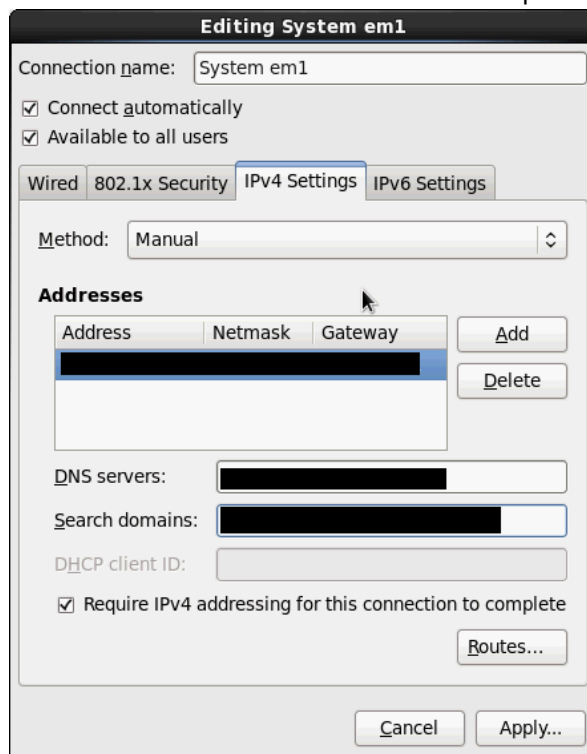
Cloned MAC address:

MTU: automatic bytes

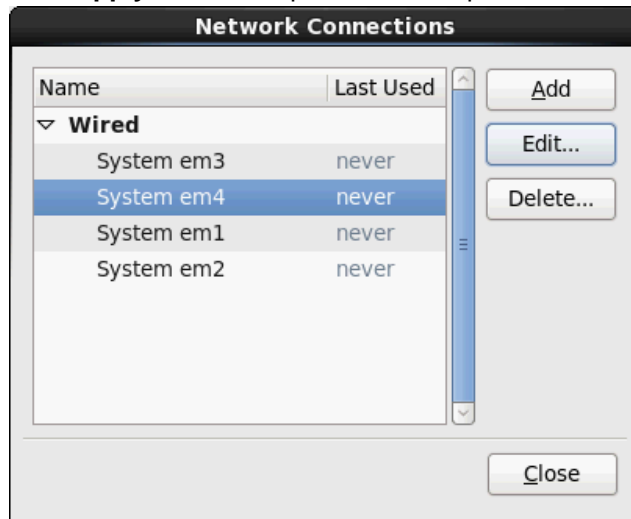
5. Open the **IPv4 Settings** tab.
6. In the **Method** drop-down list, select **Manual**, and then click **Add**.



7. Enter the network IP information and corresponding DNS information if available.

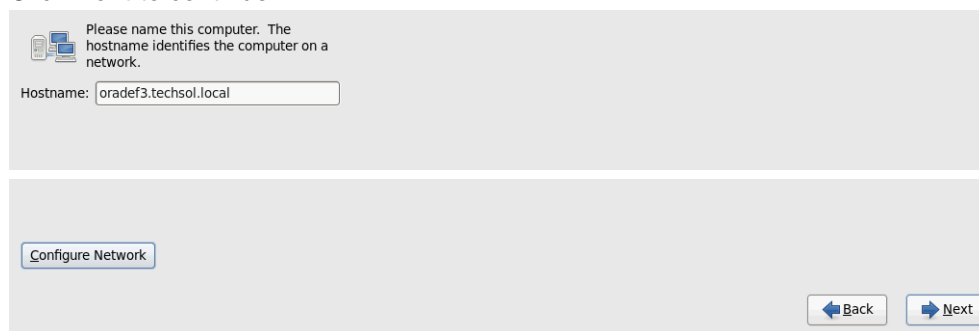


8. Click **Apply** and then repeat the same process to edit all network adapters that will be used by dNFS.



9. Click **Close** when finished defining the NICs for the public and dNFS networks.

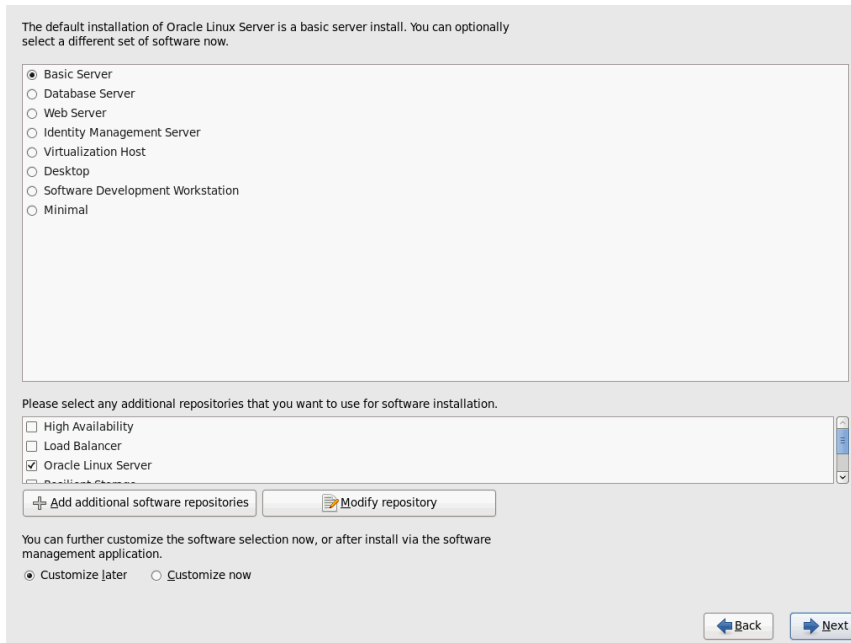
10. Click **Next** to continue.



After UEK6U4 has been completely installed, see section 8.4, "Post UEK6U4 installation" for additional network configuration instructions.

8.3 Selecting UEK6U4 package groups

UEK6U4 components need to be installed and configured according to infrastructure and business requirements. In addition, the selection of packages may impact the installation of Oracle. The following Linux package groups were selected for the environment described in this paper.



The default installation of Oracle Linux Server is a basic server install. You can optionally select a different set of software now.

- ☒ Basic Server
- ☐ Database Server
- ☐ Web Server
- ☐ Identity Management Server
- ☐ Virtualization Host
- ☐ Desktop
- ☐ Software Development Workstation
- ☐ Minimal

Please select any additional repositories that you want to use for software installation.

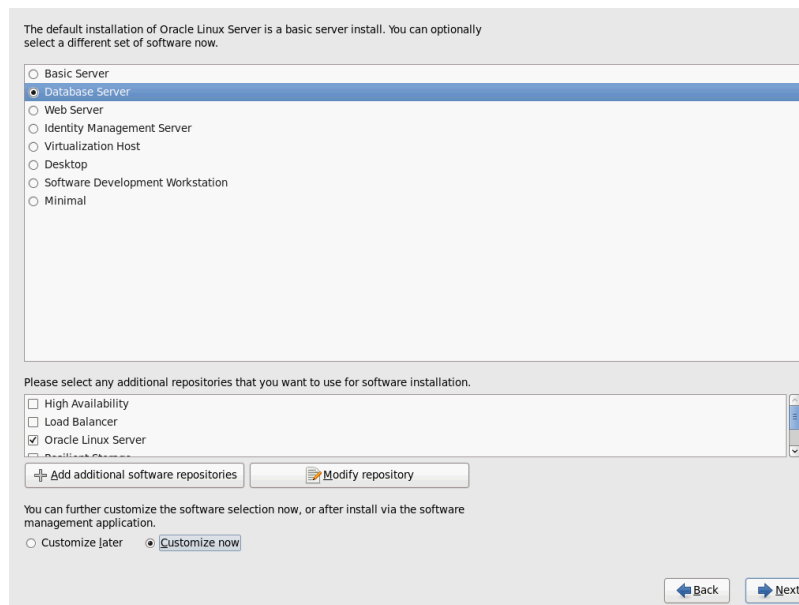
- ☐ High Availability
- ☐ Load Balancer
- ☒ Oracle Linux Server

You can further customize the software selection now, or after install via the software management application.

- ☒ Customize later
- ☐ Customize now

Figure 8 Customizing package groups

1. Select **Database Server**, **Oracle Linux Server**, and **Customize now**.
2. Click **Next**.



The default installation of Oracle Linux Server is a basic server install. You can optionally select a different set of software now.

- ☐ Basic Server
- ☒ Database Server
- ☐ Web Server
- ☐ Identity Management Server
- ☐ Virtualization Host
- ☐ Desktop
- ☐ Software Development Workstation
- ☐ Minimal

Please select any additional repositories that you want to use for software installation.

- ☐ High Availability
- ☐ Load Balancer
- ☒ Oracle Linux Server

You can further customize the software selection now, or after install via the software management application.

- ☐ Customize later
- ☒ Customize now

The installer will then prompt for the packages to install. The following options were selected and may not be sufficient for other installations. Determine what specific components are required in the target environment before proceeding with the selection.

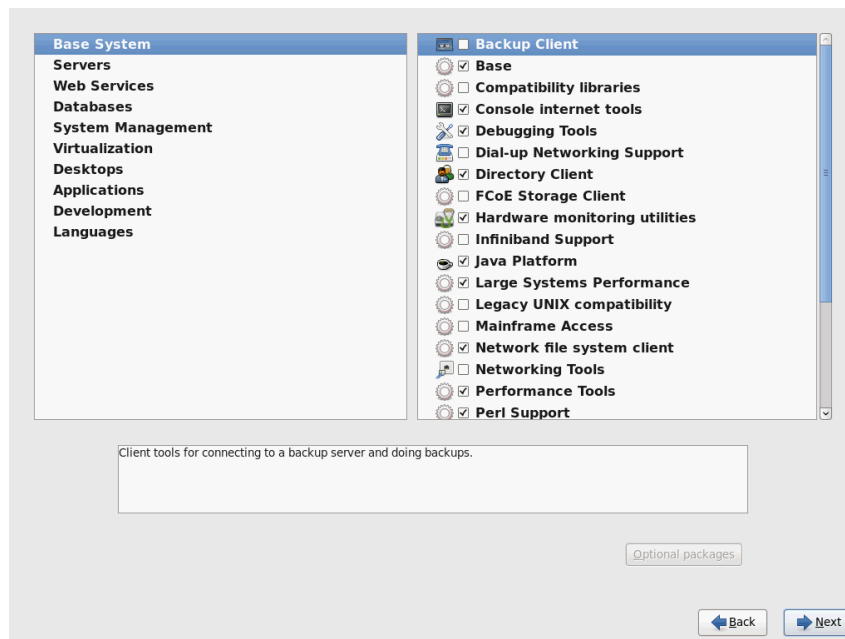


Figure 9 Electing package groups and components

All components listed below were selected unless otherwise noted as being de-selected.

- Base System
 - Base
 - Select Compatibility libraries
 - Console internet tools
 - Debugging Tools
 - Directory client
 - Hardware monitoring utilities
 - Java Platform
 - Uncheck Large Systems Performance
 - Select Legacy UNIX compatibility
 - Network file system client
 - Performance Tools
 - Perl Support
- Servers
 - Server Platform
 - System administration tools
- Web Services
 - Select PHP Support
 - Select Web Server
 - Select Web Servlet Engine

- Databases
 - Uncheck MySQL Database client
 - Uncheck MySQL Database server
 - Uncheck PostgreSQL Database client
 - Uncheck PostgreSQL Database server
- System Management
 - Select Messaging Client Support
 - Select SNMP Support
 - Select System Management
 - Select Web-Based Enterprise Management
- Desktops
 - Select Desktop
 - Select Desktop Platform
 - Select General Purpose Desktop
 - Select Legacy X Window System compatibility
 - Select X Window System
- Applications
 - Select Emacs
 - Select Internet Browser
- Development
 - Select Additional Development
 - Select Desktop Platform Development
 - Select Development tools
 - Select Eclipse
 - Select Server Platform Development

For a description of package groups, see the Red Hat document https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/6/html/Installation_Guide/s1-pkgselection-x86.html that describes the different package groups.

8.4 Post UEK6U4 installation

This section discusses some of the post UEK6U4 installation tasks. For additional information on post UEK6U4 installation tasks, see the documentation at Oracle Help Center (<https://docs.oracle.com/en/>).

8.4.1 Relax Red Hat 6 network routing filters

Red Hat 6 follows the recommendations of ingress filtering for multihomed networks (<http://tools.ietf.org/html/rfc3704>). These routing filters must be relaxed in order for the NICs to be used on the same network. The Red Hat support note at <https://access.redhat.com/solutions/53031> provides the required changes.

Execute the following changes on the database server to allow all the NICs to share the same network.

1. Record current reverse pathing filtering.

```
grep rp_filter /etc/sysctl.conf
net.ipv4.conf.default.rp_filter = 1
```

```
sysctl -a | grep rp_filter
net.ipv4.conf.all.rp_filter = 0
net.ipv4.conf.all.arp_filter = 0
net.ipv4.conf.default.rp_filter = 1
net.ipv4.conf.default.arp_filter = 0
net.ipv4.conf.lo.rp_filter = 1
net.ipv4.conf.lo.arp_filter = 0
net.ipv4.conf.em1.rp_filter = 1
net.ipv4.conf.em1.arp_filter = 0
net.ipv4.conf.em2.rp_filter = 1
net.ipv4.conf.em2.arp_filter = 0
net.ipv4.conf.em4.rp_filter = 1
net.ipv4.conf.em4.arp_filter = 0
net.ipv4.conf.em3.rp_filter = 1
net.ipv4.conf.em3.arp_filter = 0
```

2. Make the changes during runtime.

```
echo 2 > /proc/sys/net/ipv4/conf/default/rp_filter
echo 2 > /proc/sys/net/ipv4/conf/all/rp_filter
```

3. Verify the changes.

```
sysctl -a | grep rp_filter
net.ipv4.conf.all.rp_filter = 2
net.ipv4.conf.all.arp_filter = 0
net.ipv4.conf.default.rp_filter = 2
```

4. Make the changes persistent.

```
(echo "%s/net.ipv4.conf.default.rp_filter =
1/net.ipv4.conf.default.rp_filter = 2/g"; echo 'wq') | ex -s
/etc/sysctl.conf
echo "net.ipv4.conf.all.rp_filter = 2" >> /etc/sysctl.conf
```

8.4.2 Disabling Network Manager service

The following steps will disable Network Manager in UEK6U4 and use the standard network service for all interfaces. All steps need to be executed as user root.

1. Verify Network Manager is enabled or disabled.

```
chkconfig --list NetworkManager
NetworkManager 0:off 1:off 2:on 3:on 4:on 5:on 6:off
```

2. If any of the run levels for Network manager are on, turn them off.

```
chkconfig NetworkManager off
```

3. Verify Network Manager is disabled.

```
chkconfig --list NetworkManager
NetworkManager 0:off 1:off 2:off 3:off 4:off 5:off 6:off
```

4. Verify the Network Manager service is running.

```
service NetworkManager status
NetworkManager (pid 2964) is running...
```

5. If the service is running, stop it.

```
service NetworkManager stop
Stopping NetworkManager daemon: [ OK ]
```

6. Verify the Network Manager service is not running.

```
service NetworkManager status
NetworkManager is stopped
```

7. Remove the Network Manager configuration from all network interface scripts and reconfigure them to use the standard network service to take control of and activate them on boot.

```
cd /etc/sysconfig/network-scripts/
cat ifcfg-em[1234]
(echo "/^NM_CONTROLLED/s/=.*/no/"; echo 'wq') | ex -s ifcfg-em1
(echo "/^NM_CONTROLLED/s/=.*/no/"; echo 'wq') | ex -s ifcfg-em2
(echo "/^NM_CONTROLLED/s/=.*/no/"; echo 'wq') | ex -s ifcfg-em3
(echo "/^NM_CONTROLLED/s/=.*/no/"; echo 'wq') | ex -s ifcfg-em4

(echo "/^ONBOOT/s/=.*/=yes/"; echo 'wq') | ex -s ifcfg-em1
(echo "/^ONBOOT/s/=.*/=yes/"; echo 'wq') | ex -s ifcfg-em2
(echo "/^ONBOOT/s/=.*/=yes/"; echo 'wq') | ex -s ifcfg-em3
(echo "/^ONBOOT/s/=.*/=yes/"; echo 'wq') | ex -s ifcfg-em4
cat ifcfg-em[1234]
```

8. Enable the network service (rather than the Network Manager service) to start on boot.

```
chkconfig network on
chkconfig --list network
network 0:off 1:off 2:on 3:on 4:on 5:on 6:off
```

9. Start the network service.

```
service network restart
Shutting down interface em1: [ OK ]
Shutting down interface em2: [ OK ]
Shutting down interface em3: [ OK ]
Shutting down interface em4: [ OK ]
Shutting down loopback interface: [ OK ]
Bringing up loopback interface: [ OK ]
Bringing up interface em1: [ OK ]
```

```
Bringing up interface em2:      [ OK ]
Bringing up interface em3:      [ OK ]
Bringing up interface em4:      [ OK ]
```

service network status

```
Configured devices:
lo em1 em2 em3 em4
Currently active devices:
lo em1 em2 em3 em4
```

10. Verify the interfaces were configured with the correct IPs, and then from a remote server or client, ping each of the interfaces to ensure the NICs are usable.

```
# ifconfig
# ping <em1 IP>
# ping <em2 IP>
# ping <em3 IP>
# ping <em4 IP>
```

Additional information on Network Manager can be found in Red Hat documents

- https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/6/html/Deployment_Guide/ch-NetworkManager.html
- https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux_OpenStack_Platform/3/html/Installation_and_Configuration_Guide/Disabling_Network_Manager.html

8.4.3 Preparing the server for Oracle

A final step of the post UEK6U4 installation process is to configure the server for Oracle. Detail instructions for preparing the server for Oracle can be found in several documents on [Dell TechCenter](#).

How to deploy Oracle 11gR2 on RHEL6/Oracle Linux 6:

http://en.community.dell.com/techcenter/enterprise-solutions/w/oracle_solutions/3336

Dell Oracle Deployment Tar Gunzip – Version: Lin-EL6-2013-01:

http://en.community.dell.com/techcenter/enterprise-solutions/m/oracle_db_gallery/20213046

The above tarball contains a Linux package that will create the necessary groups and users for Oracle, as well as define additional Linux configurations:

- Add the system configuration for Oracle to /etc/sysctl.conf
- Apply the necessary RPM packages to the Linux kernel
- Add the security limits for Oracle to /etc/security/limits.conf
- Update /etc/profile with ulimits for the oracle and grid users

It is strongly recommended that it be used to streamline the Oracle installation process.

8.4.4 Preparing storage for Oracle and dNFS

In Oracle 11g, Direct NFS is not certified for clusterware files but NFS is. See table 4-1 Supported Storage Options for Oracle Clusterware in the Oracle Clusterware Installation Guide 11g for Linux (http://docs.oracle.com/cd/B28359_01/install.111/b28263/storage.htm) for more information on support storage options. Also see Configuring Operating System and Direct NFS Client (<http://docs.oracle.com/database/121/CWLIN/storage.htm>) for information on using NFS for ORACLE_HOME and GRID_HOME.

9 Configuring NFS

Prior to configuring dNFS, Oracle requires the NFS server and client be configured for kNFS.

Refer to section 4, “Configuring FS8600” for instructions on configuring the NFS server.

To configure the NFS client, add an entry to `/etc/fstab` for each dNFS mount point. Refer to [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#) for appropriate mount options. The following example configures an NFS mount point in `/etc/fstab` for Oracle and Grid binaries (`/u01`), and the database that will use ASM. Oracle clusterware is not certified on dNFS, therefore, a dNFS device will not be created for it, but it will still exist in `/etc/fstab` as kNFS will be used for it.

```
# cat /etc/fstab
...
# NFS for kNFS
172.16.26.39:/vol8 /gridcrs nfs rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
# NFS for dNFS
172.16.26.47:/vol7 /u01 nfs rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
172.16.26.46:/vol6 /asmdata nfs rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
172.16.26.45:/vol3 /asmfra nfs rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
```

Once the mount points have been identified, install the database software using the instructions documented in [How to deploy Oracle 11g Release 2 on RHEL6/Oracle Linux 6](#) on Dell TechCenter.

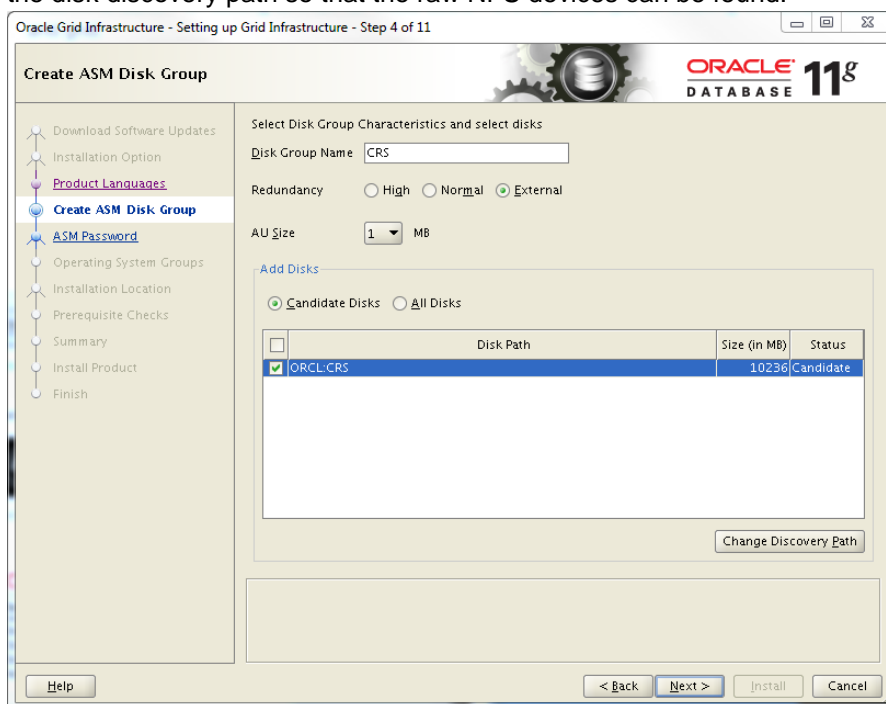
10 Deploying Oracle 11gR2 dNFS with FS8600

This section covers certain components of the deployment of Oracle 11gR2 for dNFS on UEK6U4 when using Dell FS8600. The steps presented are generic and should be adjusted as needed. Detailed instructions for deploying Oracle 11gR2 on Oracle Linux 6 can be found in [How to deploy Oracle 11g Release 2 on RHEL6/Oracle Linux 6](#) on [Dell TechCenter](#). Refer to Oracle document 1495104.1 at [support.oracle.com](#) for any necessary patches for dNFS.

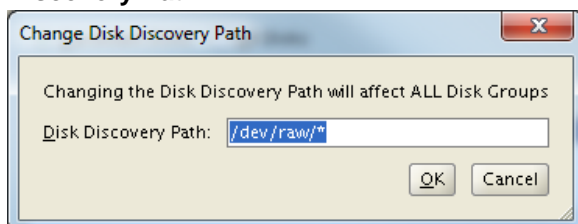
10.1 Configure dNFS

FS8600 volumes presented to the database server could either be configured as ASM raw disks or non-ASM devices. For the environment used for this paper, the FS8600 volumes were configured as ASM raw devices.

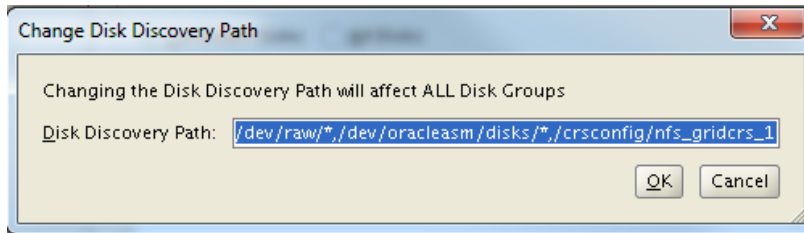
1. ASM raw devices will not reside in the `/dev/oracleasm/disks` directory, so make sure to change the disk discovery path so that the raw NFS devices can be found.



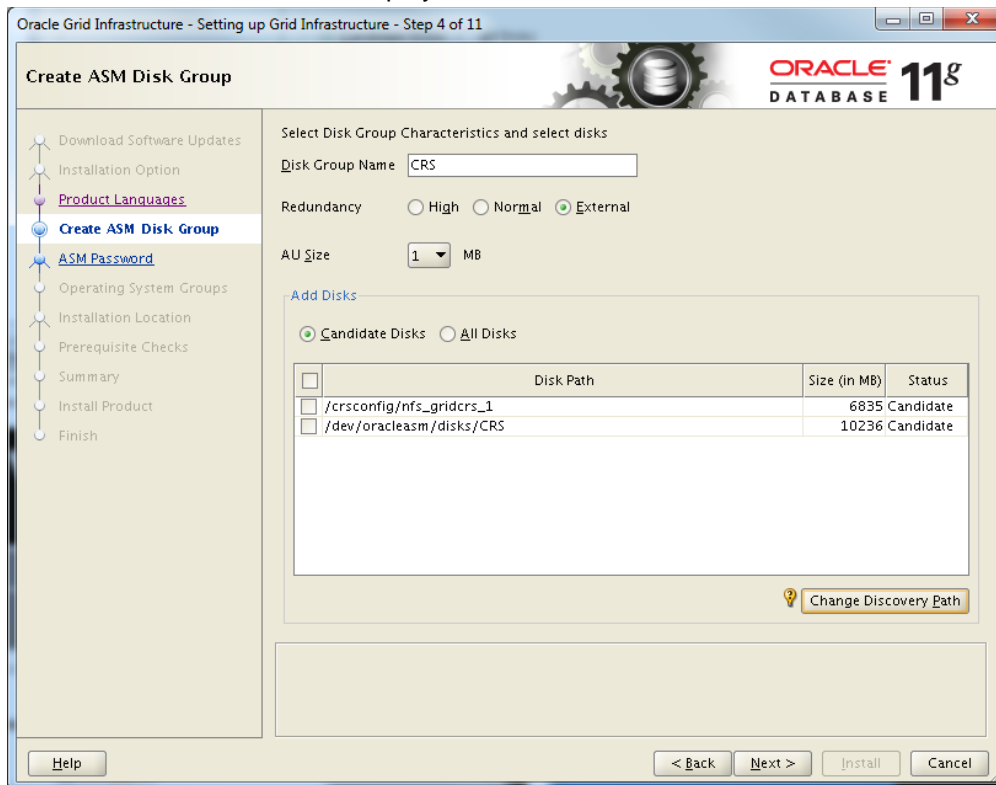
2. Name the disk group for the clusterware files. Set the redundancy to External then select **Change Discovery Path**



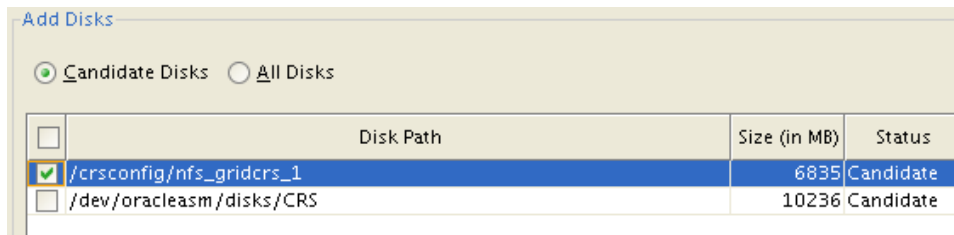
3. Next, add the NFS ASM raw device path for the clusterware to the discovery path



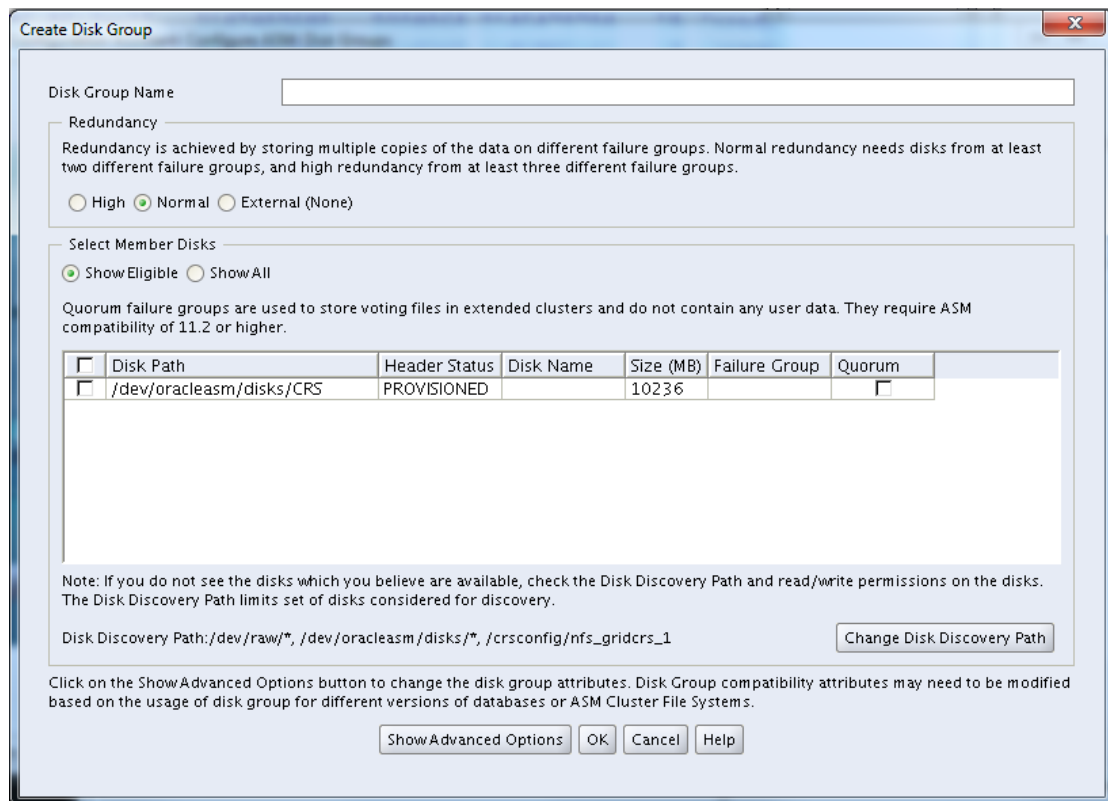
4. Select **OK**. The installer now displays the NFS device as a candidate disk for the clusterware



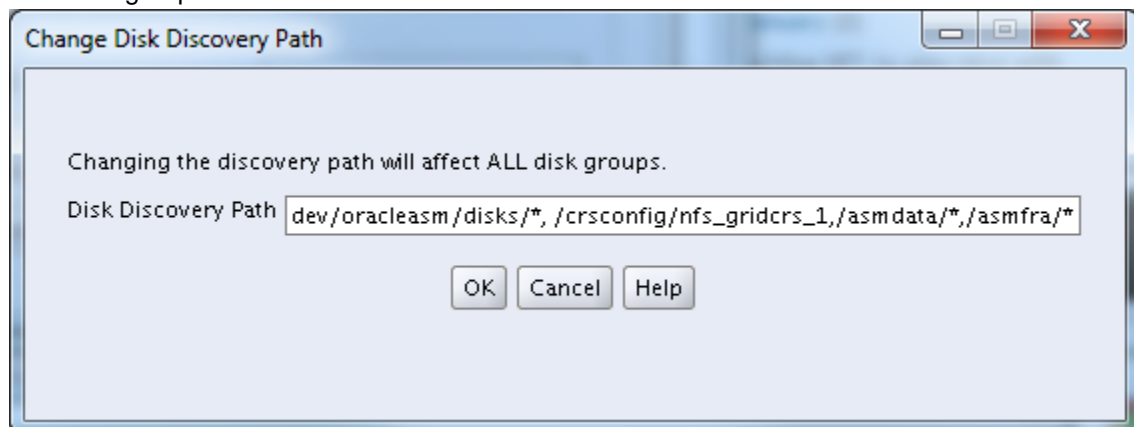
5. Select the check box associated with the NFS device.



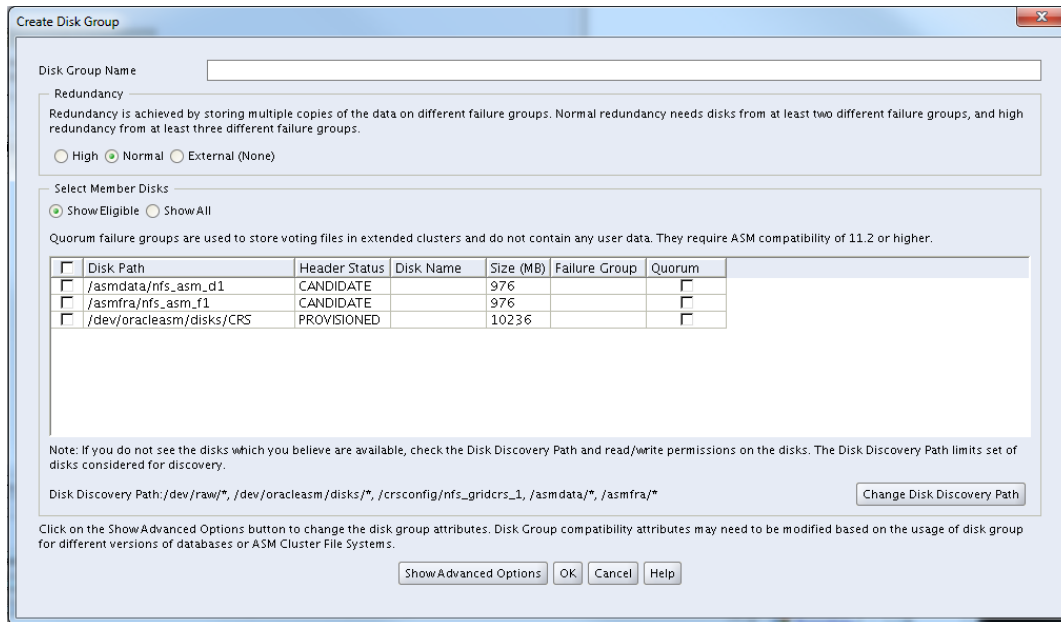
6. Select **Next** and proceed with the remainder of the Grid installation. After Grid is installed, configure a DATA and FRA disk group on the appropriate NFS mount points using `asmca`.
7. Change the disk discovery path in `asmca` so it can locate the NFS mount points.



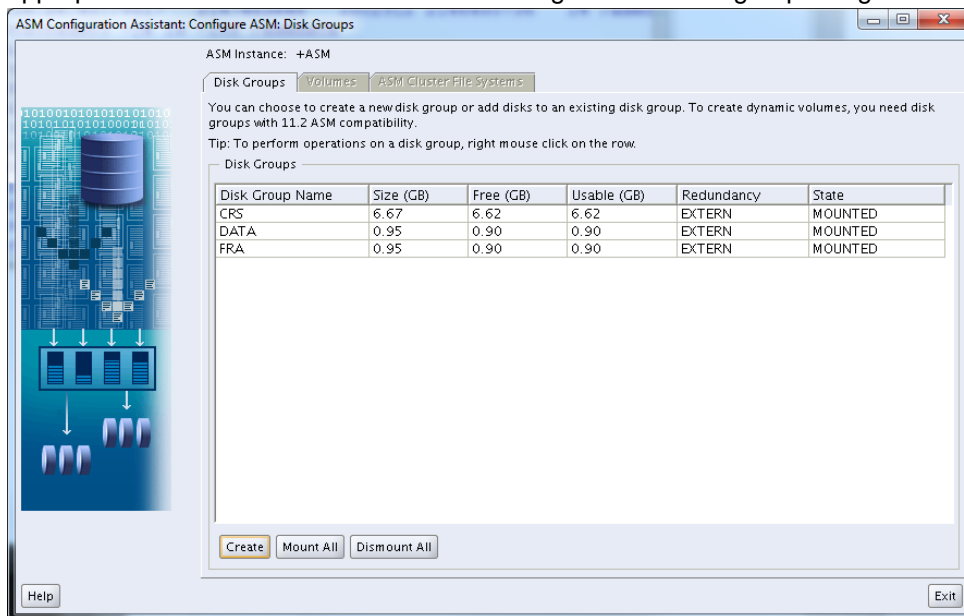
8. Select **Change Disk Discovery Path** and add the path to the raw ASM NFS disks for the DATA and FRA disk groups.



9. Select **OK**. ASMCA now displays the NFS devices.



10. Name the disk group, select external redundancy, and select the check box associated with the appropriate NFS device. Continue with creating the FRA disk group using the same process.



11. Select **Exit** after all disk groups have been created. Verify using `asmcmd` from the grid account that all disk groups have been created and that they use the NFS ASM raw devices.

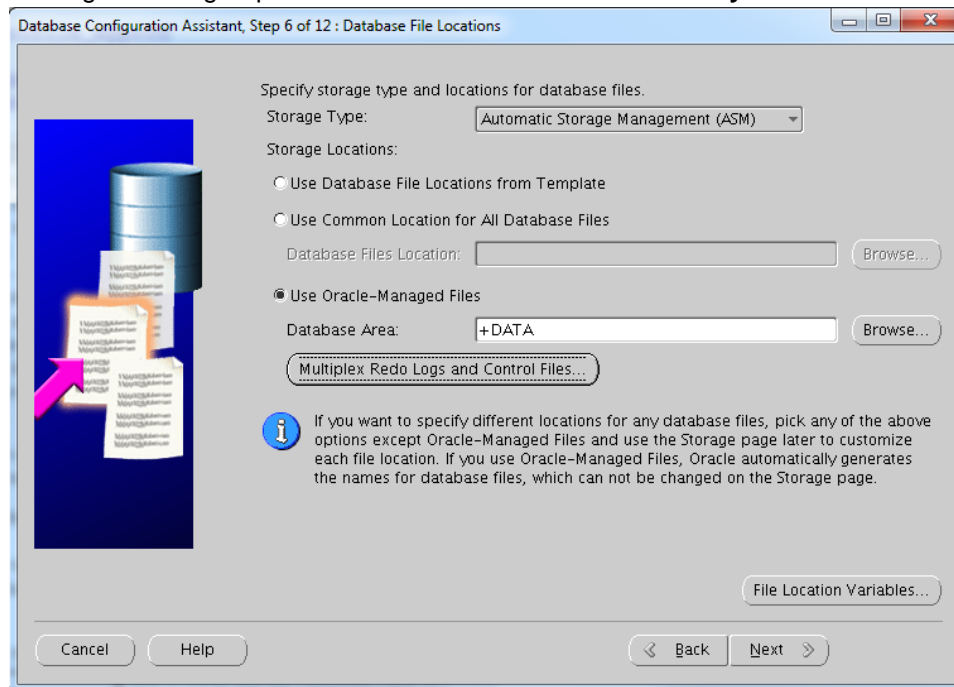
```
# asmcmd lsdisk -G CRS
Path
/crsconfig/nfs_gridcrs_1
# asmcmd lsdisk -G DATA
Path
```

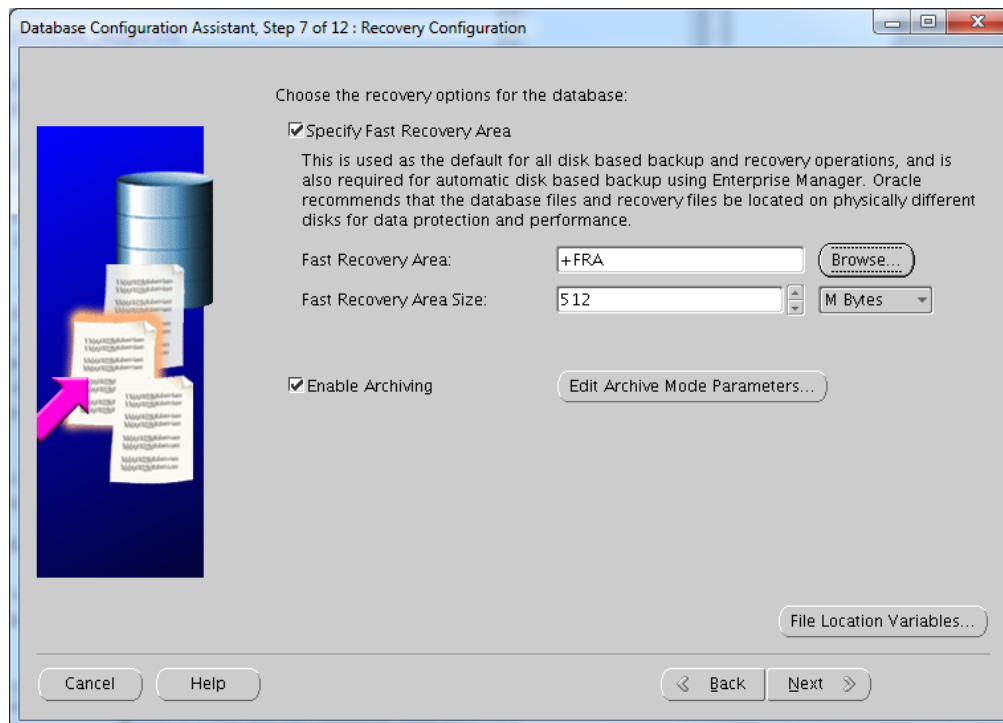
```

/asmdata/nfs_asm_d1
# asmcmd lsdsk -G fra
Path
/asmfra/nfs_asm_f1
# asmcmd lsdsk
Path
/asmdata/nfs_asm_d1
/asmfra/nfs_asm_f1
/crsconfig/nfs_gridcrs_1

```

12. After the ASM instance is created, proceed with the installation of Oracle then create the database on the NFS ASM Disk groups.
Detail instructions on how to proceed are in document [How to deploy Oracle 11g Release 2 on RHEL6/Oracle Linux 6](#) at [Dell TechCenter](#).
13. To have the database use the FS8600 NFS devices, make sure to specify the disk groups that were created above. If using DBCA to create the database, this can be accomplished by specifying the storage type of **Automatic Storage Management (ASM)**, selecting **Use Oracle-Managed Files**, and naming the disk group for **Database Area** and **Fast Recovery Area**.





14. After the database has been created, configure Oracle direct NFS (dNFS) and then enable it. dNFS can be configured for either single or multi network pathing. If single network pathing is desired, no additional configuration is needed on the NFS client. If multiple network pathing is required, file oranfstab must be configured with the appropriate mapping information between the network interfaces on the database server to the NFS filer. For detail information on how to configure multiple network pathing, see [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#).

The below oranfstab configuration sample uses multiple network pathing to illustrate how network activity can be balanced across different paths. The following oranfstab provides multi-networking pathing across three NICs on the database server to three different NFS filer mount points. Since Oracle does not support clusterware on dNFS devices, the clusterware files in this environment are configured on a kNFS device. In Red Hat 6, option **dontroute** may have to be specified in oranfstab to allow additional routing when the same network is used for multi-networking paths. Optimally, put each multi-network path on its own network.

```
$ cat oranfstab
server: FS8600_ORA
local:172.16.25.139
path:172.16.26.45
local:172.16.25.140
path:172.16.26.46
local:172.16.25.141
path:172.16.26.47
export: /vol17 mount: /asmfra
```



```

export: /vol2 mount: /asmdata
export: /vol4 mount: /u01

$ cat /etc/fstab
...
# NFS for kNFS
172.16.26.45:/vol3    /crsconfig nfs
rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
# NFS for dNFS
172.16.26.47:/vol4    /u01      nfs
rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
172.16.26.46:/vol2    /asmdata  nfs
rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600
172.16.26.45:/vol7    /asmfra   nfs
rw,bg,hard,nointr,rsiz=32768,wsiz=32768,tcp,vers=3,timeo=600

```

10.2 Enable dNFS

After dNFS has been configured, enable it by performing the following steps:

1. Shutdown the oracle database and any oracle service that exists on a dNFS device

```

su - oracle
srvctl stop database -d myprod

```

2. Shutdown the grid infrastructure if its binaries were installed on a dNFS device

```

su - grid
crsctl disable has
crsctl stop has

```

3. Enable oradism for dNFS

```

su - oracle
cd /u01/app/oracle/product/11.2.0/dbhome_1/rdbms/lib
make -f ins_rdbms.mk dnfs_on

```

4. Restart the grid infrastructure and database

```

su - grid
crsctl enable has
crs start has
exit
su - oracle
srvctl start database -d myprod

```

- During database startup, a message will appear in the database alert.log file for each network local and path mapping defined in oranfstab

```
Direct NFS: channel id [0] path [172.16.26.45] to filer [FS8600_ORA] via
local [172.16.25.139] is UP
Direct NFS: channel id [1] path [172.16.26.46] to filer [FS8600_ORA] via
local [172.16.25.140] is UP
Direct NFS: channel id [2] path [172.16.26.47] to filer [FS8600_ORA] via
local [172.16.25.141] is UP
```

- After database startup, verify the FS8600 devices are used by the dNFS server defined in oranfstab

```
col dirname format a15
select ID, SVRNAME, DIRNAME from v$dtnfs_servers;
```

| ID | SVRNAME | DIRNAME |
|----|------------|---------|
| 1 | FS8600_ORA | /vol2 |
| 2 | FS8600_ORA | /vol7 |

- Verify the mappings between ASM disks and NFS8600 raw device disks are correct

```
col group_number format 99 heading "Grp|Num"
col disk_number format 999 heading "Dsk|Num"
col name format a12
col label format a20
col path format a25
select GROUP_NUMBER, DISK_NUMBER, TOTAL_MB, NAME, LABEL, PATH from V$ASM_DISK;
```

| Grp Num | Dsk Num | TOTAL_MB | NAME | LABEL | PATH |
|------------|------------|----------|-----------|-------|--------------------------|
| 1 | 0 | 6835 | CRS_0000 | | /crsconfig/nfs_gridcrs_1 |
| 2 | 1 | 976 | DATA_0001 | | /asmdata/nfs_asm_d2 |
| 2 | 0 | 976 | DATA_0000 | | /asmdata/nfs_asm_d1 |
| 2 | 2 | 976 | DATA_0002 | | /asmdata/nfs_asm_d3 |
| 3 | 2 | 976 | FRA_0002 | | /asmfra/nfs_asm_f3 |
| 3 | 0 | 976 | FRA_0000 | | /asmfra/nfs_asm_f1 |
| 3 | 1 | 976 | FRA_0001 | | /asmfra/nfs_asm_f2 |
| ... | | | | | |

- Verify dNFS has record of all the dNFS configured devices, and

```
col filename format a25
select filename, filesize from v$dtnfs_files;
```

| FILENAME | FILESIZE |
|---------------------|------------|
| /asmdata/nfs_asm_d1 | 1024000000 |
| /asmdata/nfs_asm_d2 | 1024000000 |
| /asmdata/nfs_asm_d3 | 1024000000 |

```

/asmfra/nfs_asm_f1      1024000000
/asmfra/nfs_asm_f2      1024000000
/asmfra/nfs_asm_f3      1024000000

```

9. Verify dNFS is using all multi network paths as defined in oranfstab

```

set linesize 120
col svrname format a12
col path format a12
col local format a14
select PNUM, SVRNAME, PATH, LOCAL from v$ddfs_channels;

```

| | PNUM | SVRNAME | PATH | LOCAL |
|--|------|------------|--------------|---------------|
| | 7 | FS8600_ORA | 172.16.26.45 | 172.16.25.139 |
| | 7 | FS8600_ORA | 172.16.26.46 | 172.16.25.140 |
| | 7 | FS8600_ORA | 172.16.26.47 | 172.16.25.141 |
| | 10 | FS8600_ORA | 172.16.26.45 | 172.16.25.139 |
| | 10 | FS8600_ORA | 172.16.26.46 | 172.16.25.140 |
| | 10 | FS8600_ORA | 172.16.26.47 | 172.16.25.141 |
| | ... | | | |

11 Cloning an Oracle database

When running Oracle 11.2.0.2 or later on FS8600 NFS storage, there are several methodologies available to clone an Oracle database. For most cloning operations, one of the following two methods is sufficient.

The first method utilizes the FS8600 snapshot feature to snap the volume containing the database of interest. The volume snapped must contain all files of the specified database and may contain more than one database. If there are multiple databases on the volume, and as long as all database files are on the volume and the database is in BEGIN BACKUP mode, the volume can be snapped and used to clone the database. Savings in elapsed time and disk space consumption can be realized if FS8600 snapshots are used for cloning databases.

The second method takes advantage of the Oracle Direct NFS CloneDB, which was introduced in 11gR2. Oracle Direct NFS CloneDB utilizes dNFS rather than traditional RMAN database duplication. With CloneDB, dNFS can immediately clone a database using an existing full RMAN database backup/image copy or a storage snapshot. The speed at which a database is cloned using CloneDB versus traditional Oracle methods is improved, as Oracle uses copy-on-write technology for the clone. This means that only changed blocks exist in the locally cloned database, and unchanged blocks reside in the backup files.

11.1 Database cloning with FS8600 snapshots

Prior to creating an FS8600 snapshot of the database volume, log in to the database, switch the redo log, and then place the database in BEGIN BACKUP mode. Once this is done, the database clone is only a few mouse clicks or CLI calls away from being created. See [Running Oracle over NFS with the Dell FS8600 Scale-out File System](#) for more information on the process.

11.2 Database cloning using Oracle dNFS CloneDB

For how-to instructions on using the Oracle Clone database feature, refer to document number 1210656.1 at support.oracle.com.

12 Tracking dNFS and FS8600 issues

In most cases, triaging dNFS issues is difficult because error messages are sparsely generated and published documentation on the topic is minimal. However, there are a number of recommended Oracle events to enable in the database for additional debug information. Reference “Cannot Mount the Database After enabling dNFS with ORA” (document ID 1637301.1) at support.oracle.com.

```
event="19392 trace name context forever, level 8"
event="19394 trace name context forever, level 8"
event="19396 trace name context forever, level 2"
event="19398 trace name context forever, level 128"
```

The above events can be set in either Oracle pfiles or spfiles or by explicitly setting them with an ALTER SESSION SET EVENTS command. If the events are set in either pfile or spfile files, the database must be restarted for the events to take effect. But once the database has been restarted, the settings will be persistent between sessions, and will remain in effect until they are removed from the pfile or spfile files and the database restarted. If the events are set with ALTER SESSION, the events are only active for the duration of the database session that set the event.

12.1 Enabling persistent Oracle events

To set up persistent events in an Oracle database, execute the following commands in Linux.

```
sqlplus / as sysdba
shutdown immediate;
create pfile from spfile;
!echo '
*.event="19392 trace name context forever, level 8"
*.event="19394 trace name context forever, level 8"
*.event="19396 trace name context forever, level 2"
*.event="19398 trace name context forever, level 128"
'>> $ORACLE_HOME/dbs/init${ORACLE_SID}.ora
create spfile from pfile;
startup
quit
```

12.2 Disabling persistent Oracle events

To disable persistent events in Oracle, execute the commands below from the Oracle Linux account.

```
sqlplus / as sysdba
shutdown immediate;
create pfile from spfile;
REM Remove the dNFS events from the pfile
!vi $ORACLE_HOME/dbs/init${ORACLE_SID}.ora
create spfile from pfile;
startup
```

```
quit
```

12.3 Enabling dNFS events for an active session

To set up events for an active session in Oracle, execute the following commands from a Linux account.

```
sqlplus / as sysdba
alter session set events '19392 trace name context forever, level 8';
alter session set events '19394 trace name context forever, level 8';
alter session set events '19396 trace name context forever, level 2';
alter session set events '19398 trace name context forever, level 128';
```

12.4 Disabling dNFS events for an active session

dNFS events that are enabled for a given session can be disabled using two methods:

Method 1: Disconnect the session from the database and reconnect the session:

```
SQL> disconnect
SQL> connect <username>
```

Method 2: Execute: alter session set events '<nnnnn> trace name context off'.

```
SQL> alter session set events '19392 trace name context off';
SQL> alter session set events '19394 trace name context off';
SQL> alter session set events '19396 trace name context off';
SQL> alter session set events '19398 trace name context off';
```

12.5 Issue from enabling FS8600 secure port on Oracle NFS storage

If FS8600 volumes are configured for Oracle without selecting the **Require Secure Port**, the following message appears in the database alert.log when the database is started. The message indicates no connectivity issues with NFS.

```
ALTER DATABASE MOUNT
Direct NFS: channel id [0] path [172.16.26.39] to filer [172.16.26.39] via local [] is UP
Direct NFS: channel id [1] path [172.16.26.39] to filer [172.16.26.39] via local [] is UP
Successful mount of redo thread 1, with mount id 3534563468
Database mounted in Exclusive Mode
Lost write protection disabled
Completed: ALTER DATABASE MOUNT
Tue Apr 01 11:12:16 2014
ALTER DATABASE OPEN
LGWR: STARTING ARCH PROCESSES
Tue Apr 01 11:12:16 2014
ARC0 started with pid=23, OS id=24818
ARC0: Archival started
LGWR: STARTING ARCH PROCESSES COMPLETE
ARC0: STARTING ARCH PROCESSES
```

If FS8600 volumes are configured for Oracle with **Require Secure Port** selected, the following NFS3ERR message appears in the database alert.log when the database is started. It indicates that dNFS has issues communicating with the NFS server.

```
ALTER DATABASE MOUNT
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Successful mount of redo thread 1, with mount id 3534580257
Database mounted in Exclusive Mode
Lost write protection disabled
Completed: ALTER DATABASE MOUNT
Tue Apr 01 11:10:30 2014
ALTER DATABASE OPEN
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
LGWR: STARTING ARCH PROCESSES
Tue Apr 01 11:10:30 2014
ARC0 started with pid=23, OS id=24482
ARC0: Archival started
LGWR: STARTING ARCH PROCESSES COMPLETE
ARC0: STARTING ARCH PROCESSES
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
Direct NFS: NFS3ERR 70 error encountered. path 172.16.26.39 mntport 5006 nfsport 2055
```

There are no corresponding ORA-**<nnnnn>** errors written to the alert.log for this error. If dNFS cannot communicate with the NFS storage devices, ODM dynamic performance view **v\$dNFS_files** and **v\$dNFS_channels** will return no rows:

```
SQL> select * from v$dNFS_files;

no rows selected

SQL> select * from v$dNFS_channels;

no rows selected
```

13 Conclusion

Since its inception, NAS has become a conventional storage solution that allows for less expensive connectivity, more agility, and more simple provisioning, as it combines both storage and file systems. Because NAS uses the native NFS kernel driver on the client, there could be an impact to performance. However, with the tight integration between the NFS client and the Oracle kernel with dNFS, Oracle optimizes the I/O access path to the NFS server and provides greater stability, better reliability and more scalable access to NFS storage devices than with the native kNFS client.

Therefore, by coupling the Dell FS8600 and Oracle dNFS, a datacenter can provide a very robust, scalable and stable NFS solution environment for the deployment of Oracle databases. The way in which Oracle is deployed with NFS will be dependent on business needs. It may be more advantageous to use ASM raw disks on top of the NFS files, or perhaps using a non-ASM deployment better fulfills the business requirements. No matter what option is selected, the amount of configuration is minimal. The end result of using FS8600 and Oracle is an environment that costs less than other storage solutions, and one that provides improved performance over other NFS solutions as dNFS is integrated within the Oracle I/O library.

A FS86000 CLI examples

The following examples assume a session is connected to the CLI interface and demonstrates how a clone is created.

1. Creating a new NFS export:

```
CLI> NAS-volumes NFS-exports add Oracle_nfs_2 vol0 / -RequireSecurePort No
-Krb5 No -Krb5i No -Krb5p No
```

2. Verify the creation of the NFS export:

```
CLI> NAS-volumes NFS-exports list
```

| Export Name | Volume Name | Path | Comment |
|--------------|-------------|------|---------|
| Oracle_nfs | vol0 | / | |
| Oracle_nfs_1 | vol0 | / | |
| Oracle_nfs_2 | vol0 | / | |

3. Creating a manual Snapshot:

```
CLI> NAS-volumes snapshots add vol0 Oracle_snap2
```

4. Verifying the snapshot creation:

```
CLI> NAS-volumes snapshots list vol0
```

| Volume Name | Snapshot Name | Created At |
|-------------|---------------|--------------------|
| vol0 | Oracle_snap1 | 05-May-14 14:21:43 |
| vol0 | Oracle_snap2 | 05-May-14 14:22:30 |
| vol0 | Vol0_snap0 | 09-Apr-14 09:37:08 |

5. Creating a volume clone:

```
CLI> NAS-volumes clone volume vol0_oracle2 vol0 Oracle_snap2
```

6. Verifying the creation of a volume clone:

```
CLI> NAS-volumes list clones
```

| Cloned Volume Name | Base Volume Name | Base Snapshot Name | Base Volume Space Status |
|--------------------|------------------|--------------------|--------------------------|
|--------------------|------------------|--------------------|--------------------------|

| | | | | |
|--------------|-------|--------------|-------|--|
| vol0_clone | vol0 | Vol0_snap0 | OK | |
| ----- | ----- | ----- | ----- | |
| vol0_oracle1 | vol0 | Oracle_snap2 | OK | |
| ----- | ----- | ----- | ----- | |
| vol0_oracle2 | vol0 | Oracle_snap2 | OK | |
| ----- | ----- | ----- | ----- | |

B Technical support and resources

Dell.com/support is focused on meeting customer needs with proven services and support.

[Dell TechCenter](#) is an online technical community where IT professionals have access to numerous resources for Dell EMC software, hardware and services.

[Storage Solutions Technical Documents](#) at [Dell TechCenter](#) provide expertise that helps to ensure customer success on Dell EMC Storage platforms.

B.1 Related resources

Referenced or recommended Dell publications:

- *Dell Storage Center with Red Hat Enterprise Linux (RHEL) 7x Best Practices:*
http://en.community.dell.com/techcenter/extras/m/white_papers/20437964

Referenced or recommended Red Hat publications:

- *Red Hat Enterprise Linux 6 DM Multipath, DM Multipath Configuration and Administration:*
https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/6/html/DM_Multipath/index.html