

**Oracle Maximum  
Availability Architecture**

An Oracle and NetApp White Paper  
September 2011

**Oracle 11g Fusion Middleware  
Lifecycle Management  
Using NetApp Technologies**

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## Executive Overview

Availability of your company's applications is critical to maintaining business competitiveness, but with the high cost of recovery solutions many companies are forced to protect only their most critical applications. The trend toward a service-oriented architecture (SOA) and other advances in application deployment techniques can make application backup and recovery even more challenging. Oracle Fusion Middleware is a portfolio of middleware solutions that includes software to help you develop, deploy, and manage SOA and other applications. NetApp® and Oracle® have now teamed to provide a comprehensive solution for managing the recovery of this critical middleware data.

## Introduction

This document provides an overview of integrating Oracle 11g Fusion Middleware (FMW) with NetApp storage technologies like Snapshot™, SnapRestore®, and FlexClone® to assist with the FMW Lifecycle Management of environments from development to production. NetApp technologies can quickly and efficiently back up, recover, and assist in cloning an Oracle FMW environment, helping to dramatically reduce the time and cost required to perform these management tasks. To help maximize the benefits of Oracle FMW Lifecycle Management using NetApp technologies, this document provides specific steps involved in backing up, restoring, and cloning options for a highly available enterprise Oracle Fusion SOA installation.

## Acronyms

TABLE 1. ACRONYMS

TERM	DEFINITION
FMW	Oracle Fusion Middleware
SOA	Oracle Service Oriented Architecture
BPEL	Oracle Business Process Execution Language
EDG	Oracle Enterprise Deployment Guide
LCM	Life Cycle Management
RMAN	Oracle Recovery Manager
CG	NetApp Consistency Groups

## FMW and Lifecycle Management

Oracle 11g Fusion Middleware consists of standards-based software that provides solutions for business software applications including Java Enterprise Edition (J2EE), SOA components, Web services, content management systems, Web Center, and business intelligence, as well as development, deployment, and management tools (refer to Figure 1).

The Fusion Middleware SOA product family is used throughout this paper to demonstrate lifecycle management. Oracle SOA Suite components include:

- Oracle SOA Service Infrastructure
- Oracle BPEL Process Manager
- Oracle Mediator
- Oracle Human Workflow
- Oracle B2B
- Oracle Web Services Manager
- Oracle User Messaging Service
- Oracle JCA Adapters
- Oracle Business Activity Monitoring
- Oracle Business Process Management



Figure 1. Oracle Fusion Middleware Solution Overview

## NetApp Storage Technologies

NetApp Data ONTAP® standard features referred to in this paper are Snapshot, SnapRestore, FlexClone, FlexVol®, SnapVault®, and consistency groups.

### NetApp Snapshot

NetApp Snapshot technology enables you to create point-in-time copies of file systems, which you can use to protect data. NetApp Snapshot technology is a feature of the WAFL® (Write Anywhere File Layout) storage virtualization technology that is a part of Data ONTAP, the microkernel that ships with every NetApp storage system.

### NetApp SnapRestore

The NetApp SnapRestore feature lets you recover entire file systems or data volumes in seconds, regardless of capacity or number of files. It uses the Data ONTAP Snapshot feature, which is automatic and almost instantaneous, and takes up very little of your storage space. SnapRestore provides an easy, one-command restoration that allows you to choose and recover data from any Snapshot copy on your system.

**NetApp FlexVol**

NetApp flexible volumes (FlexVol) enable you to create volumes that you can manage and move independently from physical storage. FlexVol volumes can also be increased or decreased in size on-the-fly.

**NetApp FlexClone**

NetApp FlexClone software enables true cloning: instant replication of data files, LUNs, and volumes without requiring additional storage space at the time of creation. NetApp FlexClone provides substantial storage space savings, so you can manage many more dataset variations in less space and time, and with less risk.

FlexClone volumes are writable, point-in-time copies of a parent FlexVol volume.

**NetApp SnapVault**

NetApp SnapVault is a disk-based storage backup feature of Data ONTAP. SnapVault enables data stored on multiple systems to be backed up to a central, secondary system quickly and efficiently as read-only Snapshot copies.

**Consistency Groups**

A consistency group is a storage-level view of applications data stored in multiple volumes or controllers. Consistency groups are collections of objects (volumes) that allow an administrator to take consistent point-in-time copies of, for example, volumes today and LUNs, files, and block ranges in the future.

NetApp technologies such as Snapshot, SnapRestore, and FlexClone can work with Oracle to facilitate the lifecycle management needs of an Oracle Fusion Middleware Enterprise installation (refer to figure 2.)

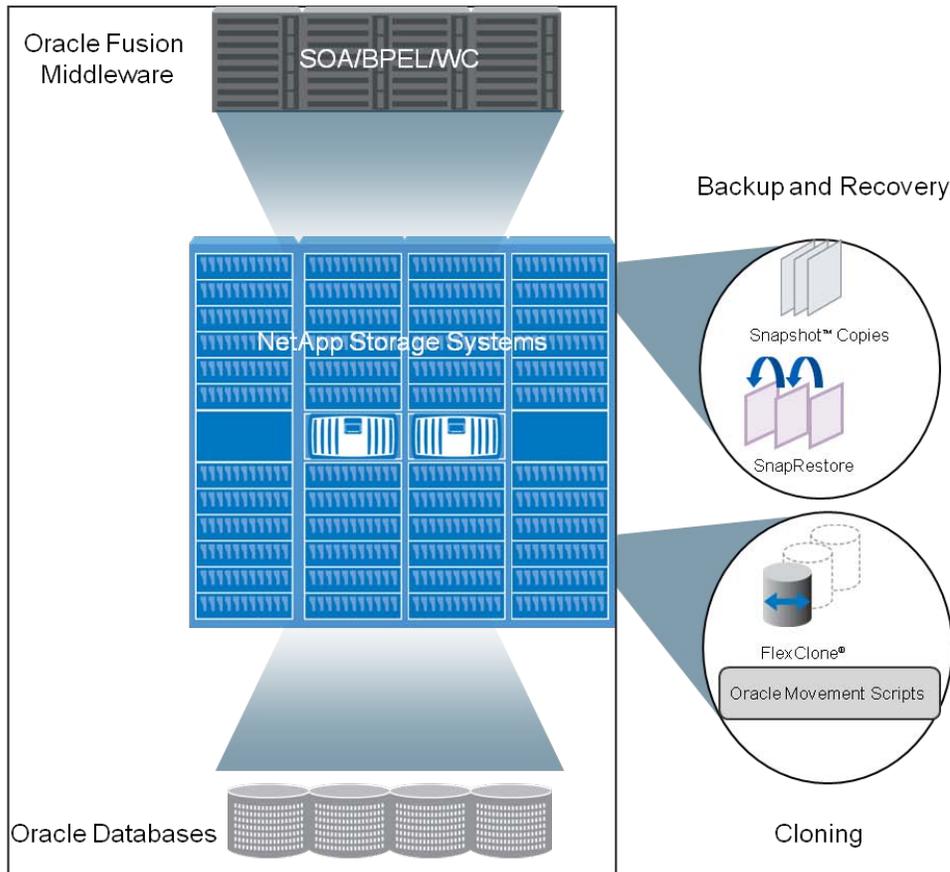


Figure 2. Oracle Fusion Middleware on NetApp Storage Systems

## Hardware and Software Used

This section describes the hardware and software environment used for this design validation. Actual customer deployments might vary.

### Server Host Deployment Details

The three host systems in our environment are configured as follows:

- Oracle Linux Server release: 5.6
- Kernel Release: 2.6.18-238.0.0.1.el5

- Memory: 8164632 KB
- Processor: Intel(R) Xeon(R) CPU E5620 running at 2.40GHz
- Number of Processors: 16
- Internal Hard Drive: 140GB

#### Storage System Deployment Details

- Clustered FAS3050 storage controllers
- NetApp Release: 7.3.5.1

#### Oracle 11g Fusion Middleware Software

- Oracle Fusion Middleware Enterprise deployments.
- Oracle Fusion Middleware 11g R11.1.1.5 SOA suite
- Oracle Enterprise Database 11g 11.1.0.7

## FMW NetApp Storage Configuration

The following directory and volume recommendations are based on best practices as outlined in the Oracle Fusion Middleware Enterprise Deployment Guide for Oracle SOA Suite. In order to meet availability requirements, redundant Middleware Homes are recommended. Further, the administration and managed server domains are separated from the Middleware Home, with JMS/TLOGs files residing on shared devices to facilitate server migration.

### NetApp Volumes and Mount Points

Volumes contain file systems that hold user data that is accessible using block and file level (SAN/NAS) protocols on the storage system.

The volume allocation detailed in Table 2 is designed to accommodate an Oracle SOA Enterprise Deployment installation. (An overview of the installation topology is detailed in Appendix C.)

- Provision two volumes for two Middleware Homes that contain redundant product binaries (VOLFMW1 and VOLFMW2).
- Provision one volume for the Administration Server domain directory (VOLADMIN).
- Provision one volume on each node for the Managed Server domain directory (VOLSOA1 and VOLSOA2). This directory is shared between all the Managed Servers on that node.
- Provision one volume for the JMS file-store and JTA transaction logs (VOLDATA). There will be one volume for the entire domain that is mounted on all the nodes in the domain.
- Provision one volume on each node for the Oracle HTTP Server Oracle home (VOLWEB1 and VOLWEB2).

- Provision one volume on each node for the Oracle HTTP Server Oracle instance (VOLWEBINST1 and VOLWEBINST2).
- Refer to Appendix A for example instructions on creating and mounting a NetApp volume.

**TABLE 2. SOA ENTERPRISE DEPLOYMENT VOLUME DESIGN  
(BASED ON “ORACLE FUSION MIDDLEWARE DISASTER RECOVERY GUIDE 11G”)**

VOLUME	HOST	MOUNT POINT	DESCRIPTION
VOLWEB1	WEBHOST1	/u01/app/oracle/product/fmw/web	Oracle HTTP server installation
VOLWEB2	WEBHOST2	/u01/app/oracle/product/fmw/web	
VOLWEBINST1	WEBHOST1	/u01/app/oracle/admin/ohs_instance	The Oracle Instance home contains system components, such as Oracle HTTP
VOLWEBINST2	WEBHOST2	/u01/app/oracle/admin/ohs_instance	
VOLFMW1	SOAHOST1	/u01/app/oracle/product/fmw	Weblogic Server and Oracle SOA Suite binaries
VOLFMW2	SOAHOST2	/u01/app/oracle/product/fmw	
VOLADMIN	SOAHOST1	/u01/app/oracle/admin/soaedg/aserver	Administration Server domain directory
VOLSOA1	SOAHOST1	/u01/app/oracle/admin/soaedg/mserver1	Managed Server domain directory
VOLSOA2	SOAHOST2	/u01/app/oracle/admin/soaedg/mserver2	
VOLDATA	SOAHOST1 SOAHOST2	/u01/app/oracle/admin/soaedg/soaCluster Subdirectories /jms & /tlogs	Transaction logs and JMS data

## Consistency Groups

FlexVol volumes can be grouped into a NetApp consistency group (CG) so that their content can be synchronized when a Snapshot backup is performed. Volumes placed into a CG will have their writes fenced (delayed) for the time of the Snapshot copy. It is recommended that on-site testing be performed to determine the impact of I/O delays and whether this is appropriate for your site.

- Create a consistency group for the volumes containing the domain directories for the Administration Server and Managed Servers (DOMAINGROUP).
- Create a consistency group for the volume containing the JMS file store and transaction log data (DATAGROUP).
- Create a consistency group for the volumes containing the Middleware Homes (FMWHOMEGROUP).

- Create a consistency group for the volumes containing the Oracle HTTP Server Oracle homes (WEBHOMEGROUP).
- Create a consistency group for the volumes containing the Oracle HTTP Server Oracle instances (WEBINSTANCEGROUP).
- Refer to Appendix B for example instructions on creating NetApp consistency groups.

**TABLE 3: SOA ENTERPRISE DEPLOYMENT CONSISTENCY GROUP DESIGN**  
(BASED ON "ORACLE FUSION MIDDLEWARE DISASTER RECOVERY GUIDE 11G")

GROUP	MEMBER	DESCRIPTION
DOMAINGROUP	VOLADMIN VOLSOA1 VOLSOA2	Consistency group for the Administration Server/Managed Server domain directory
DATAGROUP	VOLDATA	Consistency group for the JMS store and TLOGs files
FMWHOMEGROUP	VOLFMW1 VOLFMW2	Consistency group for the Middleware homes
WEBHOMEGROUP	VOLWEB1 VOLWEB2	Consistency group for the Oracle HTTP Server Oracle home
WEBINSTANCEGROUP	VOLWEBINST1 VOLWEBINST2	Consistency group for the Oracle HTTP Server Oracle instances

## FMW Backup/Recovery Considerations

An Oracle Fusion Enterprise installation recommends multiple points of software redundancy and is coupled with the availability features of an Oracle RAC Database, thus providing many backup and recovery options. This section highlights some areas that must be considered when formulating a backup and recovery strategy. (For a full discussion refer to the Oracle 11g Fusion Administration Guide.)

- 1) When formulating a middleware backup strategy, give additional consideration to the database, since many of the middleware products store state, artifacts, messages, and metadata in the database. To preserve application data consistency the middleware and database tiers must be kept closely in sync.

For instance, consider the SOA product family and its use of the database: There is a metadata schema (MDS) for artifacts; the BPEL Process Manager maintains a dehydration store (schema) to track the state of in-flight instances, and the Oracle Service Bus might create reporting tables, etc.

- 2) All JTA transactional resources must be considered when formulating an effective backup/recovery strategy (JDBC (Oracle Database), JMS, MQ-Series, and so on).

It is important to note that facilitating server migration within an Oracle Fusion Enterprise installation recommends that the JMS and JTA file repositories be collocated on the same volume so that these two resources are kept reasonably in-sync when volume backups are performed.

Given these considerations, the database must be recovered to the most current point in time and as close in time to the restoration of the JTA TLOGs and JMS queues as possible. This minimizes the chance of:

- JTA exceptions
- JMS message loss or duplication
- BPEL activity re-execution

Refer to the Oracle 11g Fusion Administration Guide for more details.

NetApp Snapshot copies provide a quick, efficient method to back up volumes that might contain file based repositories like the JTA TLOGs and JMS queues. Oracle recommends the use of technologies like NetApp Snapshot copies, which can also be used in collaboration with RMAN when backing up an Oracle database.

Finally it is important to consider the entire Oracle Fusion Middleware environment when formulating a backup and recovery strategy. A typical installation consists of components like Weblogic Server, HTTP server, Web Cache, Identity Management, and Virtual Directory. These components, their applications, and configuration need to be included in a complete strategy.

## FMW Offline Backup with NetApp

An offline backup is performed when the environment is shut down. The Administration and Managed servers plus all system components in the Oracle Instance must be down before the backup begins. This section covers the steps to perform an offline backup for a Fusion Middleware Enterprise Deployment using NetApp Snapshot copies.

### 1. Shut down all processes in the Middleware home.

Shut down the Administration and Managed Servers plus any Oracle instances running in the Middleware home.

### 2. Back up the Middleware homes:

```
Storage system> snap create VOLFMW1 snap_VOLFMW1  
Storage system> snap create VOLFMW2 snap_VOLFMW2
```

**3. Back up the Administration and Managed Server domains:**

```
Storage system> snap create VOLADMIN snap_VOLADMIN
Storage system> snap create VOLSOA1 snap_VOLSOA1
Storage system> snap create VOLSOA2 snap_VOLSOA2
```

**4. Back up the HTTP server installation:**

```
Storage system> snap create VOLWEB1 snap_VOLWEB1
Storage system> snap create VOLWEB2 snap_VOLWEB2
```

**5. Back up the Oracle Instance home:**

```
Storage system> snap create VOLWEBINST1 snap_VOLWEBINST1
Storage system> snap create VOLWEBINST2 snap_VOLWEBINST2
```

**6. Back up the TLOG/JMS logs and messages:**

```
Storage system> snap create VOLDATA snap_VOLDATA
```

**7. Back up the database using the Oracle Recovery Manager (RMAN).**

For detailed steps, see the Oracle Database Backup and Recovery User's Guide.

**8. Back up the OralInventory directory, oratab, Orainst.loc, and beahomelist files.**

## FMW Online Backup with NetApp Snapshot Copies

An online backup is performed while the environment is still active. The following are the run-time artifacts which must be backed up on a regular basis. This section covers the steps to perform an online backup for a Fusion Middleware Enterprise Deployment using NetApp Snapshot copies.

**1. Stop configuration changes until the backup is completed.**

Lock the domain configuration so that you can make changes to the configuration while preventing other accounts from making changes during your edit session. To lock the domain configuration:

1. Locate the Change Center in the upper left of the Administration Console screen.
2. Click Lock & Edit to lock the configuration edit hierarchy for the domain.

**2. Back up the Administration and Managed Server domains:**

```
Storage system> snap create VOLADMIN snap_VOLADMIN
Storage system> snap create VOLSOA1 snap_VOLSOA1
Storage system> snap create VOLSOA2 snap_VOLSOA2
```

### 3. Back up the Oracle Instance home:

```
Storage system> snap create VOLWEBINST1 snap_VOLWEBINST1
Storage system> snap create VOLWEBINST2 snap_VOLWEBINST2
```

### 4. Back up the TLOG/JMS logs and messages:

```
Storage system> snap create VOLDATA snap_VOLDATA
```

### 5. Back up the database using the Oracle Recovery Manager (RMAN).

For detailed steps, see the "Oracle Database Backup and Recovery User's Guide."

## FMW Online Backup with NetApp Consistency Groups

An online backup is performed while the environment is still active. The following are the run-time artifacts that must be backed up on a regular basis. This section covers the steps to perform an online backup for a Fusion Middleware Enterprise Deployment using NetApp Consistency Groups.

The Fusion Enterprise Deployment recommends multiple points of redundancy of data and software stores within the cluster. Consistency groups can be used to keep volumes with similar or dependent content in sync across the cluster.

Volumes placed into a consistency group will have their writes fenced (delayed) for the time of the Snapshot copy. NetApp recommends that on-site testing be performed to determine the impact on application I/O delays and whether this is appropriate for your site. Perl scripts are used to group volumes into their consistency groups. (Refer to Appendix B for instructions on how to create the required Perl scripts.)

### 1. Stop configuration changes until the backup is completed.

Lock the domain configuration so that you can make changes to the configuration while preventing other accounts from making changes during your edit session. To lock the domain configuration:

1. Locate the Change Center in the upper left of the Administration Console screen.
2. Click Lock & Edit to lock the configuration edit hierarchy for the domain.

### 2. Back up the Administration and Managed Server domains:

```
Storage system> perl cg_create_DOMAINGROUP.pl cgsnap_DOMAINGROUP
```

### 3. Back up the Oracle Instance home.

```
Storage system> perl cg_create_WEBINSTANCEGROUP.pl
cgsnap_WEBINSTANCEGROUP
```

#### 4. Back up TLOG/JMS logs and messages:

```
Storage system> perl cg_create_DATAGROUP.pl cgsnap_DATAGROUP
```

#### 5. Back up the database using the Oracle Recovery Manager (RMAN).

For detailed steps, see the "Oracle Database Backup and Recovery User's Guide."

## FMW Recovery with NetApp

The recovery of a Fusion Middleware Enterprise deployment using NetApp involves restoring the appropriate storage volume Snapshot copies to a consistent point across all platforms. Recovery must be well-planned and practiced to provide application data and software integrity. Refer to the section on "Fusion Middleware Backup/Recovery Considerations."

NetApp SnapRestore quickly restores a Fusion Middleware environment and can, in collaboration with Oracle RMAN, assist in the quick recovery of the associated Oracle database. Further, restoring NetApp consistency group Snapshot copies is no different than restoring normal Snapshot copies.

NetApp SnapRestore depends on the integrity of the Snapshot copies in order to successfully restore a volume. To guard the Snapshot copies from possible storage failure, it is recommended that the volumes with their associated Snapshot copies are periodically backed up. This can be performed using FlexClone/Split or NetApp SnapVault for remote backups (Refer to the "Data ONTAP 7.3 Data Protection Online Backup and Recovery Guide.").

The following is an example of restoring an offline backup as detailed in previous sections:

#### 1. Restore the Middleware homes:

```
Storage system> snap restore -s snap_VOLFMW1 VOLFMW1
Storage system> snap restore -s snap_VOLFMW2 VOLFMW2
```

#### 2. Restore the Administration and Managed Server domains:

```
Storage system> snap restore -s snap_VOLADMIN VOLADMIN
Storage system> snap restore -s snap_VOLSOA1 VOLSOA1
Storage system> snap restore -s snap_VOLSOA2 VOLSOA2
```

#### 3. Restore the HTTP server installation:

```
Storage system> snap restore -s snap_VOLWEB1 VOLWEB1
Storage system> snap restore -s snap_VOLWEB2 VOLWEB2
```

#### 4. Restore the Oracle Instance home:

```
Storage system> snap restore -s snap_VOLWEBINST1 VOLWEBINST1
Storage system> snap restore -s snap_VOLWEBINST2 VOLWEBINST2
```

**5. Restore the TLOG/JMS logs and messages:**

```
Storage system> snap restore -s snap_VOLDATA VOLDATA
```

**6. Restore the database volumes and then recover using the Oracle Recovery Manager (RMAN).**

For detailed steps, see the "Oracle Database Backup and Recovery User's Guide."

**7. Optional: Restore the OralInventory directory, oratab, Orainst.loc, and beahomelist files.**

## FMW Cloning with NetApp FlexClone

Cloning usually involves partially or entirely replicating a production, test, or development environment to the same or a different host. In addition, cloning is often used to create a Gold Image of a certified (fully patched) installation which can then be replicated to multiple environments.

To clone a Fusion Middleware environment Oracle provides movement scripts called copyBinary, pasteBinary, copyConfig, and pasteConfig. These scripts can replicate a Middleware Home, Oracle Homes, WebLogic Server, Domain, and certain middleware components (Refer to the 11g Oracle Fusion Middleware Administration Guide for instructions.).

Using NetApp FlexClone to clone the volumes for an entire Fusion Middleware installation would require the manual modification of a non-trivial number of files. Therefore this task is best performed using the Oracle Fusion movement scripts which automate the configuration and metadata file changes.

In light of these facts, the volume housing the Middleware Home can in fact be quickly cloned using NetApp FlexClone for the creation of Test/Dev environments. The possible advantages are:

- The ability to quickly copy and establish a Middleware Home with all executables and patches.
- The space optimizations of NetApp FlexClone, which should be helpful given that the Middleware home contains mostly read-only executables.

Take the following steps to clone the Fusion Middleware Home for testing and development purposes only. New domains and Managed servers must be created after these steps are performed.

(Note: NetApp FlexClone preserves operating system user and group permissions, and therefore NetApp recommends setting up these credentials according to the source environment.)

**Example Steps:**

Substitute volumes, directory paths, host names, and so on as appropriate.

**1. Perform a Snapshot copy of the Middleware Home.**

```
Storage system> snap create volfmw1 snap_T1_volfmw1
```

## 2. Create a cloned volume of the Middleware Home Snapshot copy.

```
Storage System> vol clone create c_volfmw1 -b volfmw1 snap_T1_volfmw1
```

## 3. Mount the cloned volume on the target system.

```
Target System> mkdir -p /u01/app/oracle/product/fmw_clone
Target System> vi /etc/fstab
    “<NetApp Filer IP>:/vol/c_volfmw1 /u01/app/oracle/product/fmw_clone nfs
    rw,bg,hard,rsize=32768,wsiz=32768,vers=3,nointr,timeo=600,tcp,actimeo=0”
Target System> exportfs -a
Target System> mount /u01/app/oracle/product/fmw_clone
```

## 4. Optional: Create the OUI (Oracle Universal Installer) location file.

If the cloned environment is to use a new OUI inventory then create a new OraInst.loc. Otherwise the existing OUI Inventory can be used to attach the cloned Oracle Homes.

```
Target System> vi /etc/oraInst.loc
```

### 4.1 Optional: Update oraInst.loc for each Oracle Home under the cloned Middleware home.

If a new /etc/oraInst.loc file was created then update the Oracle Homes to reflect this change.

For SOA and Oracle Common Homes:

```
Target System> vi $MW_HOME/soa/oraInst.loc
Target System> vi $MW_HOME/oracle_common/oraInst.loc
```

## 5. Add the cloned Fusion Middleware Home to the Weblogic Home list.

```
Target System> vi $HOME/bea/beahomelist
```

## 6. Optional: Replace the source MW\_HOME directory to the cloned MW\_HOME directory.

If the directory path for the Target Middleware Home differs from the Source Middleware Home then the path needs to be replaced in the scripts and configuration files:

“To replace '/u01/app/oracle/product/fmw' ' with '/u01/app/oracle/product/fmw\_clone”

```
Target System> grep -lr -e '/u01/app/oracle/product/fmw'* | xargs sed -i
's/\u01\app\oracle\product\fmw\/\u01\app\oracle\product\fmw_clone/g'
```

### 6.1 Optional: Visually check some files to verify successful string replacement in the preceding step.

```
Target System> vi $MW_HOME/wlserver_10.3/common/bin/commEnv.sh
Target System> vi $MW_HOME/registry.xml
Target System> vi $MW_HOME/soa/oui/bin/detachHome.sh
Target System> vi $MW_HOME/soa/oui/bin/attachHome.sh
```

```
Target System> vi $MW_HOME/oracle_common/oui/bin/detachHome.sh
Target System> vi $MW_HOME/oracle_common/oui/bin/attachHome.sh
```

### 7. Update the Domain registration.

Any domains cloned within (\$MW\_HOME/user\_project/) or outside the cloned Middleware Home are not considered valid and must be removed from the domain registration files.

```
Target System> vi $MW_HOME/domain-registry.xml
Target System> vi
$MW_HOME/wlserver_10.3/common/nodemanager/nodemanager.domains
```

### 8. Update the Node Manager properties.

Remove Keystore definitions from the node manager properties files.  
(Can be rebuilt post-cloning process.)

```
Target System> vi
$MW_HOME/wlserver_10.3/common/nodemanager/nodemanager.properties
```

### 9. Optional: Change the OHOMENAME variable.

Select a descriptive name for each Oracle Home by modifying the OHOMENAME variable.

```
Target System> vi $MW_HOME/soa/oui/bin/detachHome.sh
Target System> vi $MW_HOME/soa/oui/bin/attachHome.sh
Target System> vi $MW_HOME/oracle_common/oui/bin/detachHome.sh
Target System> vi $MW_HOME/oracle_common/oui/bin/attachHome.sh
```

### 10. Attach Oracle Homes to OUI Inventory.

For SOA and Oracle Common Homes:

```
Target System> ./$MW_HOME/soa/oui/bin/attachHome.sh
Target System> ./$MW_HOME/oracle_common/oui/bin/attachHome.sh
```

### 11. Update OUI inventory to define Oracle Common Home as a Dependent of SOA Home.

```
Target System> ./$MW_HOME/soa/oui/bin/runInstaller
                -updateHomeDeps "HOME_DEPENDENCY_LIST=
                {/u01/app/oracle/product/fmw_clone1C/soa:
                /u01/app/oracle/product/fmw_clone1C/oracle_common}"
```

### 12. Replay OUI actions for the Oracle Homes.

For SOA and Oracle Common Homes:

```
Target System> ./$MW_HOME/soa/oui/bin/runInstaller
                -clone ORACLE_HOME=<$MW_HOME>/fmw_clone/soa
Target System> ./$MW_HOME/oracle_common/oui/bin/runInstaller
                -clone ORACLE_HOME=<$MW_HOME>/fmw_clone/oracle_common
```

### 13. Optional: Split the Volumes and restart.

The cloned volumes can become independent of their source volumes. Once the cloned volumes are split they lose their space efficiency and occupy the same space as the source volumes.

```
Storage System> vol clone split start c_volfmw
```

#### **NOTE: Cloning Considerations.**

As stated, it is not practical to use NetApp FlexClone to replicate an entire Fusion Middleware environment. However if an administrator wants to attempt this type of cloning then to minimize the number of manual file modifications, the source and target environments must be aligned for:

- Directory names and paths
- Port numbers
- User and Group IDs
- Virtual server host names
- O/S software
- Etc.

The source and target environments must be very similar to make the volume cloning process feasible.

## Conclusion

This paper has demonstrated the benefits of integrating Oracle Fusion Middleware with NetApp storage technologies to efficiently manage the lifecycle of middleware products such as SOA, Oracle BPEL Process Manager, and Web Center. By following the configuration steps provided here, customers can efficiently back up, restore, and clone a highly available Enterprise Oracle Fusion SOA.

Your company can now formulate a middleware backup strategy that protects critical data stored in databases while also preserving important Oracle Fusion Middleware configuration and metadata information required to make sure that applications can restart quickly and correctly. Oracle Fusion Middleware and NetApp storage can work together to facilitate simple, fast, efficient lifecycle management of the Oracle Fusion middleware family of products.

## References

- Oracle® Fusion Middleware Enterprise Deployment Guide for Oracle SOA Suite 11g Release 1 (11.1.1)  
[http://download.oracle.com/docs/cd/E21764\\_01/core.1111/e12036/toc.htm](http://download.oracle.com/docs/cd/E21764_01/core.1111/e12036/toc.htm)
- Oracle® Fusion Middleware Administrator's Guide 11g Release 1 (11.1.1)  
[http://download.oracle.com/docs/cd/E21764\\_01/core.1111/e10105/toc.htm](http://download.oracle.com/docs/cd/E21764_01/core.1111/e10105/toc.htm)
- Oracle® Fusion Middleware Disaster Recovery Guide 11g Release 1 (11.1.1)  
[http://download.oracle.com/docs/cd/E21764\\_01/doc.1111/e15250/toc.htm](http://download.oracle.com/docs/cd/E21764_01/doc.1111/e15250/toc.htm)
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[http://download.oracle.com/docs/cd/E11882\\_01/backup.112/e10642/toc.htm](http://download.oracle.com/docs/cd/E11882_01/backup.112/e10642/toc.htm)
- Data ONTAP 7.3 Storage Management Guide:  
<http://now.netapp.com/NOW/knowledge/docs/ontap/rel733/pdfs/ontap/smg.pdf>
- Data ONTAP 7.3 Data Protection Online Backup and Recovery Guide
- <https://now.netapp.com/NOW/knowledge/docs/ontap/rel7351/html/ontap/onlinebk/frameset.html>

## Appendix A      Creating and Mounting a NetApp Volume

The following steps provide an example set of instructions for creating a volume on a NetApp storage system and then mounting that volume on a Linux/UNIX host.

### Create the NetApp volumes from either the browser or command line:

#### 1.      **Browser-based NetApp FilerView Wizard:**

- Add an aggregate.  
(Aggregates > Add).
- Add a volume, specifying name and size.  
(Volumes > Add)
- Manage NFS Exports, reviewing anonymous, root, and host access.  
(NFS > Manage Exports)

#### 2.      **Command line on the NetApp storage system:**

- Add an aggregate:  
Storage system> aggr create aggr1
- Add a volume:  
Storage system> vol create volweb1 -s volume aggr1 10m
- Manage NFS exports:  
Storage system> exportfs -p rw=<filer ip address>,root=<filer ip address>,anon=0 /vol/volweb1

### Mount the volumes to the appropriate host:

- Add the mount point to the 'fstab' file:  
<netapp filer ip>:/vol/volweb1 /u01/app/oracle/product/fmw/web nfs  
rw,bg,hard,rsize=32768,wsiz=32768,vers=3,nointr,timeo=600,tcp,actimeo=0
- Export the file system  
exportfs
- Mount the file system to the host:  
mount /u01/app/oracle/product/fmw/web

## Appendix B Creating NetApp Consistency Groups

The following steps provide an example set of instructions for creating a volume on a NetApp storage system and then mounting that volume on a Linux/UNIX host.

Consistency Group is a storage-level view of applications data stored in multiple volumes or controllers. The Fusion Enterprise Deployment recommends multiple points of redundancy with similar data and software stores within the cluster. Consistency groups can be used to keep volumes with similar or dependent content in sync across the cluster. Consistency groups are collections of objects (volumes) that allow an administrator to take consistent point-in-time copies of, for example, volumes today and LUNs, files, and block ranges in the future.

Volumes placed into a consistency group will have their writes fenced (delayed) for the time of the Snapshot copy. It is recommended that on-site testing be performed to determine the impact on application I/O delays and whether this is appropriate for your site.

Consistency Group can be enabled by running the following NetApp SDK APIs from any servers where NetApp volumes are mounted:

### **cg-start**

- Fences all writes for a volume per controller
- During write fencing, no writes can complete as volume contents are frozen
- Returns fencing success or failure
- If successful, continues with Snapshot copy creation based on frozen contents

### **cg-commit**

- Unfences volumes after the start of WAFL Consistency Point (CP) to create a Snapshot copy
- Returns success after creating a Snapshot copy
- Snapshot copies created by cg-start and cg-commit are replicated the same way as other Snapshot copies. No special handling exists today for CG Snapshot copies.
- Volume SnapMirror maintains a mirror of all Snapshot copies at the destination

To place volumes into consistency groups (CG) requires the execution of NetApp SDK APIs. Perl scripts can be developed to execute these APIs based on a configuration file that place the volumes into their consistency groups.

An example of creating one consistency group is demonstrated in the following steps.

#### **1. To obtain the NetApp APIs the "NetApp Manageability SDK" must be downloaded.**

<http://now.netapp.com/NOW/download/software/nmsdk/4.0/download.shtml>

## 2. Create a configuration file that lists the set of volumes that comprise the consistency group.

Note: Include the column headings when creating the configuration file.

```
Target Host> vi DOMAINGROUP.cfg
FileName User Password Timeout Volumes
strecstor01 oradba oracle relaxed VOLADMIN, VOLSOA1, VOLSOA2
```

## 3. Create a Perl script to execute the NetApp APIs and read the configuration file.

Copy the Perl script at the end of this section to create a new script for the required consistency group, then modify the Perl script to read the appropriate configuration files.

```
Target Host> cp cg_create_<>.pl Cg_create_DOMAINGROUP.pl
Target Host> vi cg_create_DOMAINGROUP.pl
```

Edit line #8 to change:

```
open("CFG","cg.cfg" || die "Can't open config file: $!");
to
open("CFG","DOMAINGROUP.cfg" || die "Can't open config file: $!");
```

## 4. To execute the Perl script:

```
Target Host> perl cg_create_DOMAINGROUP.pl cgsnap_ DOMAINGROUP
(Note: The following will be echo to the terminal.)
```

Input XML:

```
<cg-start>
  <snapshot> cgsnap_ DOMAINGROUP </snapshot>
  <timeout>relaxed</timeout>
  <volumes>
    <volume-name>VOLADMIN</volume-name>
    <volume-name>VOLSOA1</volume-name>
    <volume-name>VOLSOA2</volume-name>
  </volumes>
</cg-start>
```

Output XML1:

```
<results status="passed">
  <cg-id>228</cg-id>
</results>
```

Commit XML2:

```
<results status="passed"></results>
```

When you execute `cg_create_DOMAINGROUP.pl` it is parsing the configuration file `DOMAINGROUP.cfg` and passing that information to NetApp APIs to create a single named Snapshot copy that spans multiple volumes/controllers.

The following Perl script creates the consistency group Snapshot copy.

Note: Make sure to change the second line to point to the directory path of the NetApp manageability SDK Perl library.

**cg\_create <>.pl :**

```
#!/opt/local/bin/perl
use lib "NetApp";
use NaServer;
use NaElement;
sub open_cfg {
    open("CFG","cg.cfg" || die "Can't open config file: $!");
    while(<CFG>) {
        chomp;
        if(/^#\#/ || /^FilerName/) {
            next;
        }
        @cfgline = split /\s+/,;
        push(@FILERLIST,[@cfgline]);
    }
}
close(CFG);}

&open_cfg;
$snapname = shift;
&loop_cgstart;
&loop_cgcommit;
sub loop_cgstart()
{
    for $i ( 0 .. $#FILERLIST ) {
        &cg_start($FILERLIST[$i]);
    }
}
sub loop_cgcommit()
{
    for $i ( 0 .. $#FILERLIST ) {
        &cg_commit($FILERLIST[$i]);
    }
}
sub cg_start()
{
    $filename = $FILERLIST[$i][0];
    $username = $FILERLIST[$i][1];
    $password = $FILERLIST[$i][2];
    $timeout = $FILERLIST[$i][3];
```

```

    @volumes = split(",",$FILERLIST[$i][4]);
    chomp ($filename);
    chomp ($username);
    chomp ($password);
    chomp ($timeout);
    chomp ($snapname);
    chomp (@volumes);
    my $zapicon = NaServer->new($filename, 1, 3);
    $zapicon->set_style(LOGIN_PASSWORD);
    $zapicon->set_admin_user($username, $password);
        if (defined($zapicon))
        {
            print "Connection to $filename failed.\n";
        exit 2;
        }

    $zapicon->set_transport_type(NA_SERVER_TRANSPORT_HTTP);
    if (defined($zapicon))
    {
        print "Unable to set HTTP transport.\n";
        exit 2;
    }

my $zapicmd = NaElement->new("cg-start");
$zapicmd->child_add_string("snapshot",$snapname);
$zapicmd->child_add_string("timeout",$timeout);
my $volumecount = @volumes;
chomp (@volumes);
my $zapivols = NaElement->new("volumes");
while ($volumecount > 0) {
    $zapivols->child_add_string("volume-name",shift(@volumes));
    $volumecount--;
}
$zapicmd->child_add($zapivols);
my $zapiin=$zapicmd->sprintf();
print "Input XML:\n$zapiin \n";
my $zapiout = $zapicon->invoke_elem($zapicmd);
my $zapiout=$zapiout->sprintf();
print "Output XML1:\n$zapiout \n";
@precgid = split(/<cg-id>/,$zapiout);
@cgid = split(/<\/cg-id>/,$precgid[1]);
$cgid = @cgid[0];
$filenames {$i} = $cgid;
#      &loop_cgcommit;

```

```
}
sub cg_commit()
{
$filename = $FILERLIST[$i][0];
$username = $FILERLIST[$i][1];
$password = $FILERLIST[$i][2];
$timeout = $FILERLIST[$i][3];
@volumes = split(",",$FILERLIST[$i][4]);
chomp ($filename);
chomp ($username);
chomp ($password);
chomp ($timeout);
chomp ($snapname);
chomp (@volumes);
my $zapicon = NaServer->new($filename, 1, 3);
$zapicon->set_style(LOGIN_PASSWORD);
$zapicon->set_admin_user($username, $password);
if (!defined($zapicon))
{
    print "Connection to $filename failed.\n";
    exit 2;
}
$zapicon->set_transport_type(NA_SERVER_TRANSPORT_HTTP);
if (!defined($zapicon))
{
    print "Unable to set HTTP transport.\n";
    exit 2;
}
$cgid = $filenames{$i};
print "\n\n";
my $zapiout = $zapicon->invoke("cg-commit","cg-id",$cgid);
my $zapiout=$zapiout->sprintf();
print "Commit XML2:\n$zapiout \n";
}
sub syntax_printer()
{
print "USAGE: !$ <snapshot name> <config file>\n";
exit 0;
}
```

## Appendix C SOA Enterprise Deployment Topology

Figure 3 depicts the sample SOA EDG topology as shown in the SOA EDG.

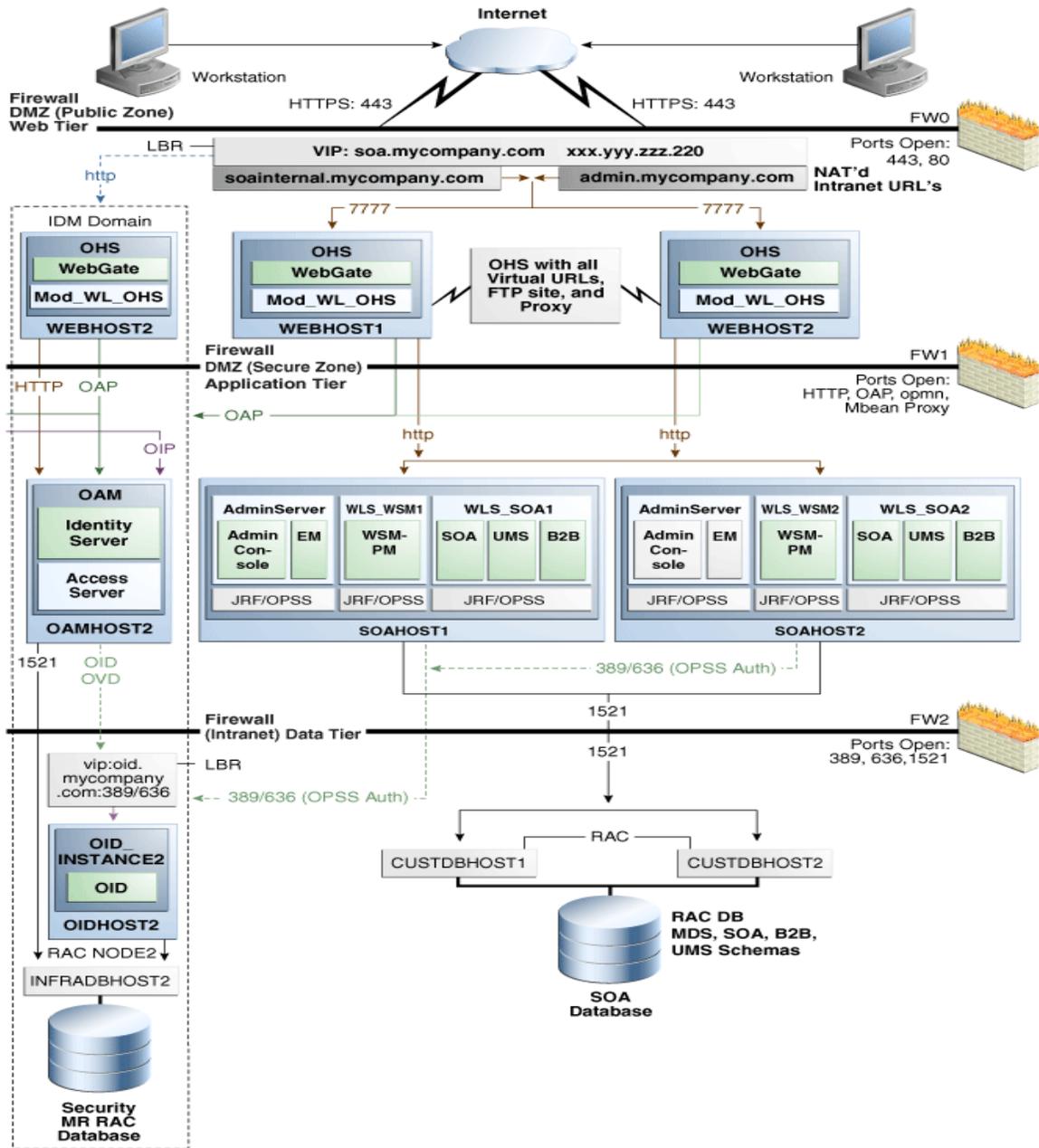


Figure 3. SOA Enterprise Deployment Topology



Oracle Fusion Middleware Lifecycle  
Management Using NetApp  
September 2011  
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