# MIGRATING ORACLE DATABASE FROM ORACLE SOLARIS 10 ON THE SUN FIRE V440 TO RED HAT ENTERPRISE LINUX 6 ON THE IBM SYSTEM x3650 M3

A migration guide commissioned by Red Hat, Inc.

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Introduction

IBM System x3650 M3

This Migration Guide reviews the approach that Principled Technologies (PT), Red Hat® Inc. (Red Hat), and IBM® recommend for a tested and validated migration of Oracle® Database 10*g* Release 2 on Oracle Solaris™ 10 to Oracle Database 11*g* Release 2 on Red Hat Enterprise Linux® 6. We present the ease of migration to Red Hat Enterprise Linux 6. We used the IBM System x3650 M3 as the server to support Red Hat Enterprise Linux 6. The IBM System x3650 M3 is an excellent server for running critical database applications.

PT has performed hands-on testing and research and drawn on real-world experiences to document best practices and help systems administrators and database administrators simplify operations and take advantage of new features in Red Hat Enterprise Linux 6 and Oracle Database 11*g* Release 2. For our test data, we migrated a 47GB Oracle database that we generated using the DVD Store Version 2 (DS2) test tool.

Scope of this Guide

This Migration Guide reviews the approach that Principled Technologies, Red Hat, and IBM recommend for planning and migrating from Oracle Solaris 10 running on a Sun Fire V440 server to Red Hat Enterprise Linux 6 running on an IBM System x3650 M3 server. We demonstrate the ease of this transition in an enterprise environment by migrating an Oracle Database 10*g* Release 2 database on the Sun Fire V440 to an Oracle Database 11*g* Release 2 database on the IBM System x3650 M3. We also cover in detail the installation of Red Hat Enterprise Linux 6 and Oracle Database 11*g* Release 2 on the IBM System x3650 M3.

Benefits of migrating to the IBM System x3650 M3

The IBM System x3650 M3 server takes full advantage of the new Intel® hex-core Westmere-EP processor technologies. With the ability to have up to 9 DIMMS per socket for a maximum of 18 DIMMS, this machine proves an effective replacement for more expensive, larger RISC systems. With the addition of Machine Check Abort (MCA) Recovery, the chips have error-correcting capabilities to detect system errors originating in the CPU or system memory and work with the operating system to correct them. Figure 1 shows an excerpt from Intel's product brief on the Intel Xeon® Processor 5600 Series.[1]

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[1]Intel Xeon Processor 5600 Series: The Next Generation of Intelligent Server Processors product brief at http://www.intel.com/Assets/en_US/PDF/prodbrief/323501.pdf.

- Intel Architecture built on Intel's [32nm second-generation high-k and metal gate technology process](#)
- Up to 6 cores per processor
- Up to 12 threads per processor with [Intel Hyper-Threading](#)
- Intel [QuickPath Interconnects](#) increase the bandwidth between processors and I/O controllers.
- 12 MB of shared cache
- Integrated memory controllers
- [Intel Turbo Boost Technology](#)
- [Automatic power management](#)
- Virtualization Support reduces overhead by allowing guests to have dedicated I/O paths and access to hardware page tables.

Figure 1. Excerpt from the Intel Xeon Processor 5600 Series product brief.

In addition, these new Intel processors and IBM System x machines are more power efficient, providing better performance while consuming less energy, depending on the configuration. The IBM System x3650 M3 is one of several System x and BladeCenter servers using the latest Intel technology. IBM's x86 portfolio includes enterprise, rack optimized, tower, blade, and workload-optimized platforms such as iDataPlex. For an overview of migration to other IBM System x servers, see http://www-03.ibm.com/systems/x/migratetoibm/index.html.

Features of Red Hat Enterprise Linux 6

Red Hat Enterprise Linux 6 introduces a wide variety of features, including the following:

Multi-core optimizations
Red Hat Enterprise Linux 6 manages systems resources on multi-core systems to improve the performance of multi-application environments.

Virtualization
Red Hat Enterprise Linux 6 provides operating system-level virtualization using Kernel-based Virtual Machine (KVM) guests.

EXT4 filesystem
The default filesystem in Red Hat Enterprise Linux 6 offers enormous storage capacity, snapshots, volume management, and improved performance over the EXT3 filesystem.

Security Enhanced Linux (SELinux)
Red Hat Enterprise Linux 6 offers policy-based security controls through kernel modules. Mandatory access controls not only limit access to system files to users with trusted roles, but also limit which processes can access them, and by what means.

Power savings

Red Hat Enterprise Linux 6 dynamically reduces power to idle I/O systems and CPUs.

Administration

Although Oracle Solaris 10 is a robust operating system, we found navigating and administrating Red Hat Enterprise Linux 6 to be much more user-friendly, which reduces time spent administrating the system and setting up any peripherals.

Planning the migration

This section reviews some of the topics you should consider prior to migrating your platform and any applications.

Considerations for moving your applications

Application data

You should never simply copy the raw data files from one system to another system of a different architecture. The data formats that applications write to disk are not generally portable. Bit orders, padding, and alignment are examples of elements that can differ as you move from one system to another. Most applications, however, provide some ability to back up or export data to portable formats. The restore/import process on the target system is likely to resolve any issues with the data layout.

Big-endian, little-endian

Sun Fire SPARC platforms use the big-endian format to store and operate on their data. The IBM System-x platforms, on the other hand, use the little-endian format. In our example, we convert the Oracle data files and tablespaces with the Oracle export/import functions. The conversion process is straightforward and fast.

Considerations for moving platforms

Power consumption

One benefit of moving from the Sun Fire V440 to the IBM System x3650 M3 is power consumption. Depending on the configuration, less power should be consumed because of the energy efficiency and consolidation of applications.

Differences in operating systems

In addition to the ease of administration, note the following:

- Key operating system files are stored in different locations.

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Migrating Oracle Database from Oracle Solaris 10 on the Sun Fire V440 to Red Hat Enterprise Linux 6 on the IBM System x3650 M3

- While many basic Unix commands are the same (i.e., – `useradd,`
  `usermod, ls, …`), many system administration commands differ.
  Figure 2 lists several examples of the differences.

Task	Red Hat Enterprise Linux 6	Oracle Solaris 10
List hardware configuration	lshw	prtconf –v
Read a disk label	Fdisf	prtvtoc
Disk partition	fdisk –l, lvcreate	format, meta*
Check swap space	cat /proc/meminfo	swap –s, swap -l
List installed software	rpm –qa, yum list installed	pkginfo
Add software	rpm –I, yum install	pkgadd
Manage system services	chkconfig, service	svcs, svcadm

Figure 2. Differences in commands between operating systems.

Installing and setting up Red Hat Enterprise Linux 6 and Oracle Database 11*g* Release 2

In this section, we focus on Installing Red Hat Enterprise Linux 6 and setting up Oracle Database 11*g* Release 2 on the IBM System x3650 M3 server. We begin by defining our environment and proceed to instructions for installing and configuring both Red Hat Enterprise Linux 6 and Oracle Database 11*g* Release 2.

Defining our environment

For our test bed, we used a Sun Fire V440 server running Oracle Solaris 10 (SPARC) 5/09 and Oracle Database 10*g* Release 2 as the source system, and an IBM System x3650 M3 running Red Hat Enterprise Linux 6 and Oracle Database 11*g* Release 2 Enterprise Edition Release for Red Hat Enterprise Linux 6 as the destination system. We connected all components via a gigabit switch. Figure 3 illustrates our setup.
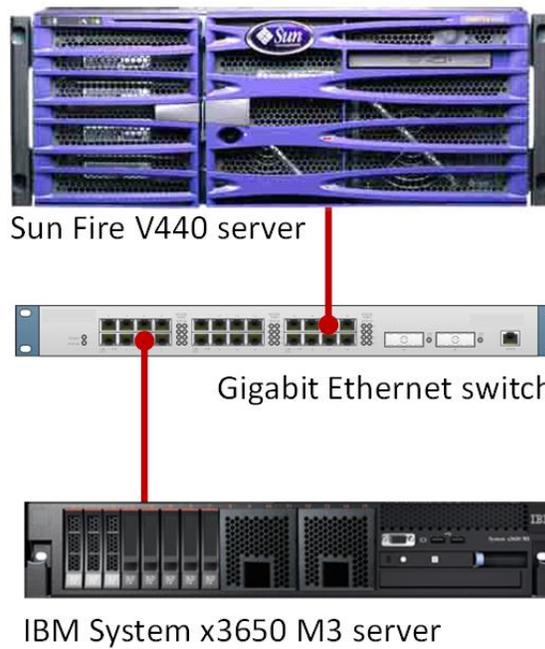
Figure 3. The setup we used in our hands-on testing and research for this Migration Guide.

Figures 4 and 5 present the hardware and software we used for our database servers.

Server	Processor	Memory	Disk
Sun Fire V440	4 x UltraSPARC IIIi 1.59 GHz	32 GB	4 x Fujitsu® MAP3735NC, SCSI, 10K RPM, 72 GB
IBM System x3650 M3, Model 7945	2 x 6-core Intel Xeon X5670 2.93 GHz	48 GB	3 x IBM 42D0641 SAS, 10K RPM, 300 GB

Figure 4. Servers we used in our hands-on testing and research for this Guide.

Server	Server OS	Oracle Database version
Sun Fire V440	Oracle Solaris 10 5/09	Oracle Database 10*g* Release 2 Enterprise Edition 10.2.0.1.0 for Solaris Operating System (SPARC) (64-bit)
IBM System x3650 M3, Model 7945	Red Hat Enterprise Linux Server 6 x86_64	Oracle Database 11*g* Release 2 Enterprise Edition Release 11.2.0.1.0 for Linux x86-64

Figure 5. Software we used in our hands-on testing and research for this Guide.

BEST PRACTICE

Use the latest tested and validated software, firmware, and driver versions for NICs, storage arrays, and other components. You can find these software components at http://www.ibm.com/support/ or from the Red Hat Customer Portal at https://rhn.redhat.com.

Installing Red Hat Enterprise Linux Server 6

This section provides an overview of the operating system installation process. (Appendix A provides complete, detailed installation instructions.)

NOTE

Plan on at least 40 minutes for installing Red Hat Enterprise Linux 6 on the IBM System x3650 M3 server. Each step below takes at least 1 minute.

1. Insert the Red Hat Enterprise Linux Server 6 x86_64 DVD into the DVD drive, and reboot the system.
2. After the welcome screen, select English for the installation language and keyboard.
3. Select the storage type for the operating system. We chose local storage.
4. Enter the hostname, time zone, and root password.
5. Select the default disk layout, which is sufficient for most purposes.
6. Select the Basic Server package set, and start the installation.
7. At the reboot screen, eject the installation DVD, and select reboot.
8. After the system finishes booting, log on as `root` to complete the network configuration.

BEST PRACTICE

Configure all database servers with static IP addresses. Doing so assures that Oracle Database resources remain available even in the event of a DHCP server failure. It also increases the stability of your networking and DNS environments.

Installing Red Hat Enterprise Linux 6 updates

If you need to install a specific package or update to a package, please refer to the Installing specific Red Hat Enterprise Linux packages section below.

NOTE

To access Red Hat Enterprise Linux package updates, you will need a valid subscription. The server should be able to connect to the Red Hat update server or your Red Hat Satellite Server, either directly through HTTPS (TCP port 443) or through a Web proxy.

Updating Red Hat Enterprise Linux packages

1. To see which packages need to be updated, type `yum check-update`
2. To update all the packages, type `yum update`, and follow the prompts.
3. To update a subset of the installed packages, type `yum update package1 package2 package3`
   Regular expressions can be used in the package name to specify many packages.
4. If a kernel has been updated, the old kernel will still be installed. Please examine the contents of `/etc/grub.conf` to ensure that the correct kernel will be used at the next reboot.
5. Reboot the system when the kernel or important system libraries (currently in use by running processes) have been updated.

Installing specific Red Hat Enterprise Linux packages

To install additional software from Red Hat, type `yum install package1 package2 package3`

By contrast, installing patches on Oracle Solaris 10 required downloading either a patch cluster or specific patches identified by numeric codes, expanding the ZIP files, and running an installer or patchadd.

Oracle Database 11*g* Release 2 pre-installation and installation tasks

Before you can install Oracle Database 11*g* Release 2, you must first perform a number of preliminary tasks. For further details, see *Oracle® Database Quick Installation Guide 11g Release 2 (11.2) for Linux x86-64*, Chapter 2: Preinstallation tasks, at http://download.oracle.com/docs/cd/E11882_01/install.112/e16766/toc.htm. Please see Appendix B in this document for detailed instructions on preparing the system for an Oracle Database installation. For detailed instructions on installing Oracle Database 11*g* Release 2 on Red Hat Enterprise Linux 6, please see Appendix C.

Migrating your data using transportable tables and data pump

We provide detailed migration instructions for using transportable tables in Appendix D. The big- to little-endian conversion can be performed on either the source or destination server, in most cases. We chose to perform the conversion on the IBM System x3650 destination server to make use of the additional processor power and memory.

We generated the 47 GB of data using the DVD Store Version 2 (DS2) test tool.

NOTE

Oracle refers to the user data and its associated metadata as a schema. We use that term where appropriate.

Post-migration considerations

After you have completed your side-by-side migration, you will typically need to perform some additional tasks. Your specific list of post-migration tasks will depend heavily on your pre-migration research and planning. In this section, we briefly discuss a few of the most common tasks, but this list is not comprehensive. For more information, see http://download.oracle.com/docs/cd/E14072_01/server.112/e10819/afterup.htm.

Please see Appendix E more detailed information.

Summing up

Moving to Red Hat Enterprise Linux 6 on an IBM System x3650 M3 server from Oracle Solaris 10 on a Sun Fire V440 can be accomplished with minimal effort considering the size of applications and databases. The hardware and operating system are fairly easy to configure, and, with proper planning, migrating applications and/or data is straightforward. As this Guide has explained, the process of deploying these products on a IBM System x3650 M3 server and the upgrade and migration of your Oracle Database 10*g* Release 2 database to Oracle Database 11*g* Release 2 in the new environment is relatively simple; you can perform a basic installation and migration in less than a day. Spending some up-front time planning can help you avoid potential problems during your migration.

Appendix A. Methodology: Installing Red Hat Enterprise Linux 6 on the IBM System x3650 M3 Server platform

Install Red Hat Enterprise Linux 6 x86_64 by following these steps. We provide approximate times for each group of steps in the first step of that group.

Allow at least 40 minutes to complete the installation. We used Red Hat Enterprise Linux 6 x86_64, which we downloaded from the Red Hat Customer Portal and burned to a DVD.

NOTE

In this appendix, we use the primary network interface name, which in our case was eth0. You should use the name of the primary network interface that you encounter, which may differ slightly from what we present here.

1. Insert the Red Hat Enterprise Linux Server 6 x86_64 DVD, and reboot. At the IBM System x screen, press F12, and select Boot from CD.
2. Red Hat Enterprise Linux installation starts. At the Media Test screen, select Skip Media test. (You may choose to verify the DVD.)
3. At the Red Hat Enterprise Linux welcome screen, click Next.
4. Select English for the installation language, and click Next.
5. Select U.S. English for the default keyboard, and click Next.
6. Because we are not using external storage, select Basic Storage, and click Next.
7. If a pop-up appears warning about Reinitialization of storage, select Re-initialize.
8. Enter the hostname in the text box, and click Next.
9. Select your time zone from either the map or from the drop-down menu, and click Next.
10. Enter the root password twice in the text boxes, and click Next. If a pop-up screen warns of a weak root password, click Use Anyway to continue, or click Cancel to change the password by repeating this step.
11. Select Use All Space, and Review and Modify Partition Layout. Click Next.
12. Review the automatically chosen disk layout, modify as desired, and click Next. The default will use logical volumes for the filesystems. The default filesystem type will be ext4.
13. Select Format on the warning pop up. The selected disks will be overwritten.
14. The default bootloader device suffices (e.g., /dev/sda1). Click Next.
15. Select Basic Server as a good baseline for an Oracle Database Server. Choose Red Hat Enterprise Linux Server 6 for the software repository. Select Customize Packages Later, and click Next.

TIP

No 32-bit packages are required to use Oracle Database 11*g* Release 2 on Red Hat Enterprise Linux 6.

16. The next screen displays a progress bar as the packages are installed.
17. At the reboot screen, click Reboot, and eject the installation DVD, if necessary.
18. At the login prompt, login as `root`
19. Configure the network with the network administration tool; i.e., assign eth0's IP address and network mask, and specify the IP addresses of the system's network gateway and DNS server.

```
# system-config-network
```

20. Add the IP address and hostname to `/etc/hosts`
21. Restart the network with the following command:

```
# chkconfig network on
# service network restart
```

22. In order to install updates to the Red Hat software, you will need a Red Hat support contract. Use the following command to register the server for updates:

```
# rhn_register
```

23. After registering, run the following command to download and install updates:

```
# yum update
```

NOTE

Of the various methods for managing system packages on a Red Hat Enterprise Linux 6 server, we prefer yum at the command line as it automatically determines package dependencies.

Appendix B. Methodology: Pre-installation tasks for Oracle Database 11*g* Release 2 on Red Hat Enterprise Linux 6

Oracle pre-installation tasks

Before you can install Oracle Database 11*g* Release 2, you must first perform a number of preliminary tasks. For further details, see *Oracle*[®] *Database Installation Guide 11g Release 2 (11.2) for Linux*, Chapter 2 Preinstallation tasks at http://download.oracle.com/docs/cd/E11882_01/install.112/e16763/pre_install.htm. Please note that our server met many of the prerequisites for installing Oracle Database 11*g* Release 2, so we do not discuss checking those prerequisites here. The Oracle document we cite above covers this topic in detail.

Allow at least 30 minutes to complete the preparation.

1. Log in as `root`
2. The server needs to display X Window applications. To work locally, you can use the command `xhost localhost:0`
3. Verify that networking is set up correctly, using the following set of commands:

    `# grep hosts /etc/nsswitch.conf`
    The output should contain an entry for files.

    `# hostname` should return the hostname for this system.

    `# domainname` should not return any results.

    `# grep <hostname> /etc/hosts` should return the fully qualified host name.

NOTE

If you install OracleDatabase 11*g* Release 2 on a system using DHCP or on a *multihomed* system, you will need to take additional steps. Please see the Oracle Database 11*g* Release 2 Preinstallation tasks document for further details.

4. Create the Oracle inventory and dba groups with these commands:

    ```
    # /usr/sbin/groupadd oinstall
    # /usr/sbin/groupadd dba
    ```

5. Create the Oracle software owner user with this command:

    ```
    # /usr/sbin/useradd –g oinstall –G dba oracle
    ```

6. Set the password of the Oracle user with this command:

```
# passwd oracle
```

The command prompts you for the new password.

It is good practice to assign the same user and group id numbers (UID and GID) for the Oracle accounts on each Linux/Unix server. If you desire, use the following commands to change the UID for oracle and the GIDs for oinstall and dba to your organization's values:

```
# /usr/sbin/usermod –u <NEW_UID> oracle
# /usr/sbin/groupmod –g <NEW_GID> oinstall
# /usr/sbin/groupmod –g <NEW_GID> dba
```

7. Create and set the home directory of the Oracle user with these commands:

```
# mkdir /home/oracle
# chown –R oracle:oinstall /home/oracle
# chmod –R 775 /home/oracle
# usermod –d /home/oracle oracle
```

8. Using a text editor, create the file .profile in /home/oracle. Add the following lines, and save the file:

```
umask 022
export DISPLAY=:0.0
export TMP=/tmp
export TMPDIR=/tmp
```

9. Assign ownership of the file to the Oracle user and set the access permissions with these commands:

```
# chown oracle:oinstall /home/oracle/.profile
# chmod 770 /home/oracle/.profile
```

10. Set the resource limits for the Oracle user by adding these lines to the file /etc/security/limits.conf :

```
oracle      soft  nproc      2047
oracle      hard  nproc      16384
oracle      soft  nofile     1024
oracle      hard  nofile     65536
oracle      soft  stack      10240
oracle      hard  stack      32768
```

11. Using a text editor, add the following lines to /etc/sysctl.conf to set Oracle's recommended kernel parameters:

```
kernel.sem = 250 32000 100 128
kernel.shmmax = 536870912
```

```
fs.file-max = 6815744
fs.aio-max-nr = 1048576
net.ipv4.ip_local_port_range = 9000 65500
net.core.rmem_default = 262144
net.core.rmem_max = 4194304
net.core.wmem_default = 262144
net.core.wmem_max = 1048586
```

12. Run the following command to activate the modifications to the kernel parameters:

```
# sysctl –p
```

13. Install these additional Linux packages needed for Oracle Database with either the installation DVD, rpm or yum. For example, to use the yum package installer, use the following command:

```
# yum install numactl-devel make libstdc++-
devel libaio-devel ksh glibc-headers glibc-
devel gcc-c++ gcc binutils compat-libstdc++-33
```

14. Create the directory for the Oracle software and data files with these commands:

```
# mkdir –p /u01/app/oracle
# chown –R oracle:oinstall /u01/app/oracle
# chmod –R 775 /u01/app/oracle
```

NOTE

You will have the opportunity to adjust these settings during the installation of Oracle Database.

Appendix C. Methodology: Installing Oracle Database 11*g* Release 2 on the IBM System x3650 M3 running Red Hat Enterprise Linux 6

Installing Oracle Database 11*g* Release 2

We downloaded the Oracle Database 11*g* Release 2 software distribution from http:/www.oracle.com/technetwork/database/enterprise-edition/downloads/index as two archives files, linux.x64_11gR2_database_1of2.zip and linux.x64_11gR2_database_2of2.zip.

Allow at least 30 minutes to complete the Oracle Database 11*g* Release 2 installation. Be sure to perform the pre-installation tasks described in Appendix B.

1. Log into the Linux server as `root` and change your directory to the location of the Oracle downloads. Extract the Oracle distribution with the following commands:

   ```
   unzip linux.x64_11gR2_database_1of2.zip;
   unzip linux.x64_11gR2_database_2of2.zip
   ```

2. Change directory to `database` and start the installation. Type

   ```
   ./runInstaller
   ```

   (The name is case sensitive and the leading `./` is required.)

3. At the Oracle Database 11*g* Release 2 Installer, Step 1 of 9: Configure Security Updates screen, enter your Oracle user name and password, and click Next.

Migrating Oracle Database from Oracle Solaris 10 on the Sun Fire V440 to Red Hat Enterprise Linux 6 on the IBM System x3650 M3
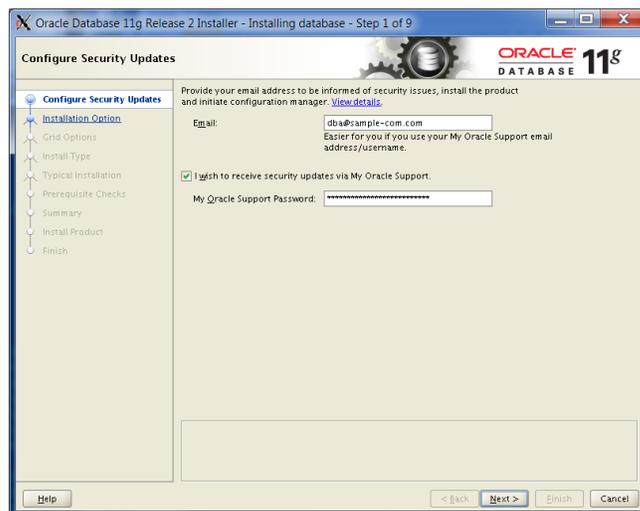
4. At the Oracle Database 11*g* Release 2 Installer, Step 2 of 9: Select Installation Method Option screen, select Install database software only.
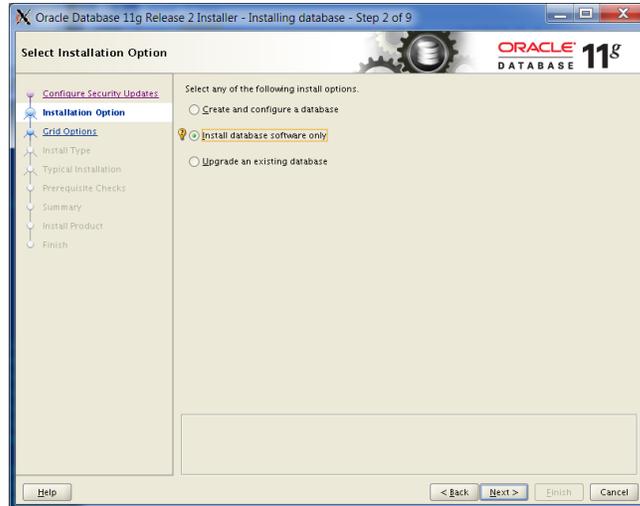

5. At the Oracle Database 11*g* Release 2 Installer, Step 3 of 9: Node Selection screen, select Single instance database installation, and click Next.


NOTE

The number of steps displayed on the screen changes after some choices – for example, from 9 to 11 at Step 4, and from 11 to 12 at Step 8.

6. At the Oracle Database 11*g* Release 2 Installer, Step 4 of 11: Select Product Languages screen, accept the default, English, and click Next.
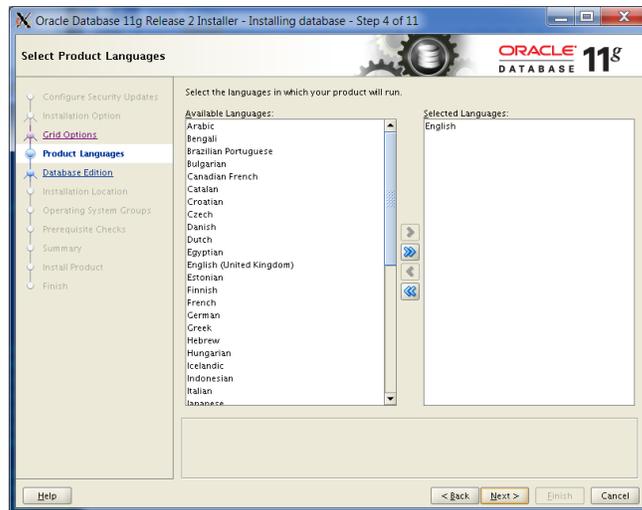
7. At the Oracle Database 11*g* Release 2 Installer, Step 5 of 11: Select Installation Type screen, accept the default, Standard Edition, and click Next.
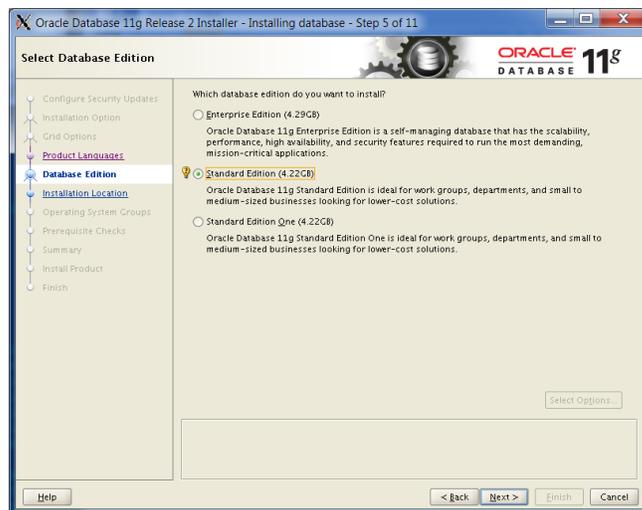
8. At the Oracle Database 11*g* Release 2 Installer, Step 6 of 11: Specify Installation Location screen, change the Software installation location to `/u01/app/oracle/product/11.2.0/DS2`, and click Next.
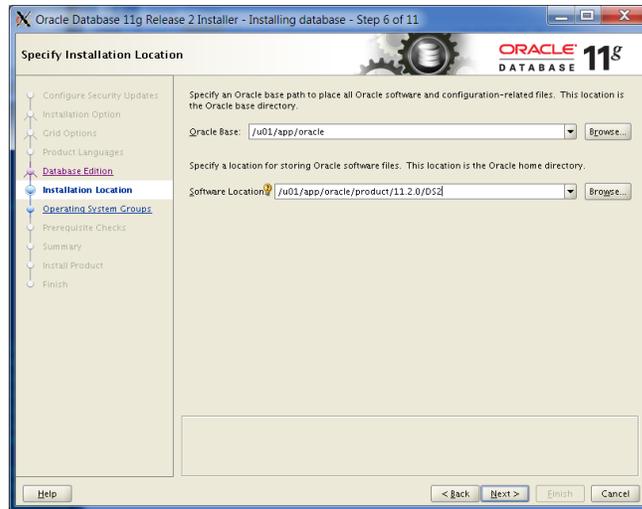
9. At the Oracle Database 11*g* Release 2 Installer, Step 7 of 11: Create Inventory screen, accept the defaults, and click Next.

10. At the Oracle Database 11*g* Release 2 Installer, Step 8 of 12: Privileged Operating System Groups screen, accept the defaults, and click Next.
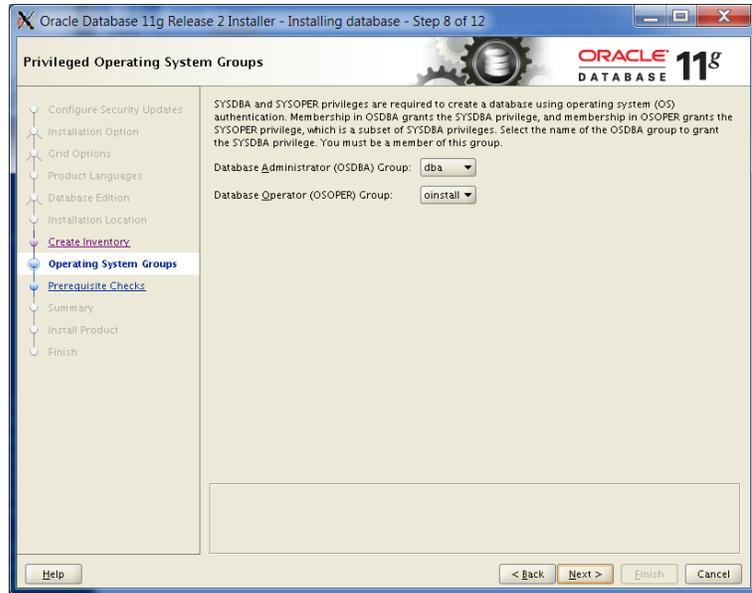
NOTE

On the Perform Prerequisite Checks screen, a warning that some the installed packages are at higher levels than Oracle expected might appear. If so, you can ignore it.

11. At the Oracle Database 11*g* Release 2 Installer, Step 9 of 12: Perform Prerequisite Check screen, review the results. If the 10 system software packages are listed as being at the wrong level – all at a higher level, select Ignore All, and click Next. Otherwise, resolve the issues before proceeding. The methods in Appendix B may be useful.

Migrating Oracle Database from Oracle Solaris 10 on the Sun Fire V440 to Red Hat Enterprise Linux 6 on the IBM System x3650 M3
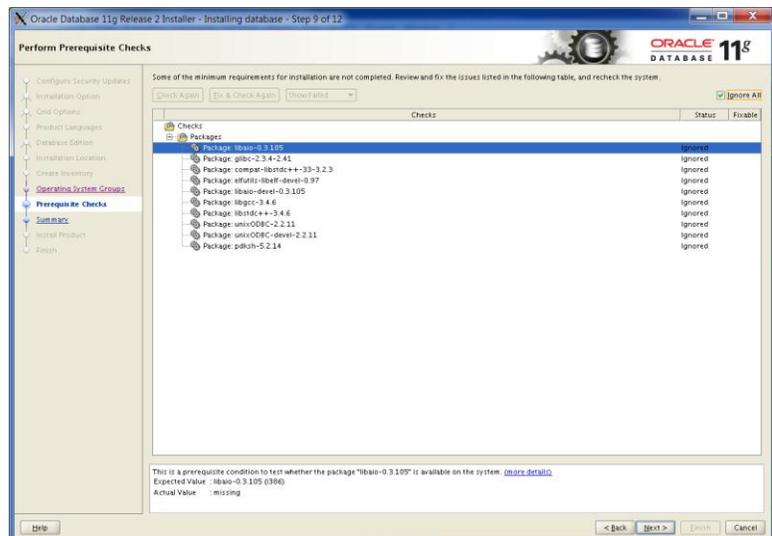
12. At the Oracle Database 11*g* Release 2 Installer, Step 10 of 12: Summary screen, review your settings, and click Install. The Install screen, which shows a progress bar, appears (Step 11 of 12). (This will take approximately 15 minutes.)
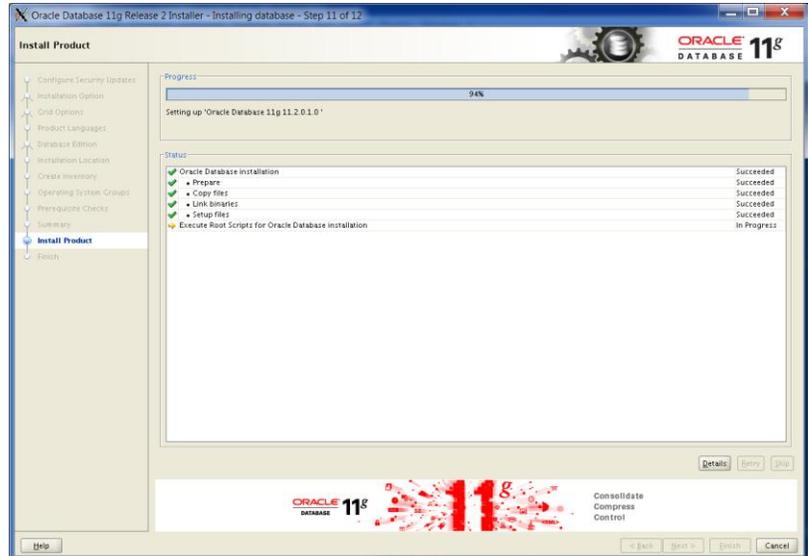
13. When the progress bar completes, Oracle asks you to run two scripts as root. Open a terminal by right-clicking the desktop and selecting Open Terminal. You can cut and paste the paths to the scripts into the command line terminal.
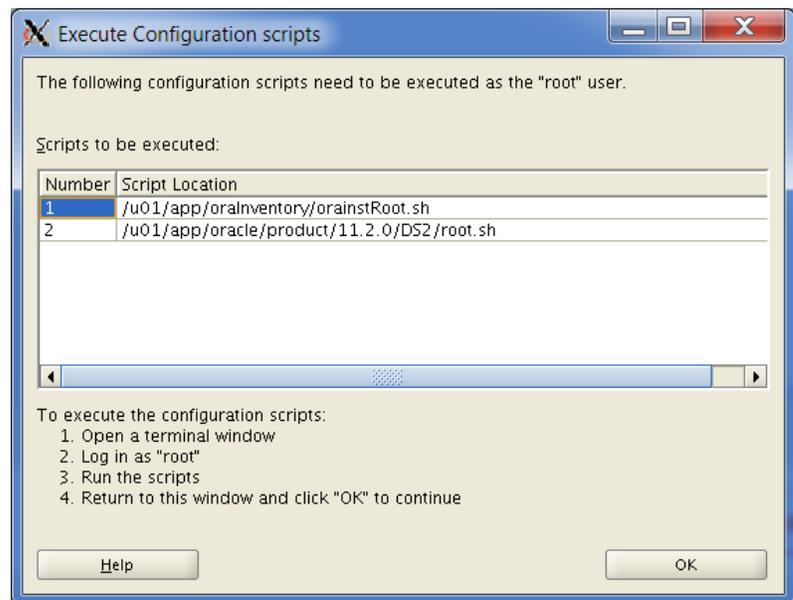
14. The first script is orainstRoot.sh. You will only see this script the first time you install Oracle on a system. Should you need to reinstall Oracle, you will not run it again.
15. The second script is root.sh. It asks you to type in the name of the local bin directory, which is `/usr/local/bin`
16. In the Execute Configuration scripts dialog, click OK.
17. At the Oracle Database 11g Release 2 Installer, Step 12 of 12: Finish screen, click Close.
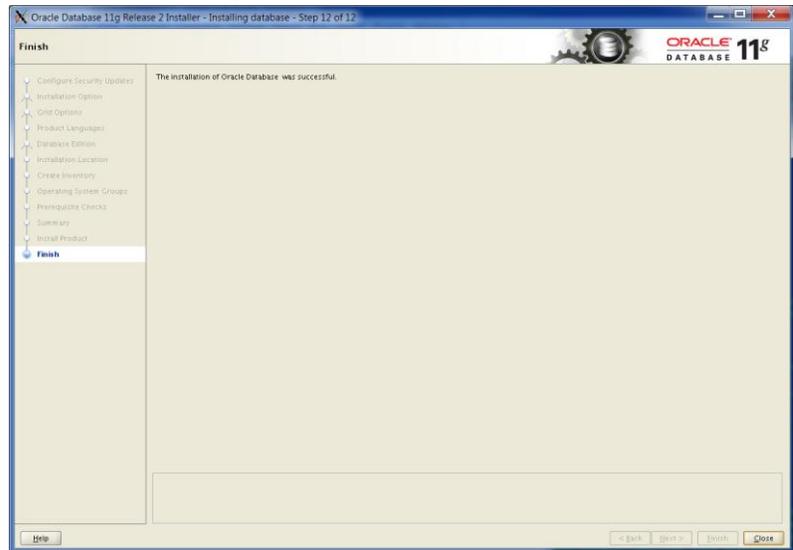
Creating an empty database

Allow at least 45 minutes to create the database using the following steps:

1. After exiting the installer program, set the ORACLE_HOME environment variable. We used the following command:

   ```
   $ export ORACLE_HOME=\
   /u01/oracle/oracle/product/11.2.0/DS2
   ```

2. Update your PATH variable by typing

   ```
   $ export PATH=$ORACLE_HOME/bin:$PATH
   ```

3. Type `dbca` to launch the Database Configuration Assistant.
4. When the Database Configuration Assistant: Welcome screen appears, click Next.
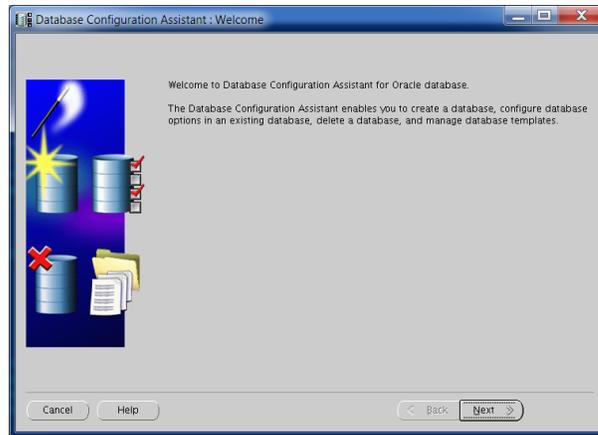
5. On the Database Configuration Assistant, Step 1 of 12: Operations screen, select Create a Database, and click Next.
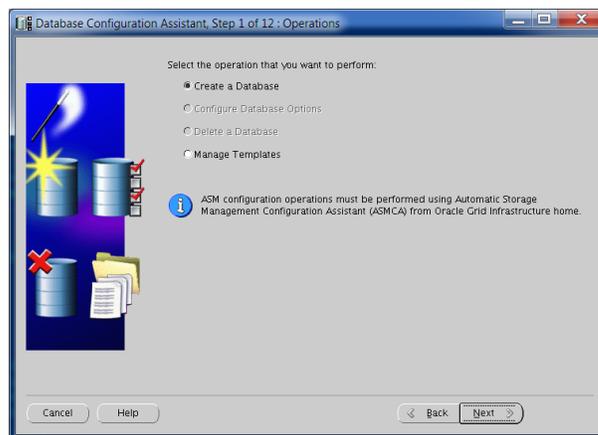

6. On the Database Configuration Assistant, Step 2 of 12: Database Templates screen, select Custom Database, and click Next.
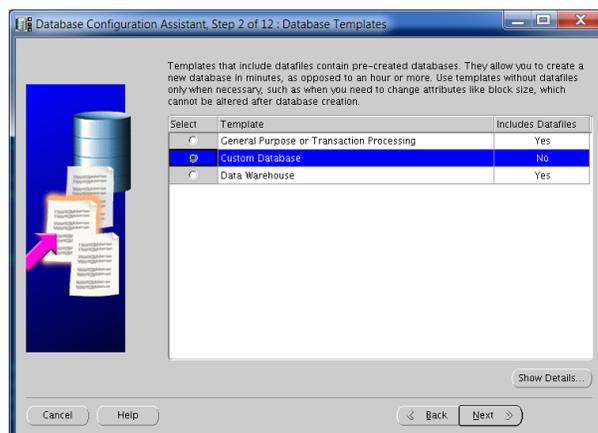
7. On the Database Configuration Assistant, Step 3 of 12: Database Identification screen, enter the Global Database Name. By default, Oracle uses this name for the SID as well.
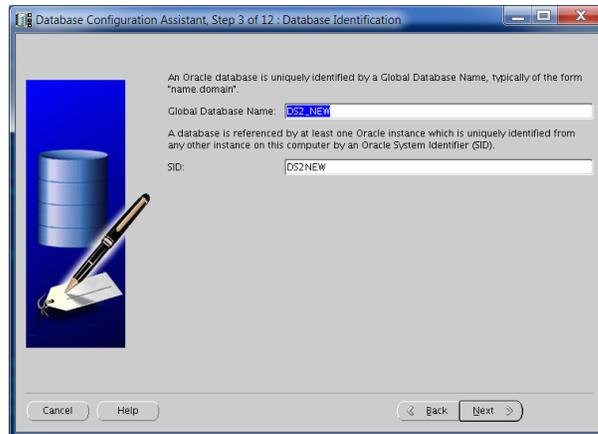

8. On the Database Configuration Assistant, Step 4 of 12: Management Options screen, accept the defaults, and click Next.
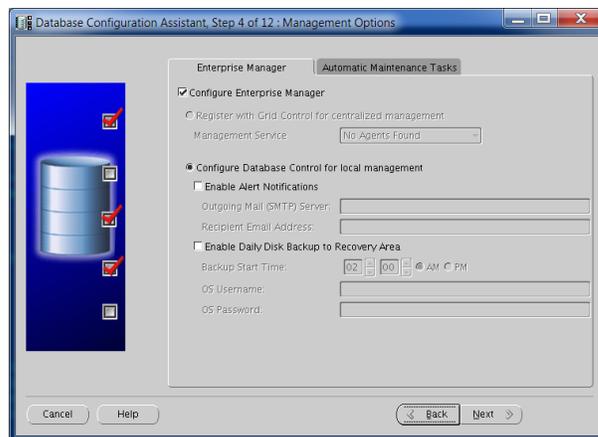

9. On the Database Configuration Assistant, Step 5 of 12: Database Credentials screen, enter a password, and click Next. We chose to use the same administrative password for the listed accounts.
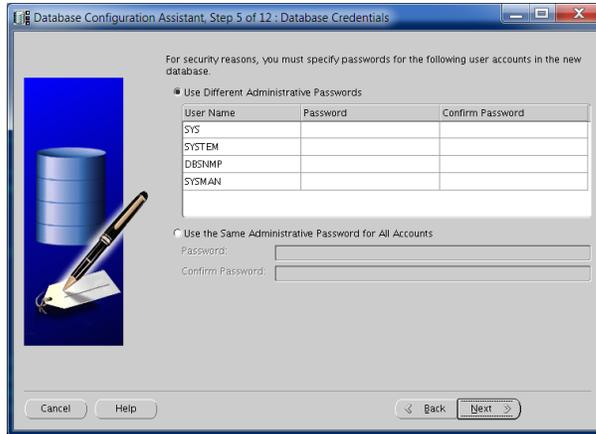
10. On the Database Configuration Assistant, Step 6 of 12: Storage Options, select File System for the storage type, and click Finish to accept the remaining defaults.
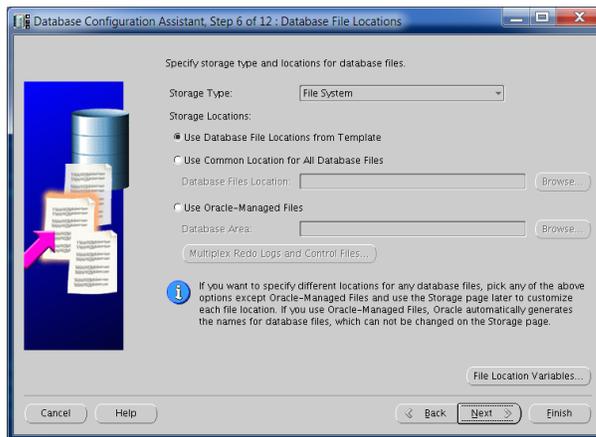
11. On the Database Configuration Assistant: Confirmation screen, review your selections, and click OK to create the database.

Migrating Oracle Database from Oracle Solaris 10 on the Sun Fire V440 to Red Hat Enterprise Linux 6 on the IBM System x3650 M3
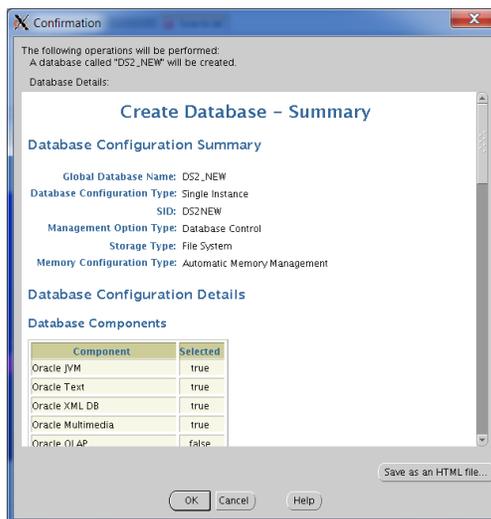
12. The Database Configuration Assistant screen appears and shows a progress bar. (This will take approximately 30 minutes.)
13. When the Database creation complete screen appears, click Exit.

Appendix D. Methodology: Migrating the DS2 data

Exporting tablespace and datafiles from Oracle Database 10*g* Release 2 on the Sun Fire V440 running Oracle Solaris 10

In our examples, we used a sample schema called DS2, which contained four tablespaces. The total size of our schema objects was about 47 GB. Exporting the 47GB Transportable Tablespace set on the Sun Fire V440 was very simple.

In the following steps, the directory /u01 is an example; you may store the dump file wherever you wish. We also chose to put the tablespaces in read-only mode. If you have a larger database and downtime is an issue, you can choose to run the same process from a backup of the database to minimize any inconvenience.

Allow at least 1 hour to complete the export.

1. Make tablespaces in the set read-only. Use the following command from a SQL*Plus command prompt:

   ```
   SQL> ALTER TABLEPSACE tablespace1 READ ONLY;
   ```

   (Repeat this step for the remaining tablespaces.)

2. Create directory for dump, and set permissions in the OS and Oracle. Use the following shell and SQL*Plus commands:

   ```
   $ mkdir /u01/export
   $ chmod 1777 /u01/export
   $ chown oracle:oinstall /u01/export

   SQL> CREATE DIRECTORY dump_dir AS
   '/u021/export';
   SQL> GRANT READ,WRITE ON DIRECTORY dump_dir TO
   PUBLIC;
   ```

3. Use Data Pump export utility, and set selected tablespaces for transportable set. Use the following command:

   ```
   $ expdp system/password DUMPFILE=expdat.dmp
   DIRECTORY=dump_dir TRANSPORT_TABLESPACES =
   tablespace1,tablespace2,…
   $ chmod 644 /u01/export/expat.dmp
   ```

Importing data into Oracle Database 11*g* Release 2 on the IBM System x3650 M3 running Red Hat Enterprise Linux 6

NOTE

While we chose to use NFS to share the exported data between the two servers and found it to be efficient, you can use a variety of methods to copy the data between systems. In the instructions below, we assume the exported data is available in directory /mnt/01/export, and the original data files are found in /mnt/u01/oradata.

1. Log onto the Red Hat server as user oracle.
2. Create the directory for the import dump, set permissions in the OS and Oracle Database, and copy expdat.dmp from the Sun Fire V440 server to it. Use the following shell and SQL*Plus commands:

```
$ su –c 'mkdir /u01/import'
$ su –c 'chmod 1777 /u02'
$ cp /mnt/01/export/expdat.dmp /u01/import
$ chmod 644 /u01/import/expdat.dmp

SQL> CREATE DIRECTORY dump_dir AS
'/u01/import';
SQL> GRANT READ,WRITE ON DIRECTORY dump_dir TO
PUBLIC;
```

3. Convert datafiles from big-endian format to little-endian format. The datafiles can be converted all at once, or, as we do below, individually. We use the DB_FILE_NAME_CONVERT option in RMAN to specify the local directory where the new datafiles will be stored and /u01/oradata for the local directory:

```
$ rman TARGET /

RMAN> CONVERT DATAFILE
'/mnt/u01/oradata/data1.dbf'
2>    FROM PLATFORM 'Solaris[tm] OE (64-bit)'
3>    DB_FILE_NAME_CONVERT
'/mnt/u01/oradata','/u01/oradata'
```

(Repeat this step for each datafile.)

4. Use the Oracle Data Pump import utility to add the tablespace metadata and datafiles to database.

NOTE

Because there may be dependencies between tablespaces, import the datafiles as a set. Use the following command, where password is the Oracle Database 11*g* Release 2 password for the system:

```
$ impdp system/password DUMPFILE=expdat.dmp
DIRECTORY=dump_dir TRANSPORT_DATAFILES
```

```
='/u01/oradata/data1.dbf','/u01/oradata
/data2.dbf',…
```

5. Restore tablespaces on both databases to read/write mode using the following SQL command on each server:

```
SQL> ALTER TABLESPACE tablespace1 READ WRITE;
```

Repeat this step for each tablespace.

Appendix E. Post-migration considerations

Environmental and configuration changes

Updating environment variables

In the Red Hat Enterprise Linux 6 environment, you will need to make sure that the following environment variables point to the new Oracle Database 11*g* Release 2 directories:

- ORACLE_HOME
- PATH
- ORA_NLS10
- LD_LIBRARY_PATH

Updating SSL users

If you have externally authenticated SSL users, you must upgrade them as well. Do so with the following command:

```
$ ORACLE_HOME/rdbms/bin/extusrupgrade --
dbconnectstring <hostname:port_no:sid> --dbuser <db
admin> --dbuserpassword <password> -a
```

Changing passwords on DBA accounts

Oracle recommends you change the passwords on all Oracle-supplied accounts. One good way to make sure this happens is to lock all those accounts, except for SYS and SYSTEM, and then set their passwords to expire immediately. This technique forces users to change those passwords the next time they log into those accounts.

You can use following SQL statement to check the status of the accounts:

```
SQL> SELECT username, account_status FROM dba_users
ORDER BY username;
```

To cause passwords to expire, issue the following SQL statement:

```
SQL> ALTER USER username PASSWORD EXPIRE ACCOUNT
LOCK;
```

Backing up your database

After the successful migration of the Oracle Database from the Oracle Solaris 10 environment to the Red Hat Enterprise Linux 6 environment, you should make a full backup of your production database. This will ensure that you do not have to repeat the import should any problems occur, and will also serve as a baseline for all future backups.

About Principled Technologies

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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.