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ORACLE12C VIRTUAL CLUSTERWARE FOR THE CLOUD BOX

AN INNOVATIVE DATABASE-FOCUSED CLOUD COMPUTING PARADIGM.

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NYOUG Winter 2015 General Meeting

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ORACLE12C VIRTUAL CLUSTERWARE FOR THE CLOUD BOX

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The Grid is the cloud. The cloud is the grid...

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Agenda

- Conceptual Framework
- Oracle12c Clusterware
- Virtualizing the Clusterware

Conceptual Framework

Functional, Technical, and Business Concepts

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Introduction

- Understanding Clusters
- Oracle12c Clusterware
- Virtualizing the Clusterware

Oracle12c Clusterware Concepts

- A cluster consists of one or more servers.
- Access to an external network is the same for a server in a cluster (also known as a cluster member or node) is similar to that of a standalone server.
- Each cluster member or node requires a second network named Interconnect.
- A cluster member or node requires at least two network interface cards: one for a public network (e.g., eth0, TCP/IP) and one for a private network (e.g., eth1, UDP).
- The interconnect network is a private network using a switch (or multiple switches) that only the nodes in the cluster can access.

Oracle12c Clusterware Concepts

Voting Files

- Oracle Clusterware uses voting files to determine node membership in a cluster. You can configure voting files on Oracle ASM, or you can configure voting files on shared storage.
- If you configure voting files on Oracle ASM, then you do not need to manually configure the voting files. Depending on the redundancy of your disk group, an appropriate number of voting files are created.
- Otherwise, Oracle recommends that you have a minimum of three voting files on physically separate storage to avoid a single point of failure. If a single voting file is configured, then external mirroring is required to provide redundancy.
- Oracle recommends that you do not use more than five voting files, although a maximum of 15 is supported.

Oracle12c Clusterware Concepts

Oracle Cluster Registry

- Oracle Clusterware uses the Oracle Cluster Registry (OCR) to store and manage information about the components that Oracle Clusterware controls, such as Oracle RAC databases, listeners, virtual IP addresses (VIPs), and services and any applications.
- OCR stores configuration information in a series of key-value pairs in a tree structure. To ensure cluster high availability, Oracle recommends that you define multiple OCR locations. Besides:
  - Up to five OCR locations are supported
  - Each OCR location must reside on shared storage that is accessible by all of the nodes in the cluster
  - A failed OCR location can be replaced online if it is not the only OCR location
  - It is possible to update OCR through supported utilities such as Oracle Enterprise Manager, the Oracle Clusterware Control Utility (CRSCTL), the Server Control Utility (SRVCTL), the OCR configuration utility (OCRCONFIG), or the Database Configuration Assistant (DBCA).

Oracle12c Clusterware Networking Concepts

- Oracle Clusterware Network Configuration Concepts
- Oracle Clusterware enables a dynamic Oracle Grid Infrastructure through the self-management of the network requirements for the cluster.
- Oracle Clusterware 12c supports:
- Dynamic Host Configuration Protocol (DHCP)
- Stateless address auto-configuration for the VIP addresses
- Single Client Access Name (SCAN) address, but not the public address.

Oracle12c Clusterware Technology Stack

Oracle Clusterware consists of two separate technology stacks:

- **The upper technology stack anchored by the Cluster Ready Services (CRS) daemon (CRSD)**
- **The lower technology stack anchored by the Oracle High Availability Services daemon (OHASD).**

Oracle12c Clusterware Technology Stack

- A summary of these technology stacks involves, among others:
- The Cluster Ready Services Technology Stack
- The Oracle High Availability Services Technology Stack
- The Cluster Ready Services Technology Stack
- The following list describes the processes that comprise CRS:
  - Cluster Ready Services (CRS): The primary program for managing high availability operations in a cluster.
  - The CRSD manages cluster resources based on the configuration information that is stored in OCR for each resource. This includes start, stop, monitor, and failover operations.
  - Cluster Synchronization Services (CSS): Manages the cluster configuration by controlling which nodes are members of the cluster and by notifying members when a node joins or leaves the cluster.
  - The cssdagent process monitors the cluster and provides I/O fencing. This service formerly was provided by Oracle Process Monitor Daemon (oprocd), also known as OraFenceService on Windows. A cssdagent failure may result in Oracle Clusterware restarting the node.
  - Oracle ASM: Provides disk management for Oracle Clusterware and Oracle Database.
  - Cluster Time Synchronization Service (CTSS): Provides time management in a cluster for Oracle Clusterware.

Oracle12c Clusterware Technology Stack

- Event Management (EVM): A background process that publishes events that Oracle Clusterware creates.
- Grid Naming Service (GNS): Handles requests sent by external DNS servers, performing name resolution for names defined by the cluster.
- Oracle Agent (oraagent): Extends clusterware to support Oracle-specific requirements and complex resources. This process runs server callout scripts when FAN events occur. This process was known as RACG in Oracle Clusterware 11g release 1 (11.1).
- Oracle Notification Service (ONS): A publish and subscribe service for communicating Fast Application Notification (FAN) events.
- Oracle Root Agent(orarootagent): A specialized oraagent process that helps the CRSD manage resources owned by root, such as the network, and the Grid virtual IP address.
- The Cluster Synchronization Service (CSS), Event Management (EVM), and Oracle Notification Services (ONS) components communicate with other cluster component layers on other nodes in the same cluster database environment. These components are also the main communication links between Oracle Database, applications, and the Oracle Clusterware high availability components. In addition, these background processes monitor and manage database operations.

Oracle12c Clusterware Technology Stack

The Oracle High Availability Services Technology Stack

Processes that comprise the Oracle High Availability Services technology stack:

- **appagent: Protects any resources of the application resource type used in previous versions of Oracle Clusterware.**
- **Cluster Logger Service (ologgerd): Receives information from all the nodes in the cluster and persists in an Oracle Grid Infrastructure Management Repository-based database. This service runs on only two nodes in a cluster.**
- **Grid Interprocess Communication (GIPC): A support daemon that enables Redundant Interconnect Usage.**
- **Grid Plug and Play (GPNPD): Provides access to the Grid Plug and Play profile, and coordinates updates to the profile among the nodes of the cluster to ensure that all of the nodes have the most recent profile.**
- **Multicast Domain Name Service (mDNS): Used by Grid Plug and Play to locate profiles in the cluster, and by GNS to perform name resolution. The mDNS process is a background process on Linux and UNIX and on Windows.**
- **Oracle Agent (oraagent): Extends clusterware to support Oracle-specific requirements and complex resources. This process manages daemons that run as the Oracle Clusterware owner, like the GIPC, GPNPD, and GIPC daemons.o as the server cluster. A client cluster advertises its names with the server cluster. Only one GNS daemon process can run on the server cluster. Oracle Clusterware puts the GNS daemon process on one of the nodes in the cluster to maintain availability.**

Oracle12c Clusterware Technology Stack

In order for GNS to function on the server cluster, the following should be in place:

- **The DNS administrator must delegate a zone for use by GNS**
- **A GNS instance must be running somewhere on the network and it must not be blocked by a firewall**
- **All of the node names in a set of clusters served by GNS must be unique.**

Oracle12c Clusterware Technology Stack

Single Client Access Name (SCAN)

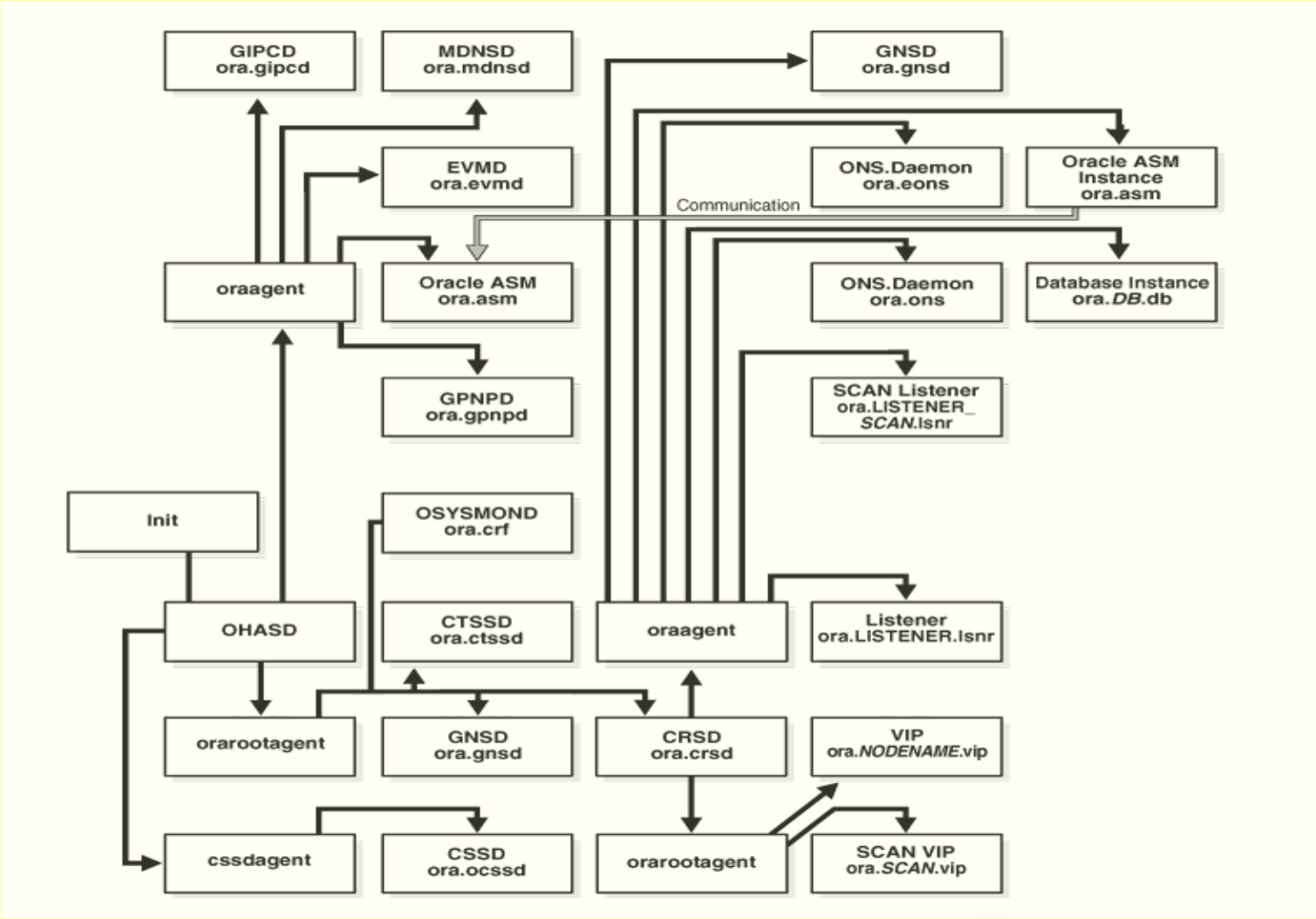
The SCAN is a domain name registered to at least one and up to three IP addresses, either in DNS or GNS. When using GNS and DHCP, Oracle Clusterware configures the VIP addresses for the SCAN name that is provided during cluster configuration.

The node VIP and the three SCAN VIPs are obtained from the DHCP server when using GNS. If a new server joins the cluster, then Oracle Clusterware dynamically obtains the required VIP address from the DHCP server, updates the cluster resource, and makes the server accessible through GNS.

Configuring Addresses Manually

- One public address and host name for each node.
- One VIP address for each node.
- The DBA must assign a VIP address to each node in the cluster. Each VIP address must be on the same subnet as the public IP address for the node and should be an address that is assigned a name in the DNS. Each VIP address must also be unused and unpingable from within the network before you install Oracle Clusterware.
- Up to three SCAN addresses for the entire cluster.
- The SCAN must resolve to at least one address on the public network. For high availability and scalability, Oracle recommends that you configure the SCAN to resolve to three addresses on the public network.

Oracle12c Clusterware HAS Technology Stack: Processes and Services



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Working with the Oracle12c Clusterware

Functional, Technical, and Business Concepts

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Managing Oracle12c Clusterware Environments

List of tools and utilities to manage Oracle Clusterware environment:

- **Cluster Health Monitor (CHM)**
- **Cluster Verification Utility.**
- **Oracle Cluster Registry Configuration Tool (OCRCONFIG)**
- **OCRCHECK**
- **OCRDUMP**
- **Oracle Clusterware Control (CRSCTL), (Node-to-Node cluster-aware).**
- **Oracle Enterprise Manager**
- **Oracle Interface Configuration Tool (OIFCFG)**
- **Server Control (SRVCTL)**

Managing Oracle12c Clusterware Environments: OCRCHECK CLI Reference

- ocrconfig –delete
- ocrconfig –downgrade
- ocrconfig –export
- ocrconfig –import
- ocrconfig –manualbackup
- ocrconfig –overwrite
- ocrconfig –repair
- ocrconfig –replace
- ocrconfig –restore
- ocrconfig –showbackup
- ocrconfig –upgrade

Cloning and Extending Oracle12c Clusterware

Overview of Cloning and Extending Oracle Clusterware in Grid Environments

Cloning nodes is the preferred method of creating new clusters. The cloning process copies Oracle Clusterware software images to other nodes that have similar hardware and software. Use cloning to quickly create several clusters of the same configuration. Before using cloning, you must install an Oracle Clusterware home successfully on at least one node using the instructions in your platform-specific Oracle Clusterware installation guide.

For new installations, or if you must install on only one cluster, Oracle recommends that you use the automated and interactive installation methods, such as Oracle Universal Installer or the Provisioning Pack feature of Oracle Enterprise Manager. These methods perform installation checks to ensure a successful installation. To add or delete Oracle Clusterware from nodes in the cluster, use the addnode.sh and rootcrs.pl scripts**.**

Administering Oracle12c Clusterware

Role-separated management is a feature you can implement that enables multiple applications and databases to share the same cluster and hardware resources, in a coordinated manner, by setting permissions on server pools or resources, to provide or restrict access to resources, as required.

There are two possible Role-separated management implementations, namely:

Vertical implementation (between layers) describes a role separation approach based on different operating system users and groups used for various layers in the technology stack. Permissions on server pools and resources are granted to different users (and groups) for each layer in the stack using access control lists. Oracle Automatic Storage Management (ASM) offers setting up role separation as part of the Oracle Grid Infrastructure installation based on a granular assignment of operating system groups for specific roles.

Horizontal implementation (within one layer) describes a role separation approach that restricts resource access within one layer using access permissions for resources that are granted using access control lists assigned to server pools and policy-managed databases or applications.

Grid Naming Service Configuration Options

Network Administration Tasks for GNS and GNS Virtual IP Address

To implement GNS, your network administrator must configure the DNS to set up a domain for the cluster, and delegate resolution of that domain to the GNS VIP. You can use a separate domain, or create a subdomain.

GNS distinguishes between nodes by using cluster names and individual node identifiers as part of the host name for that cluster node,

You can use GNS without DNS delegation in configurations where static addressing is being done, such as in Oracle Flex ASM or Oracle Flex Clusters. However, GNS requires a domain be delegated to it if addresses are assigned using DHCP.

The GNS daemon and the GNS VIP run on one node in the server cluster. The GNS daemon listens on the GNS VIP using port 53 for DNS requests.

Grid Naming Service Configuration Options

GNS can run in either automatic or standard cluster address configuration mode.

Automatic configuration uses either the Dynamic Host Configuration Protocol (DHCP) for IPv4 addresses or the **Stateless Address Autoconfiguration Protocol (autoconfig) (RFC 2462 and RFC 4862) for IPv6 addresses.**

Administering Oracle12c Clusterware

Changing the Virtual IP Addresses Using SRVCTL

- Clients configured to use public VIP addresses for Oracle Database releases before Oracle recommends configuring clients to use SCANs, but you are not required to use SCANs. Upon upgrade either both SCAN usage or continued VIP address usage are possible.
- If you continue to use VIP addresses for client connections, you can modify the VIP address while Oracle Database and Oracle ASM continue to run. However, you must stop services while you modify the address. When you restart the VIP address, services are also restarted on the node.

```
$ srvctl stop service -db database_name -service "service_name_list" -node
        node_name
$ srvctl stop service -db grid -service "sales,oltp" -node mynode
$ srvctl config vip -vipname node03-vip VIP exists: /node03-
        vip/192.168.3.28/255.255.255.0/eth0
$ srvctl stop vip -node node_name
$ srvctl modify nodeapps -node node_name -address new_vip_address
$ srvctl modify nodeapps -node mynode -address 192.168.3.144/255.255.255.0/eth0
$ srvctl start vip -node node_name
$ srvctl start vip -node mynode
$ cluvfy comp nodecon -n all -verbose
```

Administering Oracle12c Clusterware

Transitioning from IPv4 to IPv6 Networks for VIP Addresses Using SRVCTL

The following command is used to remove an IPv4 address type from a combined IPv4 and IPv6 network:

$ srvctl modify network -iptype ipv6

This command starts the removal process of IPv4 addresses configured for the cluster.

Support for IPV6 can enhance capabilities when using server pools.

Overview of Oracle Flex Clusters

Oracle Grid Infrastructure installed in an Oracle Flex Cluster configuration is a scalable, dynamic, robust network of nodes. Oracle Flex Clusters provide a platform for a variety of applications, including Oracle Real Application Test. All nodes in an Oracle Flex Cluster belong to a single Oracle Grid Infrastructure cluster. This architecture centralizes policy decisions for deployment of resources based on application needs, to account for various service levels, loads, failure responses, and recovery.

Oracle Flex Clusters contain two types of nodes arranged in a hub and spoke architecture: Hub Nodes and Leaf Nodes. The number of Hub Nodes in an Oracle Flex Cluster can be as many as 64. The number of Leaf Nodes can be many more. Hub Nodes and Leaf Nodes can host different types of applications:

- **Hub Nodes are similar to Oracle Grid Infrastructure nodes in an Oracle Clusterware standard Cluster configuration: they are tightly connected, and have direct access to shared storage.**
- **Leaf Nodes are different from standard Oracle Grid Infrastructure nodes, in that they do not require direct access to shared storage, but instead request data through Hub Nodes.**

Managing Oracle12c Clusterware Scenarios

Use the following procedure to import OCR on Linux or UNIX systems:

1 $ olsnodes

2. # crsctl stop crs

If there is an error, stop Oracle Clusterware by running the following command as root on all of the nodes:

crsctl stop crs -f

3. Then run the following line as root:

crsctl start crs -excl

Run as root:

crsctl stop resource ora.crsd -init

4. Import OCR by running the following command as root:

ocrconfig -import file_name

5. Verify the integrity of OCR:

ocrcheck

6. Stop Oracle Clusterware on the node where it is running in exclusive mode:

crsctl stop crs -f

7. Begin to start Oracle Clusterware by running the following command asroot on all of the nodes:

crsctl start crs

8. Verify OCR integrity of all of the cluster nodes that are configured as part of your cluster by running the following CVU command:

$ cluvfy comp ocr -n all -verbose

Managing Oracle12c Clusterware Scenarios

Storing Voting Files on Oracle ASM

Oracle ASM manages voting files differently from other files that it stores

Once you configure voting files on Oracle ASM, you can only make changes to the voting files' configuration using the crsctl replace votedisk command.

The number of voting files you can store in a particular Oracle ASM disk group depends upon the redundancy of the disk group.

By default, Oracle ASM puts each voting file in its own failure group within the disk group.

The redundancy level that you choose for the Oracle ASM disk group determines how Oracle ASM mirrors files in the disk group, and determines the number of disks and amount of disk space that you require.

A quorum failure group is a special type of failure group that is used to store the Oracle Clusterware voting files. Redundancy levels include:

External redundancy: An external redundancy disk group requires a minimum of one disk device. The effective disk space in an external redundancy disk group is the sum of the disk space in all of its devices.

External, Normal, and High Redundancy Levels are possible. External redundancy should be protected with the appropriate RAID storage device.

Using the crsctl replace votedisk command, you can move a given set of voting files from one Oracle ASM disk group into another, or onto a certified file system.

Managing Oracle12c Clusterware Scenarios

Prerequisite Steps for Adding Cluster Nodes

1. Make physical connections.
   Connect the nodes' hardware to the network infrastructure of your cluster. In a virtual environment, configure your Virtual Machine accordingly.
2. Install the operating system.
   Install a cloned image of the operating system that matches the operating system on the other nodes in your cluster, including required service patches, updates, and drivers.
   Oracle recommends that you use a cloned image. However, if the installation fulfills the installation requirements, then install the operating system according to the vendor documentation.
3. Create Oracle users.
   You must create all Oracle users on the new node that exist on the existing nodes.
   4. Ensure that SSH is configured on the node.
   SSH is configured when you install Oracle Clusterware 12c.
5. Verify the hardware and operating system installations with the Cluster Verification Utility (CVU).

a. $ cluvfy comp peer [-refnode ref_node] -n node_list [-orainv orainventory_group] [-osdba osdba_group] [-verbose]

b. Ensure that the Grid Infrastructure Management Repository has at least an additional 500 MB of space for each node added above four, as follows:
   $ oclumon manage -get repsize

Add additional space, if required, as follows:
$ oclumon manage -repos change_repos_size *total_in_MB*

Oracle12c Clusterware HAS Techology Stack: Processes and Services: CLUVFY Utility CLI

Verification to Perform	CVU Commands to Use
System requirements verification	cluvfy comp sys
Oracle Cluster File System verification	cluvfy stage [-pre | -post] cfs
Storage verifications	• cluvfy comp space • cluvfy comp ssa • cluvfy stage [-pre | -post] acfscfg
Network verification	cluvfy stage -post hwos
Connectivity verifications	• cluvfy comp nodecon • cluvfy comp nodereach
Cluster Time Synchronization Services verification	cluvfy comp clocksync
User and Permissions verification	cluvfy comp admprv
Node comparison and verification	cluvfy comp peer
Installation verification	• cluvfy stage -pre dbcfg • cluvfy stage -pre dbinst • cluvfy stage [-pre | -post] crsinst • cluvfy stage [-pre | -post] hacfg • cluvfy stage [-pre | -post] nodeadd
Deletion verification	cluvfy stage -post nodedel
Oracle Clusterware and Oracle ASM Component verifications	• cluvfy comp acfs • cluvfy comp asm • cluvfy comp clumgr • cluvfy comp crs • cluvfy comp dhcp

Verification to Perform	CVU Commands to Use
• Oracle Clusterware and Oracle ASM Component verifications	• cluvfy comp dns • cluvfy comp gns • cluvfy comp gpnp • cluvfy comp ha • cluvfy comp nodeapp • cluvfy comp ocr • cluvfy comp ohasd • cluvfy comp olr • cluvfy comp scan • cluvfy comp software • cluvfy comp vdisk

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Oracle Resources and Agents

Oracle Clusterware Resources and Agents

Describing the framework that Oracle Clusterware uses to monitor and manage resources, to ensure high application availability:

- **Resources**
- **Resource Types**
- **Agents**
- **Action Scripts**
- **Building an Agent**
- **Registering a Resource in Oracle Clusterware**
- **Resources**

Adding User-Defined Resources

- **Adding a Resource to a Specified Server Pool**

$ crsctl add resource myApache -type cluster_resource -attr "ACTION_SCRIPT=/opt/cluster/scripts/myapache.scr, PLACEMENT=restricted, SERVER_POOLS=*server_pool_list*, CHECK_INTERVAL=30, RESTART_ATTEMPTS=2, START_DEPENDENCIES=hard(appsvip), STOP_DEPENDENCIES=hard(appsvip)"

Use the crsctl add resource command to add a resource to a server pool.

To add the Apache Web server to a specific server pool as a resource using the policy-based deployment scheme, run the following command as the user that is supposed to run the Apache Server (i.e., as root).

Adding Resources Using Oracle Enterprise Manager

To add resources to Oracle Clusterware using Oracle Enterprise Manager:

1. **Log into Oracle Enterprise Manager Cloud Control.**
2. **Select the cluster target that you want to modify.**
3. **From the cluster target menu, select Administration > Resources >Manage.**
4. **Enter a cluster administrator user name and password to display the Add Resource page.**
5. **Enter a name for the resource in the Name field.**

(N.B. A resource name cannot begin with a period nor with the character string ora.)

6. **Choose either cluster_resource or local_resource from the Resource Type drop down.**
7. **Optionally, enter a description of the resource in the Description field.**
8. **Select Start the resource after creation if you want the resource to start immediately.**
9. **The optional parameters in the Placement section define where in a cluster Oracle Clusterware places the resource.**

Configuring the Virtual Environment for Oracle12c Clusterware

Functional, Technical, and Business Concepts

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Oracle12c Clusterware Installation

- **Oracle Virtual Box**
  - **Installation**
  - **Configuration**
    - **Storage**
    - **Network**
    - **Capacity Planning**

Oracle12c Clusterware Installation

- **Oracle Grid Infrastructure Installation**
  - **Oracle ASM Configuration**
    - **ASM**
    - **Flex ASM**
  - **Oracle ASM Customization**
  - **Oracle12c Database Installation and Configuration**

When selecting an installation type, it should reflect the need for RAC, RAC One Node cluster databases or Standalone Databases.

Installation and Configuration

Virtual Clusterware for RAC, RAC One Node and Standalone Databases

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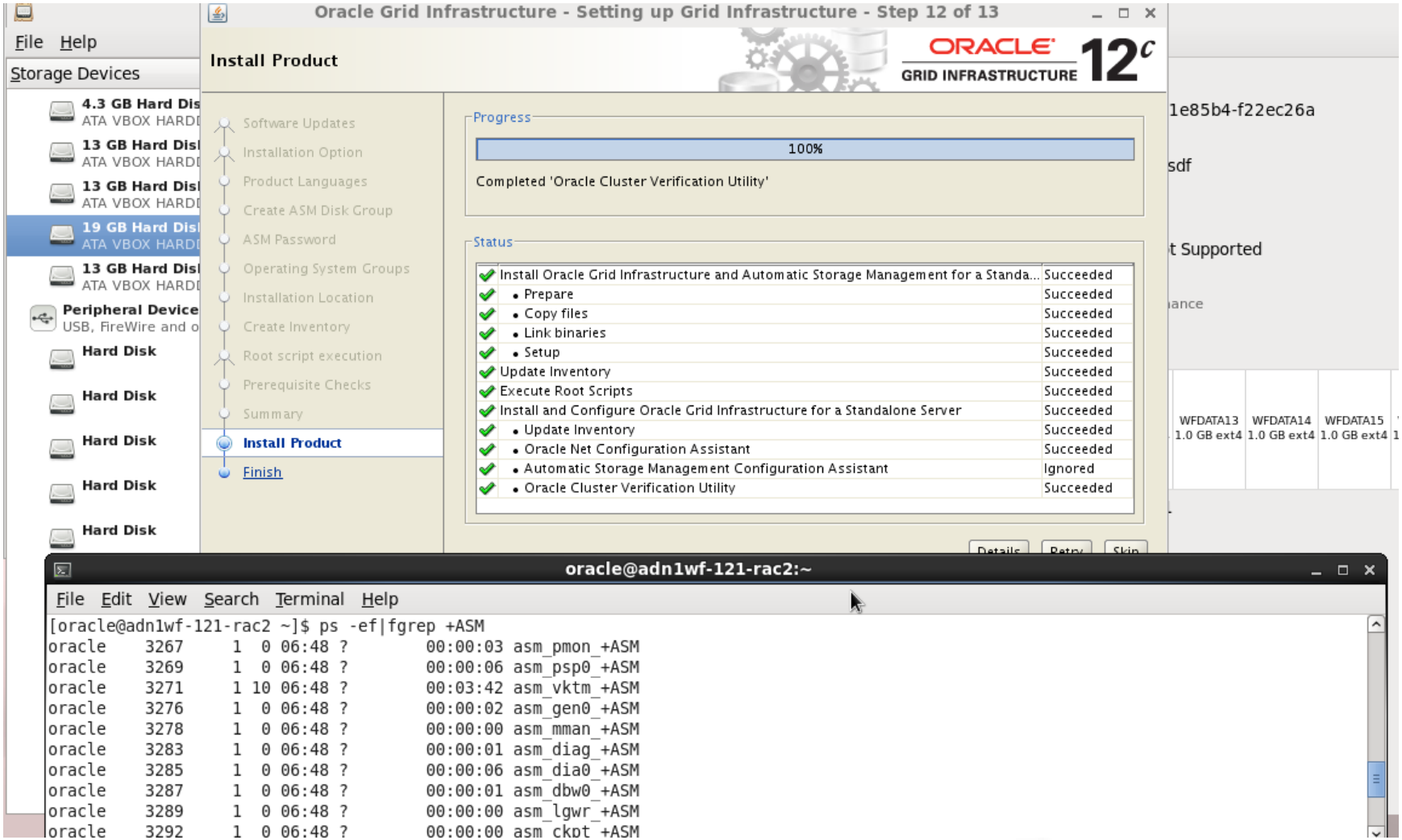
Oracle12c Clusterware Installation

- **Installation Map for a Virtual Environment**
  - **Oracle Virtual Box Environment Configuration**
    - **Storage Stack**
    - **Memory and Computing Resources Requirements**
  - **Oracle Grid Infrastructure Installation**
    - **Oracle ASM Installation and Configuration**
      - **ASM**
      - **FlexASM Configuration**
      - **Oracle ASM Extensions**
        - **ASM Dynamic Volume Management (ADVM)**
        - **ASM Cluster File System (ACFS)**

Oracle12c Database Installation and Configuration

- Standalone Installation and Configuration
- RAC Cluster Database Installation and Configuration
- RAC One Node Database Installation and Configuration

Working with the Oracle12c Clusterware



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Virtualizing and Customizing Oracle12c Clusterware

Customizing Clusterware Services

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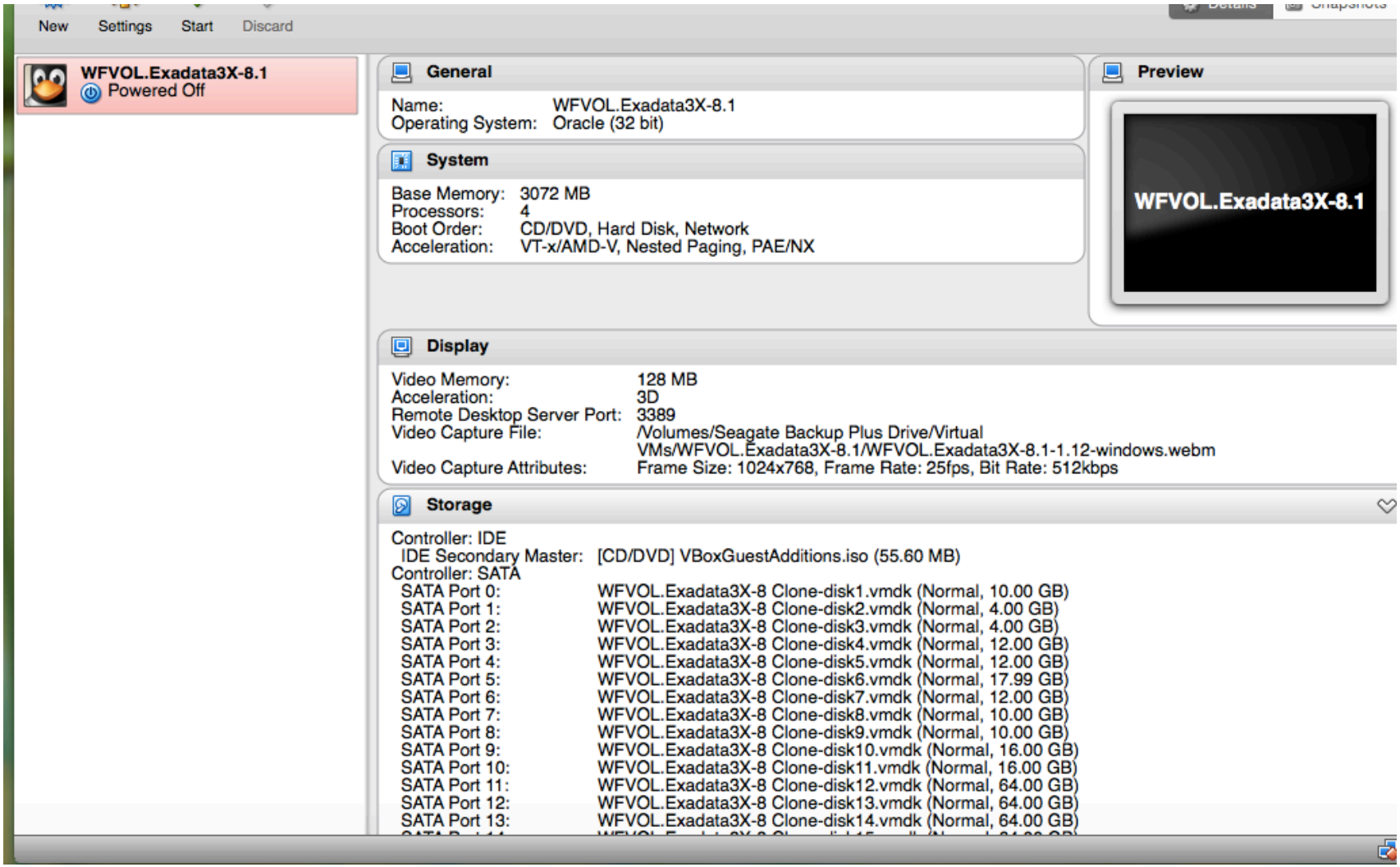
Oracle Virtual Box Configuration



Adding a Cluster Node on Linux and UNIX Systems

To add a node:

1. Ensure that you have successfully installed Oracle Clusterware on at least one node in your cluster environment. See Also:

2. Verify the integrity of the cluster and node3:

$ cluvfy stage -pre nodeadd -n node3 [-fixup] [-verbose]

3. To extend the Oracle Grid Infrastructure home to the node3, navigate to the Grid_home/addnode directory on node1 and run the addnode.shscript as the user that installed Oracle Clusterware.

To run addnode.sh in interactive mode, run addnode.sh fromGrid_home/addnode.

For an Oracle Clusterware standard Cluster:

```
./addnode.sh -silent "CLUSTER_NEW_NODES={node3}" "CLUSTER_NEW_VIRTUAL_
        HOSTNAMES={node3-vip}"

./addnode.sh -silent "CLUSTER_NEW_NODES={node3}" "CLUSTER_NEW_VIRTUAL_
        HOSTNAMES={node3-vip}" "CLUSTER_NEW_NODE_ROLES={hub}"

./addnode.sh -silent "CLUSTER_NEW_NODES={node3,node4}"
        "CLUSTER_NEW_VIRTUAL_HOSTNAMES={node3-vip,}"
        "CLUSTER_NEW_NODE_ROLES={hub,leaf}"
```

Adding a Cluster Node on Linux and UNIX Systems

4. If prompted, then run the orainstRoot.sh script as root to populate the /etc/oraInst.loc file with the location of the central inventory. For example:

```
# /opt/oracle/oraInventory/orainstRoot.sh
```

5. If you have an Oracle RAC or Oracle RAC One Node database configured on the cluster and you have a local Oracle home, then do the following to extend the Oracle database home to node3:

a. Navigate to the Oracle_home/addnode directory on node1and run the addnode.sh script as the user that installed Oracle RAC using the following syntax:

```
$ ./addnode.sh "CLUSTER_NEW_NODES={node3}"
```

b. Run the Oracle_home/root.sh script on node3 as root, where Oracle_home is the Oracle RAC home.

If you have a shared Oracle home that is shared using Oracle Automatic Storage Management Cluster File System (Oracle ACFS), then do the following to extend the Oracle database home to node3:

c. Run the Grid_home/root.sh script on node3 as root, where Grid_home is the Oracle Grid Infrastructure home.

Adding a Cluster Node on Linux and UNIX Systems

d. Run the following command as the user that installed Oracle RAC from the Oracle_home/oui/bin directory on the node you are adding to add the Oracle RAC database home:

```
$ ./runInstaller -attachHome ORACLE_HOME="ORACLE_HOME"
  "CLUSTER_NODES={node3}" LOCAL_NODE="node3"
  ORACLE_HOME_NAME="home_name" -cfs
```

e. Navigate to the Oracle_home/addnode directory on node1and run the addnode.sh script as the user that installed Oracle RAC using the following syntax:

```
$ ./addnode.sh -noCopy "CLUSTER_NEW_NODES={node3}"
```

N.B.:

Use the -noCopy option because the Oracle home on the destination node is already fully populated with software.

If you have a shared Oracle home on a shared file system that is not Oracle ACFS, then you must first create a mount point for the Oracle RAC database home on the target node, mount and attach the Oracle RAC database home, and update the Oracle Inventory, as follows:

f. Run the srvctl config database -db db_namecommand on an existing node in the cluster to obtain the mount point information.

Adding a Cluster Node on Linux and UNIX Systems

g. Run the following command as root on node3 to create the mount point:

mkdir -p mount_point_path

h. Mount the file system that hosts the Oracle RAC database home.

i. Run the following command as the user that installed Oracle RAC from the Oracle_home/oui/bin directory on the node you are adding to add the Oracle RAC database home:

$ ./runInstaller -attachHome ORACLE_HOME="ORACLE_HOME" "CLUSTER_NODES={local_node_name}" LOCAL_NODE="node_name" ORACLE_HOME_NAME="home_name" -cfs

j. Navigate to the Oracle_home/addnode directory on node1 and run the addnode.sh script as the user that installed Oracle RAC using the following syntax:

$ ./addnode.sh -noCopy "CLUSTER_NEW_NODES={node3}"

6. Run the Grid_home/root.sh script on the node3 as root and run the subsequent script, as instructed. Note below:

a. If you ran the root.sh script in the step 5, then you do not need to run it again.

b. If you have a policy-managed database, then you must ensure that the Oracle home is cloned to the new node before you run the root.sh script.

2. Start the Oracle ACFS on the new node by running the following from grid home"

srvctl start filesystem -device volume_device_name -node node3

3. Run the following CVU command as the user that installed Oracle Clusterware:

$ cluvfy stage -post nodeadd -n node3 [-verbose]

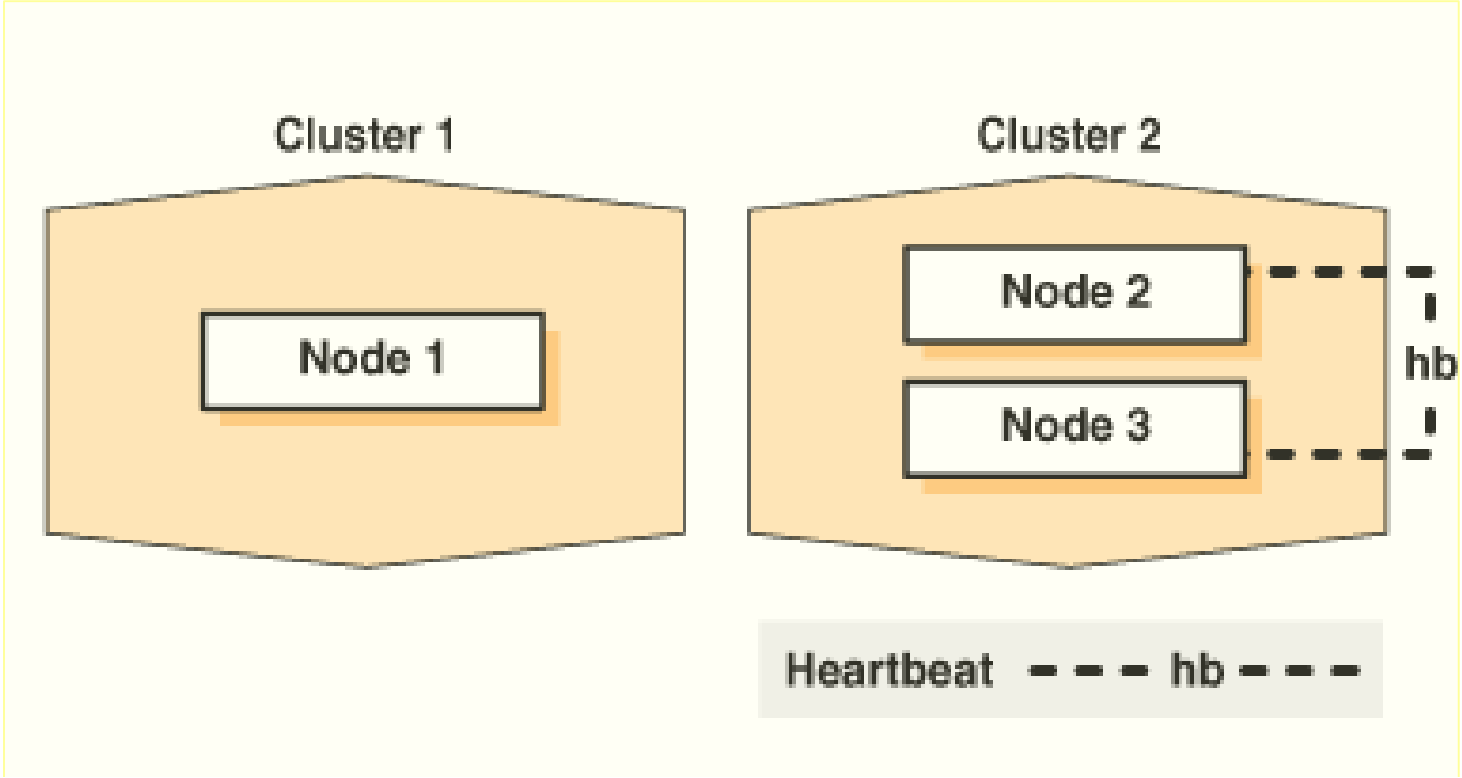
Cloning Oracle Clusterware

Cloning is the process of copying an existing Oracle Clusterware installation to a different location and then updating the copied installation to work in the new environment. Changes made by one-off patches applied on the source Oracle Grid Infrastructure home are also present after cloning. During cloning, you run a script that replays the actions that installed the Oracle Grid Infrastructure home.

Cloning requires that you start with a successfully installed Oracle Grid Infrastructure home. You use this home as the basis for implementing a script that extends the Oracle Grid Infrastructure home to create a cluster based on the original Grid home.

Manually creating the cloning script can be error prone.

Cloning Oracle Clusterware




```
$ perl clone.pl -silent ORACLE_BASE=/u01/app/oracle ORACLE_HOME=
/u01/app/12.1/grid ORACLE_HOME_NAME=OraHome1Grid
INVENTORY_LOCATION=/u01/app/oraInventory LOCAL_NODE=node1 CRS=TRUE
```

Oracle12c Clusterware Options

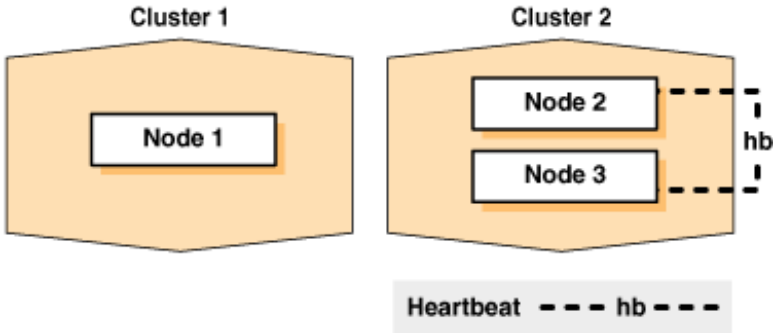
- ASM
- Flex ASM

- Voting File Options
- Quorum Disk Options
- OCR Location Options
  - ASM Location
  - Non-ASM Location

- DATABASE OPTIONS
- RAC
- RAC One Node
- Standalone database

Oracle12c Clusterware Advanced Customization

- Installing the Clusterware in a Virtual Environment
- Cloning the Clusterware
- Adding a node

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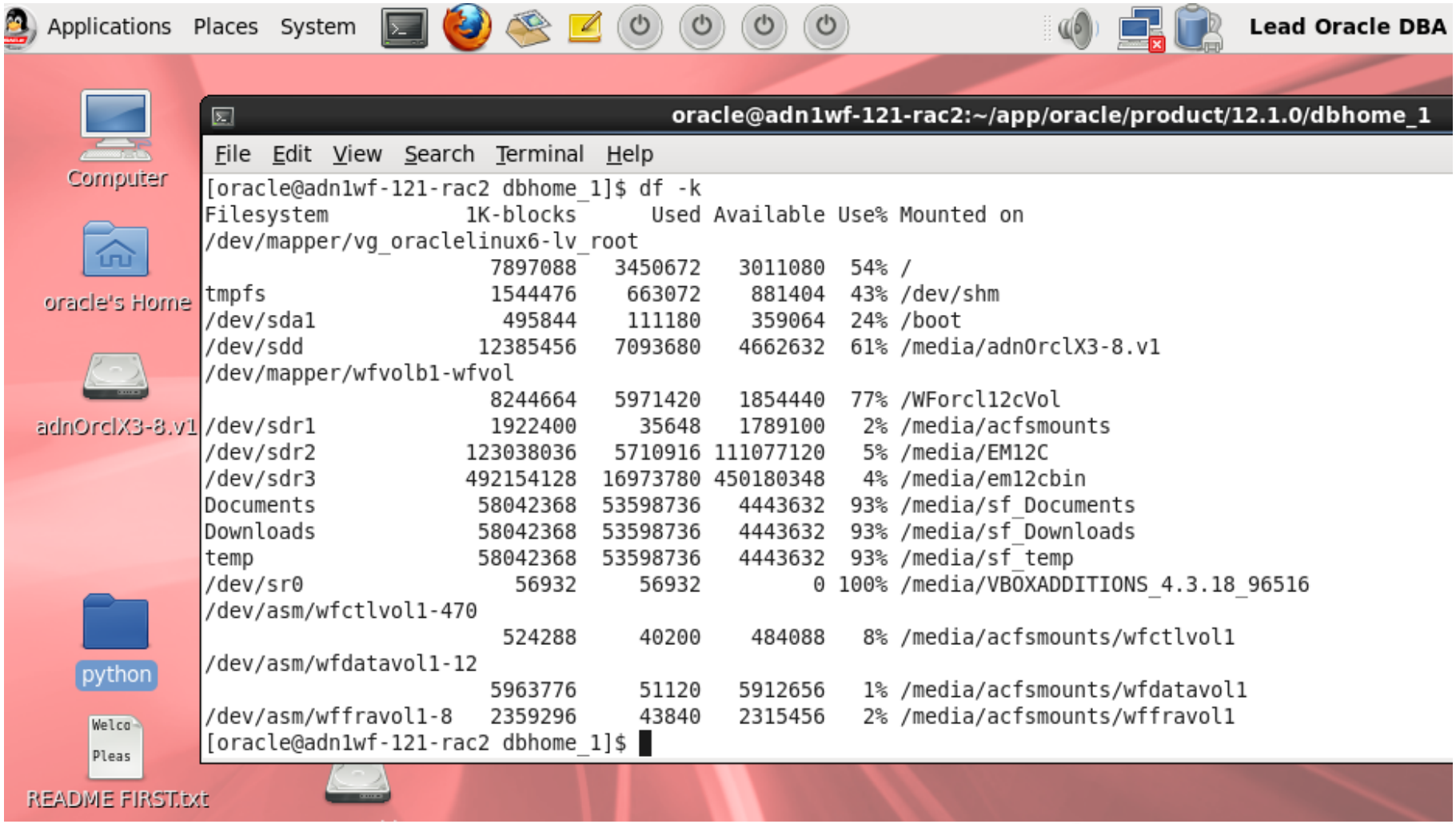
/u01/app/12.1/grid ORACLE_HOME_NAME=OraHome1Grid
INVENTORY_LOCATION=/u01/app/oraInventory LOCAL_NODE=node1 CRS=TRUE
```

Oracle12c Clusterware Advanced Customization

- Capacity Planning
- Policy Management
- Policy Set
- Server Pool
- Enterprise Manager Features
- Agent Features
- Resource Utilization
- Enhanced Deployment

Oracle12c Clusterware Storage Management



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Administering and Maintaining Oracle12c Clusterware

Customizing Clusterware Services

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The Grid is the cloud. The cloud is the grid...

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Clusterware Networking

Von Neumann Architecture

- Standard Usage of Computing Resources
  - By the box computing
  - Limited Usage of Pool Resources.

Cloud Computing Architecture

- Enhanced and Consolidated Cloud Computed Architecture
  - Aggregation of Von Neumann Architecture Resources
  - Pooling of Resources for Optimization, Load Balancing and Scalability

Clusterware Networking

Virtual Boxes/Containers

- Virtually unlimited Number of In-the-Box Containers.
- Extended Support for Flex ASM Clusters Support
- Resource Pool Optimization.
- Flexible and Fast Provisioning of Resources.

Software-Defined Networks

- In-the-Box Virtual Networking
- On-Demand Sharing and Pooling of Network Resources
- Reduced Network Computing Propagation Delay
- Reduced Cost of Operations (CAPEX and OPEX)
- Best Return on Investment (ROI)
- Reduced Total Cost of Ownership (CTO).

Manageability: Oracle Clusterware CLI vs. GUI Tools

CLI Tools and Utilities

- CRSCTL
- SRVCTL
- ORCCHECK
- ORCDUMP
- ASMCMD
- Cluster Verification Utility (CLUVFY)

GUI Tools

- Enterprise Manager Cloud Control (EMCC Release 5)
- ASMCA
- Cluster Health Monitor (CHM)
- Oracle Cluster Registry Configuration Tool (OCRCONFIG)

Clusterware Functionality and Usability

Functionality

- Application Ready Stack Layer (CRS)
- Infrastructure Ready Stack Layer (CSS)
- IAM (Identity and Management)
- Built-in Encryption and Domain-Driven Data Privacy Environment

Usability and Manageability

- ITIL Tools
- Role-Managed Paradigm
  - Vertical Role Segmentation (Between Layers)
  - Horizontal Role Segmentation (Within Layer)

Working with Oracle Databases

Database Support

- Supports current and earlier database releases.
- Refer to Oracle Support for specific database support.

Database Upgrade or Migration

- Grid Infrastructure environment provides support for standard upgrades or migrations and rolling updates.
- Comprehensive support for Patching and Software Maintainability.

Working with Oracle Middleware

Support for Oracle Fusion Middleware

- Oracle Clusterware supports Fusion Middleware in Virtual Environment as in Physical Environments.
- WebLogic-based Middleware support.

Support for Other Middleware

- Supports for third-party certified middleware as in physical platforms.

Working with Oracle Applications

Supports for Oracle Applications

- Most Oracle Applications are certified for Oracle Clusterware.
- Support for PeopleSoft, JD Edwards, and Oracle EBS.
- Support for Oracle Fusion Applications.

Support for Other Applications

- Support for other vendor certified applications.
- Support for user-defined legacy application implementation.
- API Capable for rapid provisioning.

Oracle12c Clusterware Security Framework

- Oracle Advanced Security
  - Oracle Encryption
  - Virtual Private Database
  - Oracle Label
  - Oracle Database Volt
  - Oracle Redaction
  - Oracle Network Advanced Security with Protocol and Algorithmic Support
    - IPSec
    - 3DES
    - PKI
    - Kerberos
    - SHA1

Oracle12c Clusterware Security Framework

Public Clouds

- Support for Out-of-the Box Web Services.
- Support for Out-of-the Box IAM.
- Out-of-the Box Global Web Authoring.

Private Clouds

- Support for In-the-Box IAM Clusterware, Database, and Application Authentication.
- Oracle Advanced Security Framework.

Applying Oracle12c Virtual Clusterware

Simulation and RAT

- Enhanced Environment for Real Application Testing and True Simulation.
- Scaled Load Testing and Simulation
- Support for Oracle Data Masking.
- Enhnaced IAM Support for RAT.

QA and QoS Benmark

- Scalability for Capacity Planning
- Scalability for Storage, Network QoS
- Scalability for Predictive Network Throughput and Latency Prevention.
- Predictive Analytics for QA and QoS.
- ITIL Comprehensive and Scalable Support.

Envisioning the Cloud Box

In-the-Box Computing and Networking

- Virtual Box
- Containers
- SDF Networks with Support for:
  - TCP/IP Support
  - UDP Support
  - IIOP
  - HTTP
  - FTP Suport

Out-of-the-Box Computing and Networking

- Web Services
- Cloud Box Firewall
- Managed Security:
  - Privileges-based
  - Credential-Based
  - VPD Based
  - Label-based
  - Volt
  - Redaction-based
- Custom Network Protocol Support

Envisioning the Cloud Box

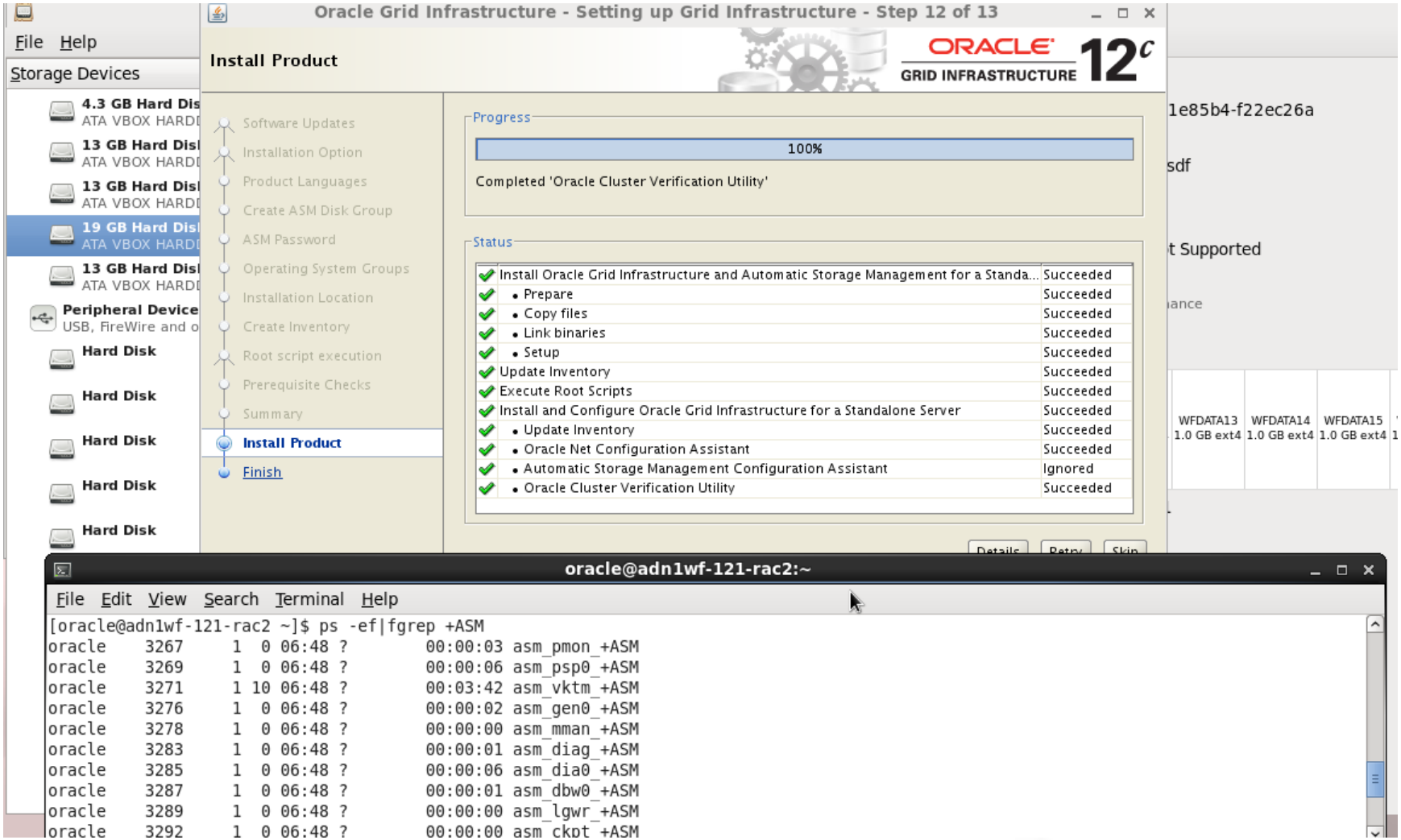
In-the-Box Computing

- IAM
  - Login
  - SSO
  - OS Credentials
  - Database Credentials
    - VPD
    - Label
    - Redaction
  - LDAP

Out-of-the-Box Computing

- Application connectivity
- Middleware Business Tier Interaction
- IAM Authentication
  - Global Privileges
  - Global Credentials
  - PKI Infrastructure

Working with the Oracle12c Clusterware



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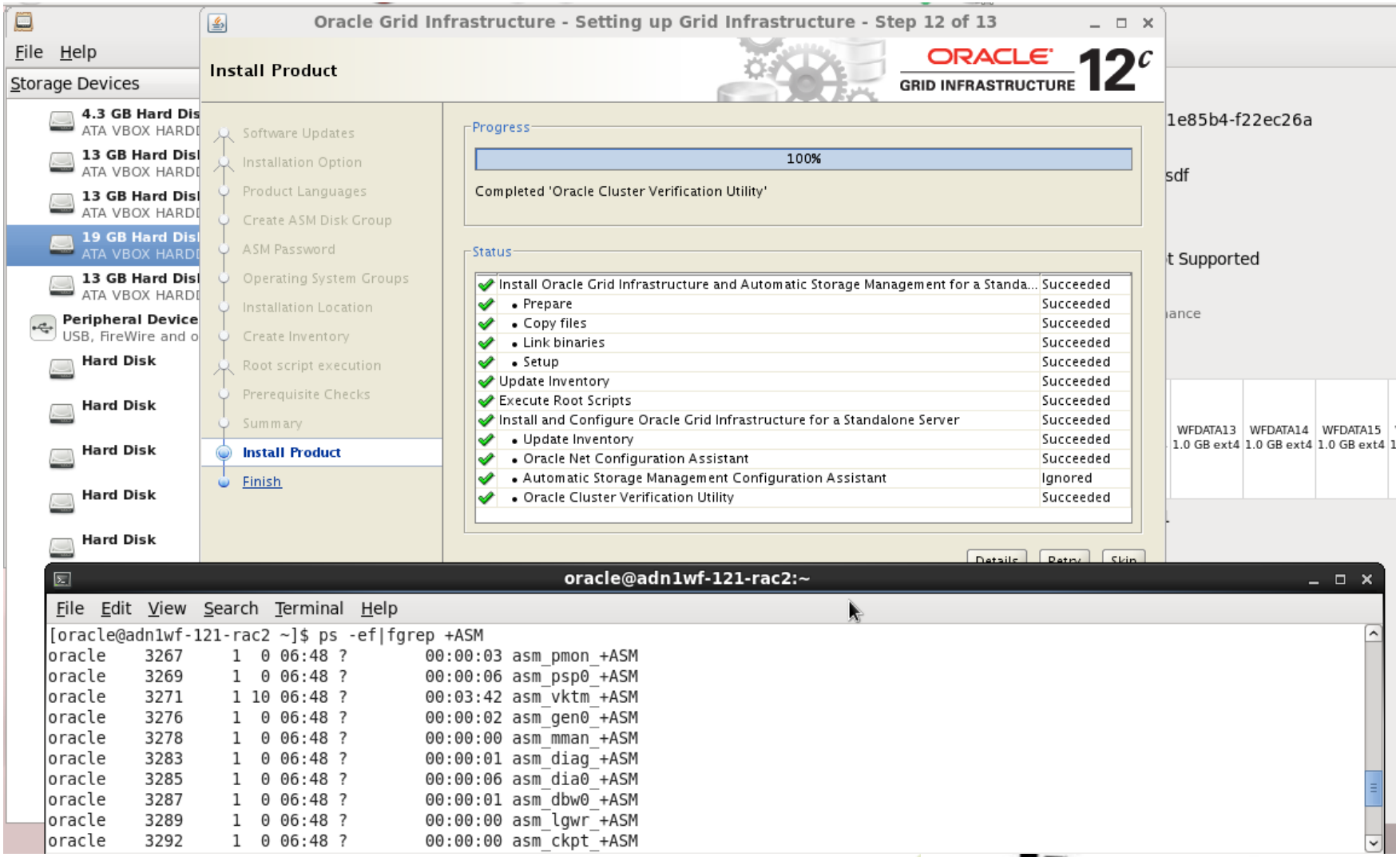
Working with the Oracle12c Clusterware



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New and Deprecated Features

The Grid is the cloud. The cloud is the grid...

New Features in Oracle12c Clusterware

- Oracle Clusterware support for the Diagnosability Framework
- Oracle Trace File Analyzer Collector
- Cluster Health Monitor Enhancements for Oracle Flex Clusters
- IPv6 Support for Public Networks
- Shared Grid Naming Service
- Oracle Grid Infrastructure User Support on Windows

New Features in Oracle12c Clusterware

- Oracle Grid Infrastructure Rolling Migration for One-Off Patches
- Policy-Based Cluster Management and Administration
- Restricting Service Registration with Valid Node Checking
- What-If Command Evaluation
- Online Resource Attribute Modification
- Oracle Cluster Registry Backup in Oracle ASM Disk Group Support

Deprecated Features in Oracle12c Clusterware

- Deprecation of single-letter SRVCTL CLI options
- Deprecation of Oracle Restart
- Management of Cluster Administrators using a stored list of administrative users
- Oracle Cluster File System on Windows
- Oracle Enterprise Manager Database Control → EMDBX
- Raw (block) storage devices for Oracle Database and related technologies

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Envisioning the Cloud Box

Cloud Box Specifications

Atomicity

- Amplified Von Neumann Architecture
- Unified Usability and Functionality with Tiered-Access
- Single Instantiation with Tiered-Access
  - IAM-Based Visualization and Accessibility
  - In-the-Box and Out-of-the Box Specs
  - No unauthorized out-of-the-box instantiation
  - Unified Cluster-aware Grid Computing Entity

Pooled Grid Computing Resources, including Clusters Entities, and Storage and Network Components

Diagnosability through the entire Cloud Box via Clusterware Resources.

Envisioning the Cloud Box

Privacy and Independent

- Private Cloud Environment
- Restricted Access from Outside the Private Cloud Box
  Cloud Contains: Computing, Storage, and Network Resources as a Consolidated Networked Grid Computing Unit.

Platform Issues

- Can be OS Platform Agnostic
- Can Support Heterogeneous OS Clusterware Abiding by the Same Policies or Policy Sets.

Boundedness, Closure, and Completeness

- The Cloud Box is fully bounded via a Secured Private Cloud Approach
- Operations, Functions, Protocols, Database Listening, and other Resource Operability, and Manageability within the Box is subject to boundedness, closure, and completeness for cluster balance optimization.

Envisioning the Cloud Box

Computability and Complexity

- Algorithmic Complexity in Executed Code within Clusterware complies with Classic Computability and Complexity Theories, such as, for instance, NP-Complete.
- The Clusterware and the Nodes Involved will work in collaboration via Managers and Agents among the box's Clusters' in order to optimize resource utilization, attain high-availability, and reliability.
- The Clusters in the Cloud Box will seek collaboration via speculative computing approaches via Software-Defined-Networks, Containers, Snapshots, Virtual Machines, and other Virtual Resources, in contrast with traditional cabled computing and networking.

Cloud Box Topology and Networking

- Based on ASM Flex Clusters
- Based on Regular ASM Clusters

Current and Future Oracle Clusterware Virtualization

By the Node Perspective

- Bounded by Virtual Box Perspective
- Limited Cluster Visualization

Unified Cloud Box Perspective

- Unified Administrators' View

DEMONSTRATION

Fundamental Clusterware Drills:

Installation and Configuraiton Summary

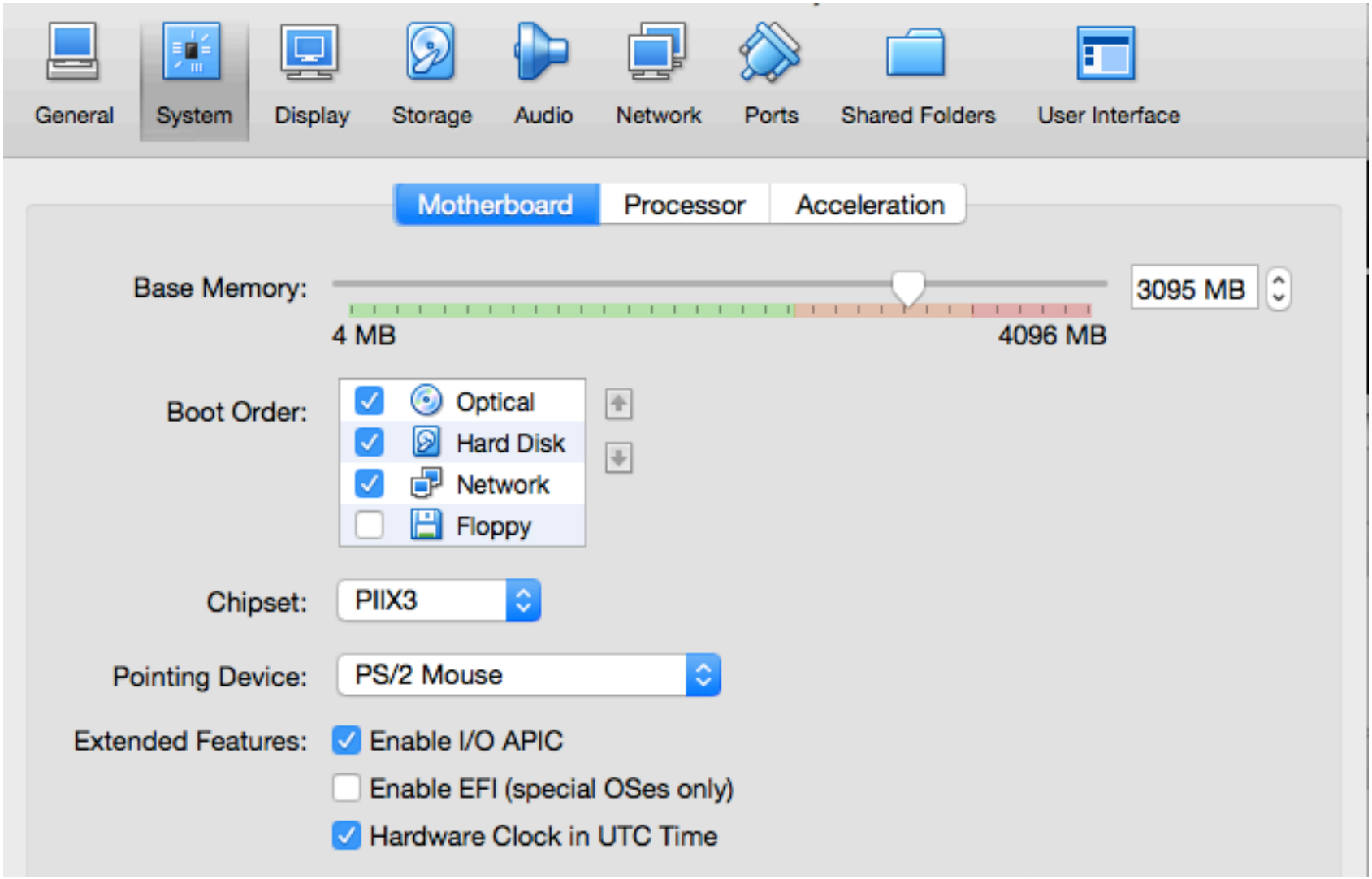
Storage Management

Basic Command and Tool Summary

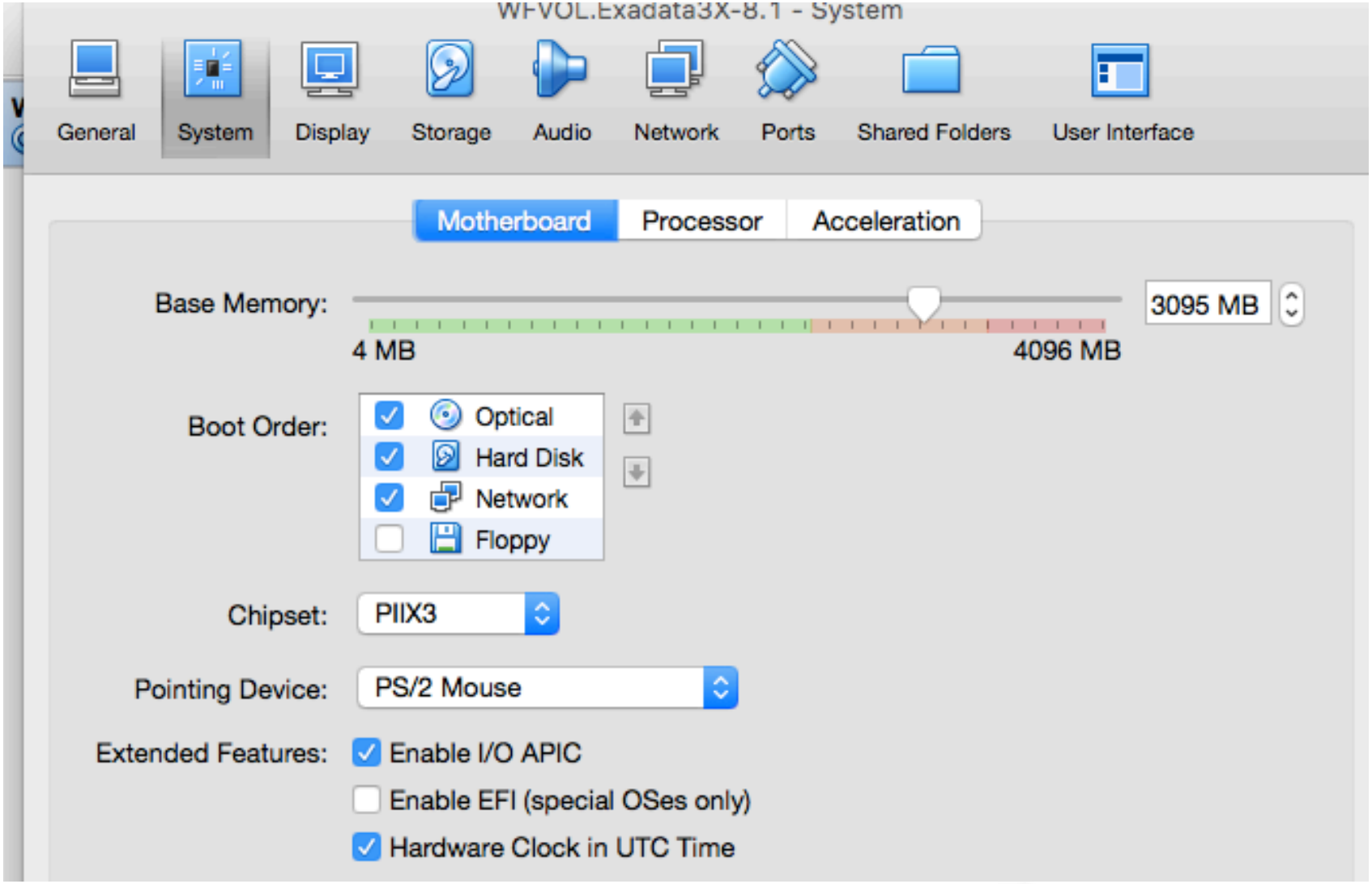
CLI and Tool Drills

ASM Storage Management Drills

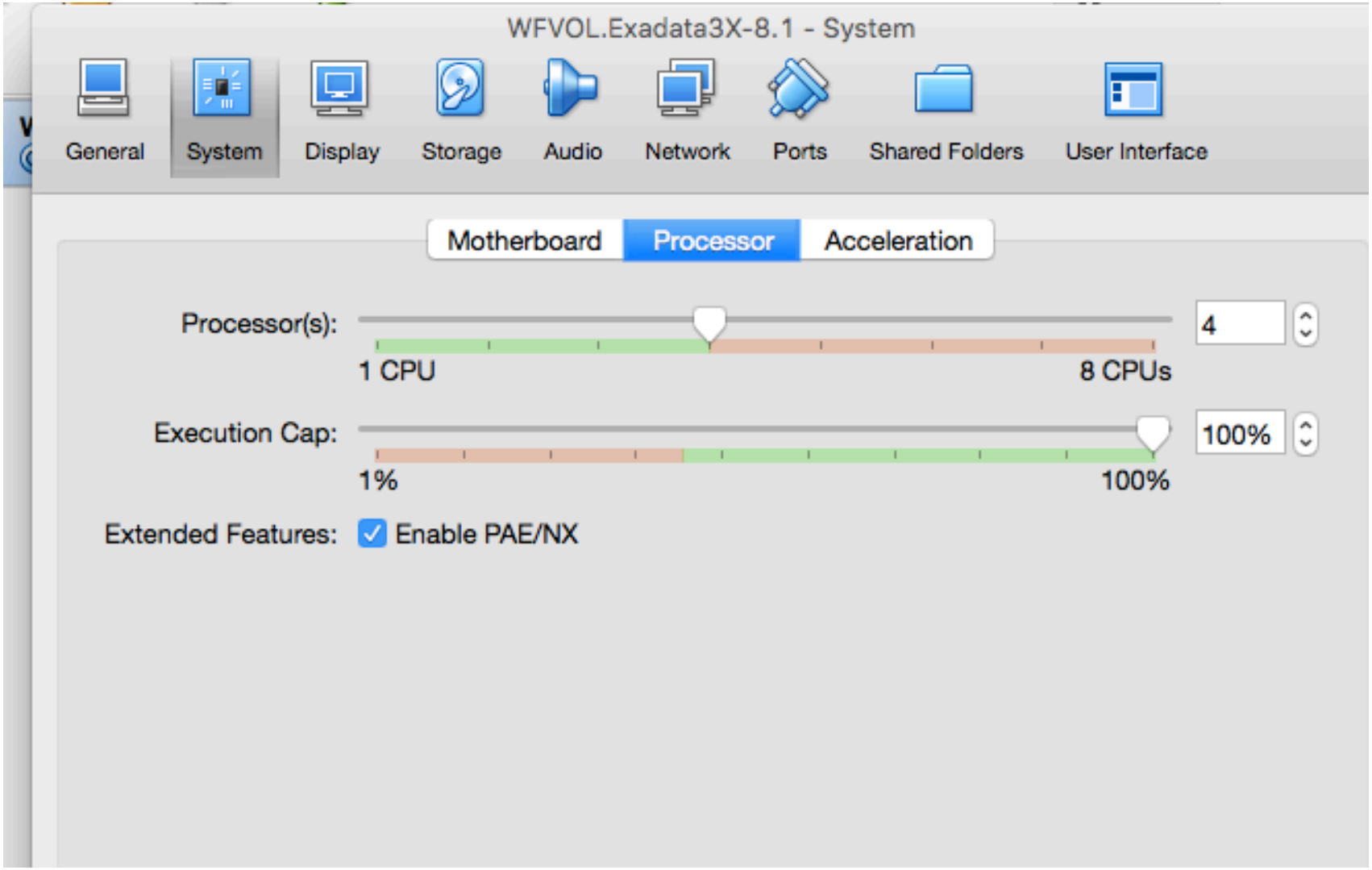
Oracle Virtual Box Configuration



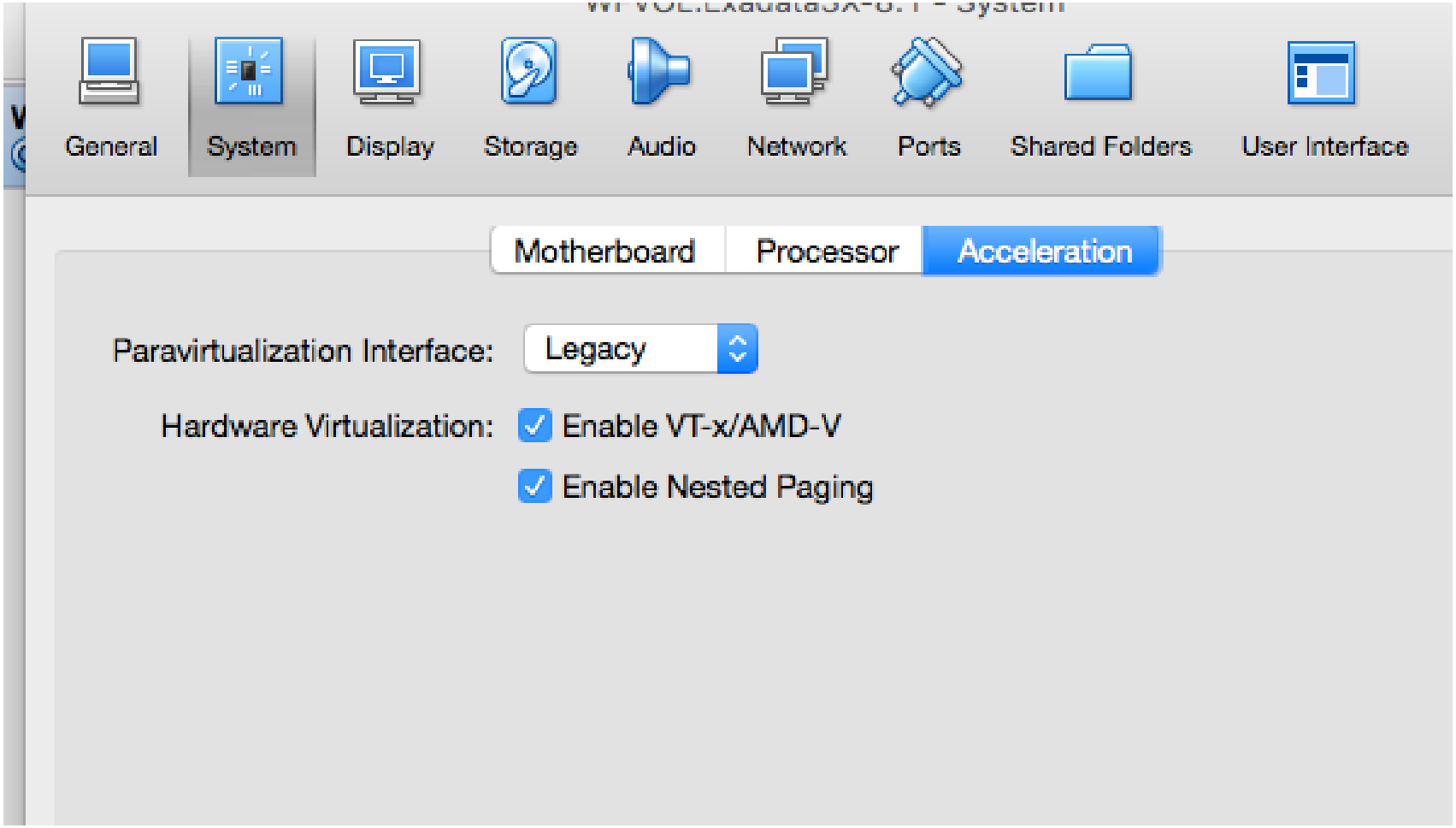
Oracle Virtual Box Configuration



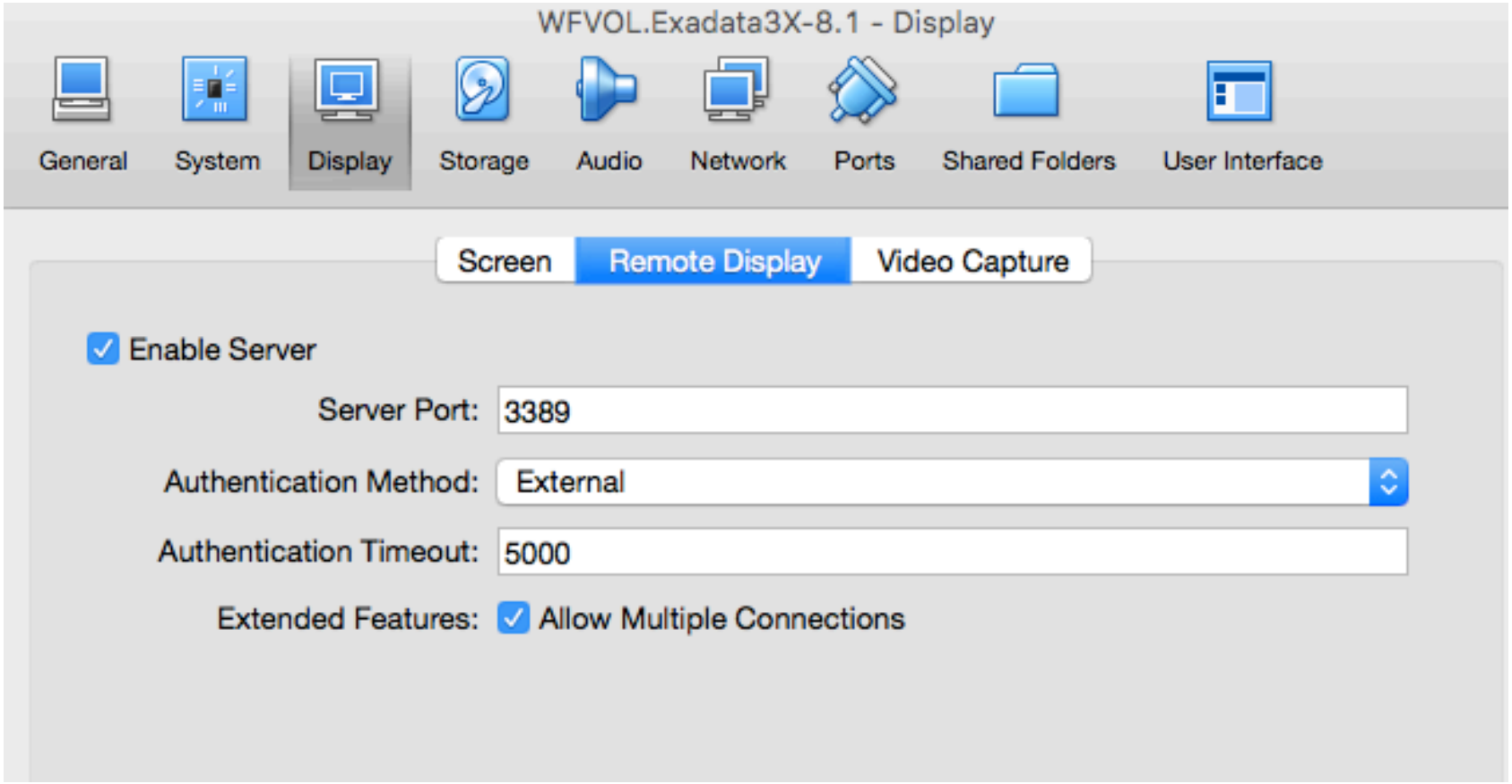
Oracle Virtual Box Configuration



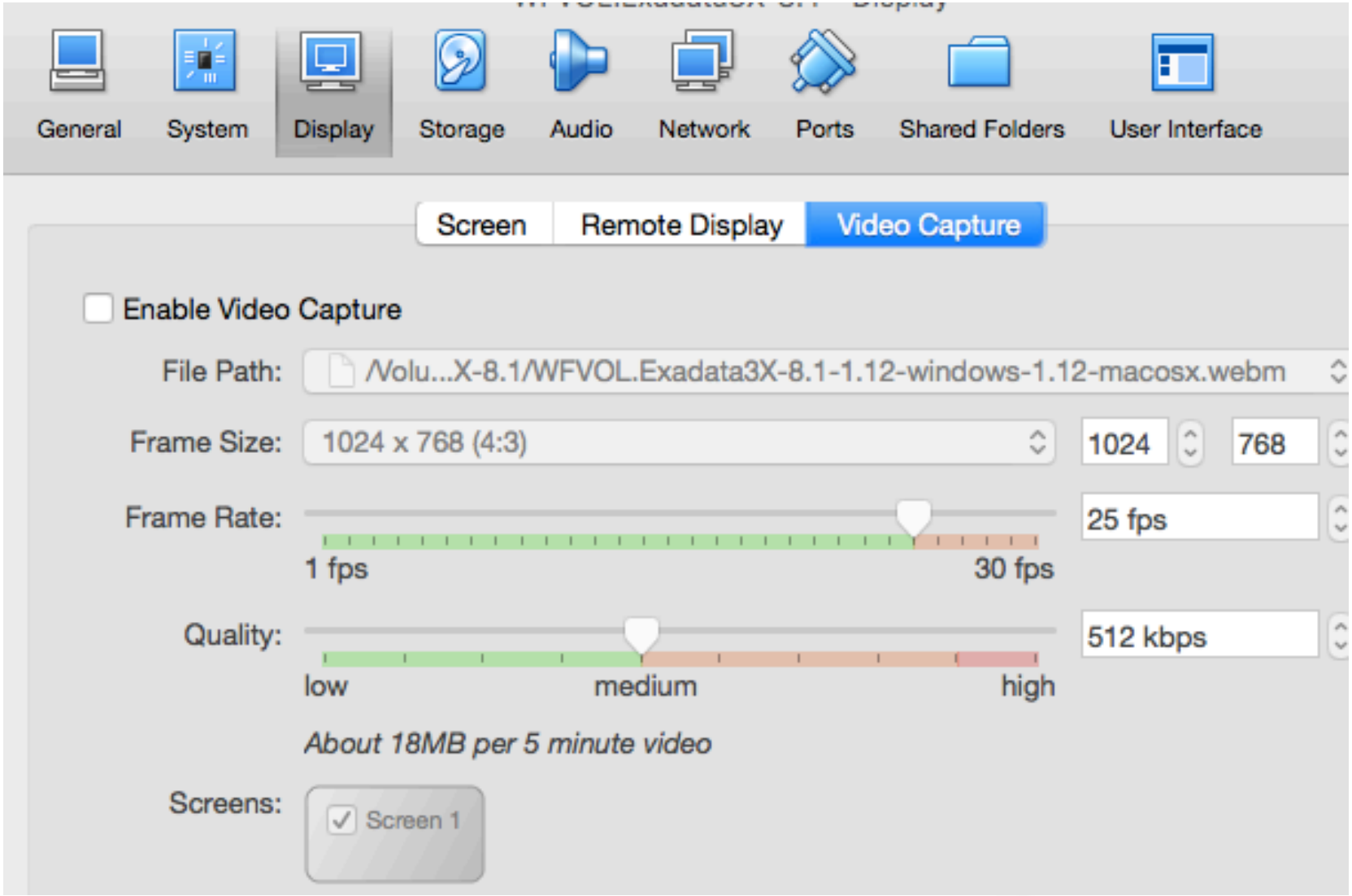
Oracle Virtual Box Configuration



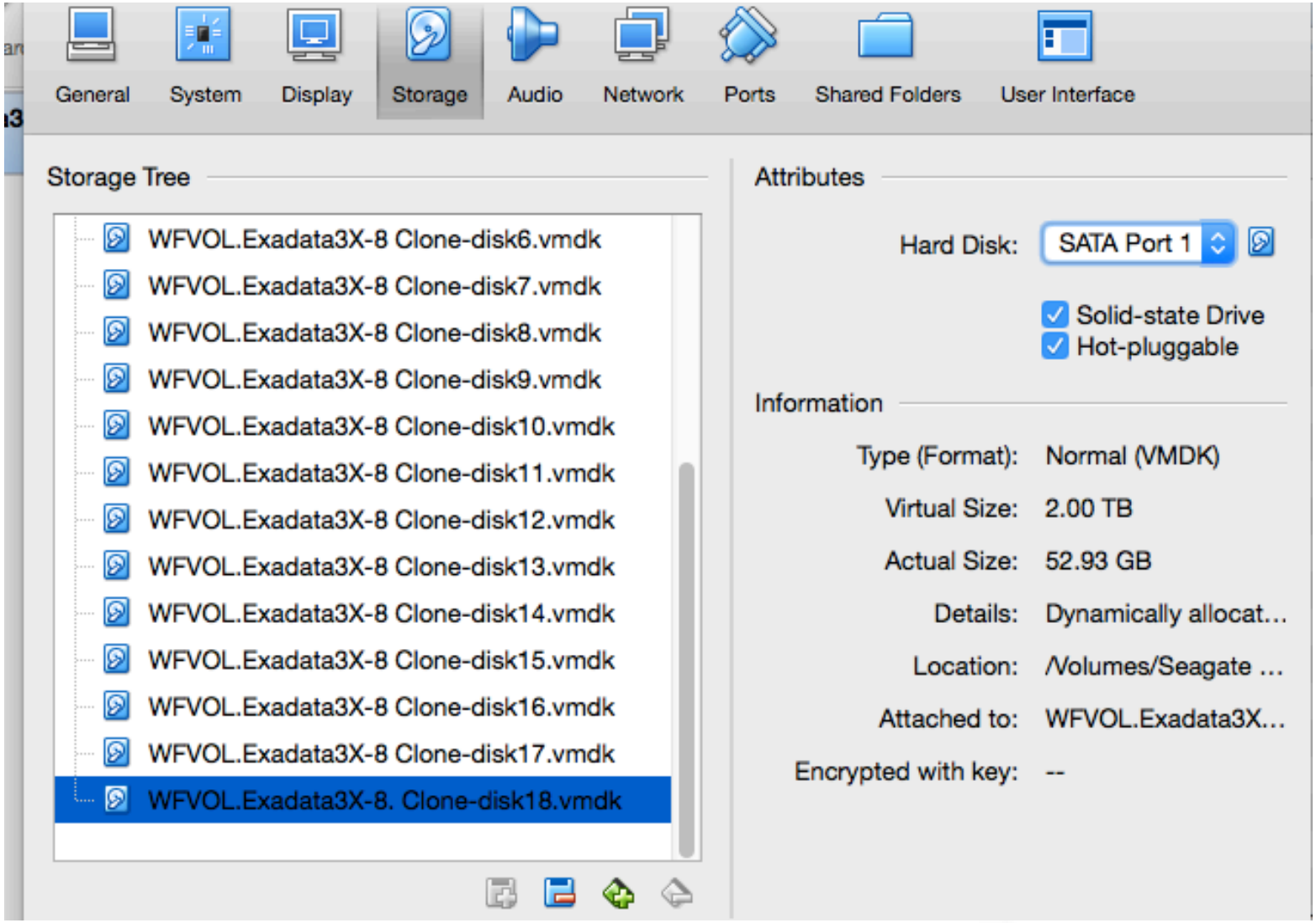
Oracle Virtual Box Configuration



Oracle Virtual Box Configuration



Oracle Virtual Box Configuration



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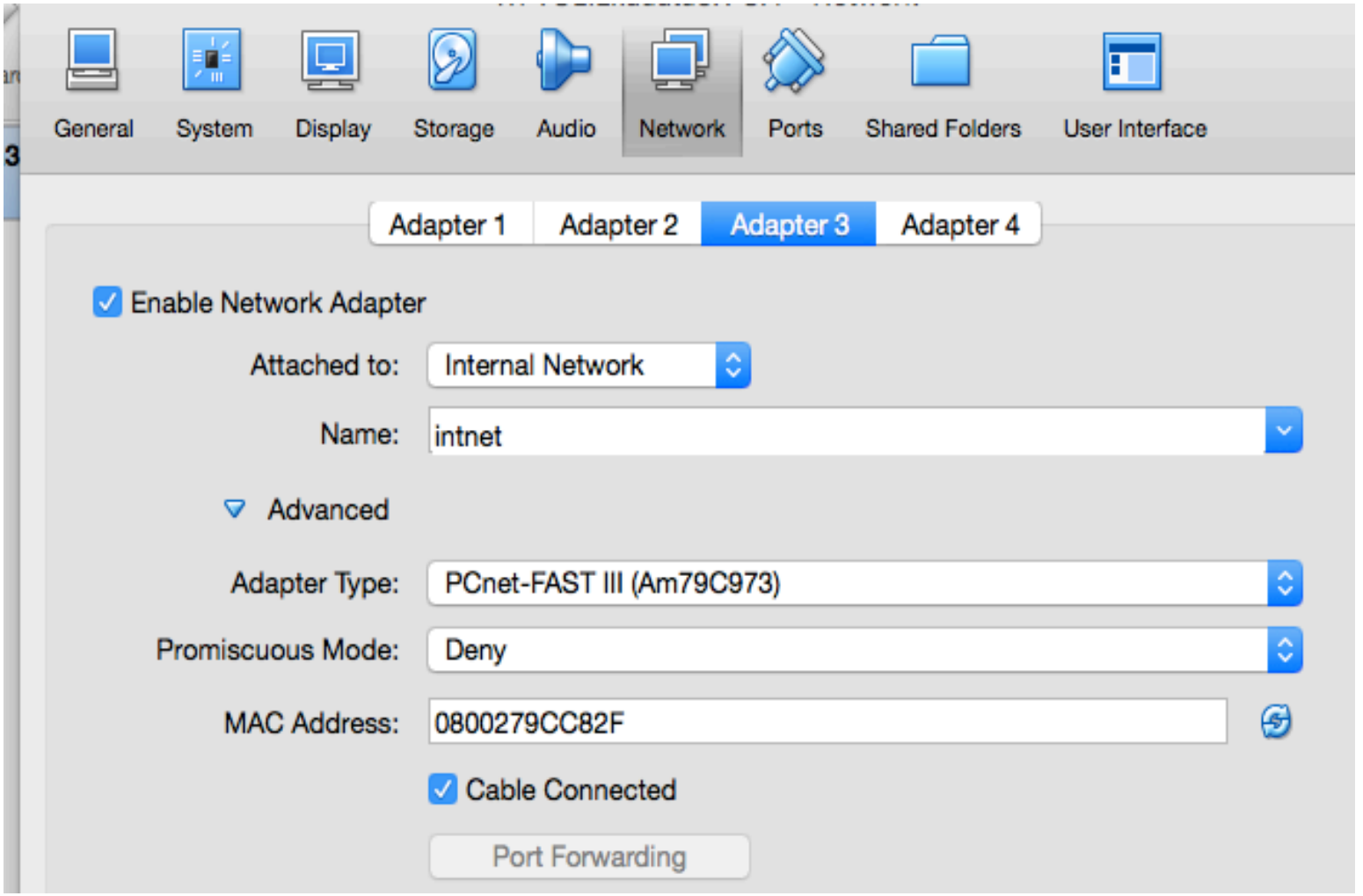
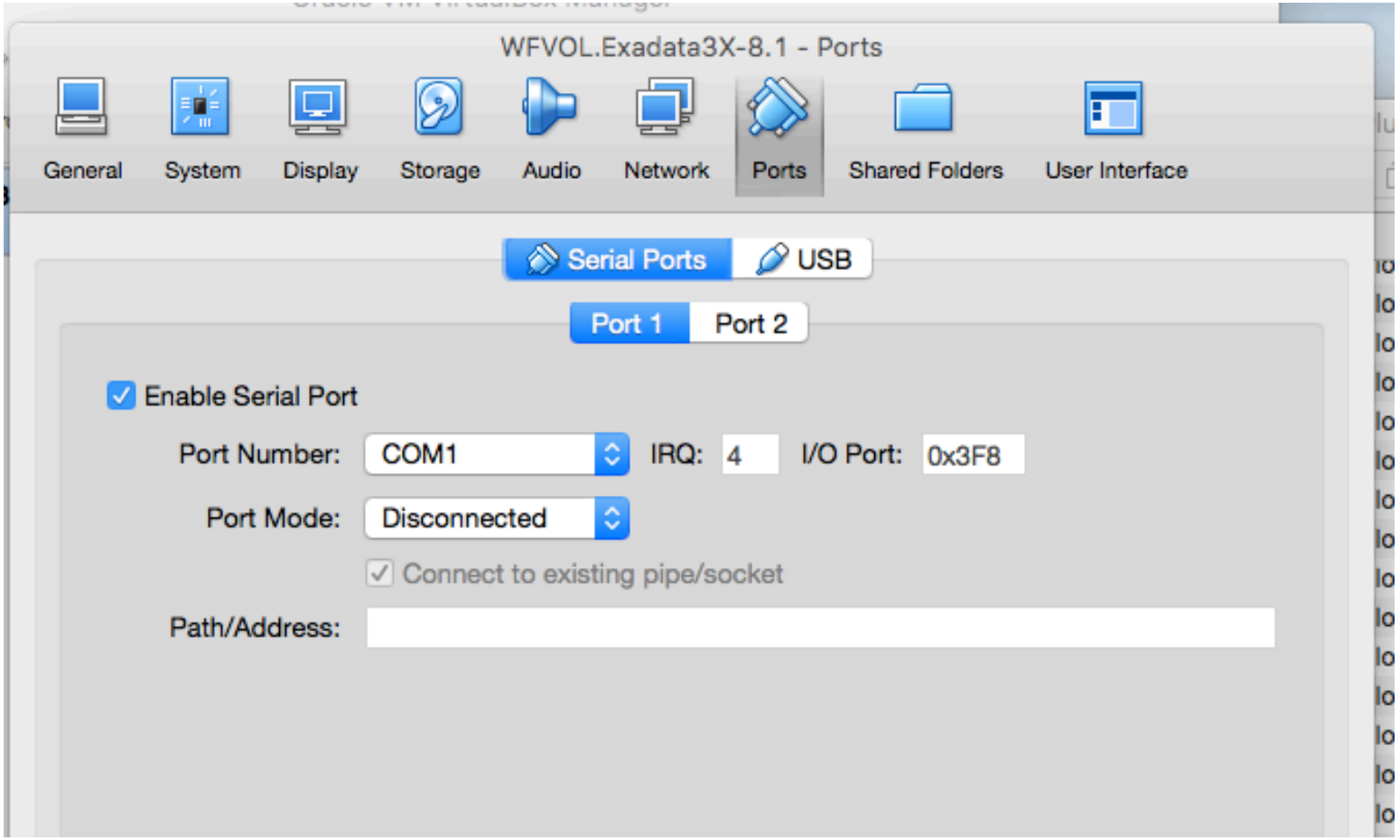
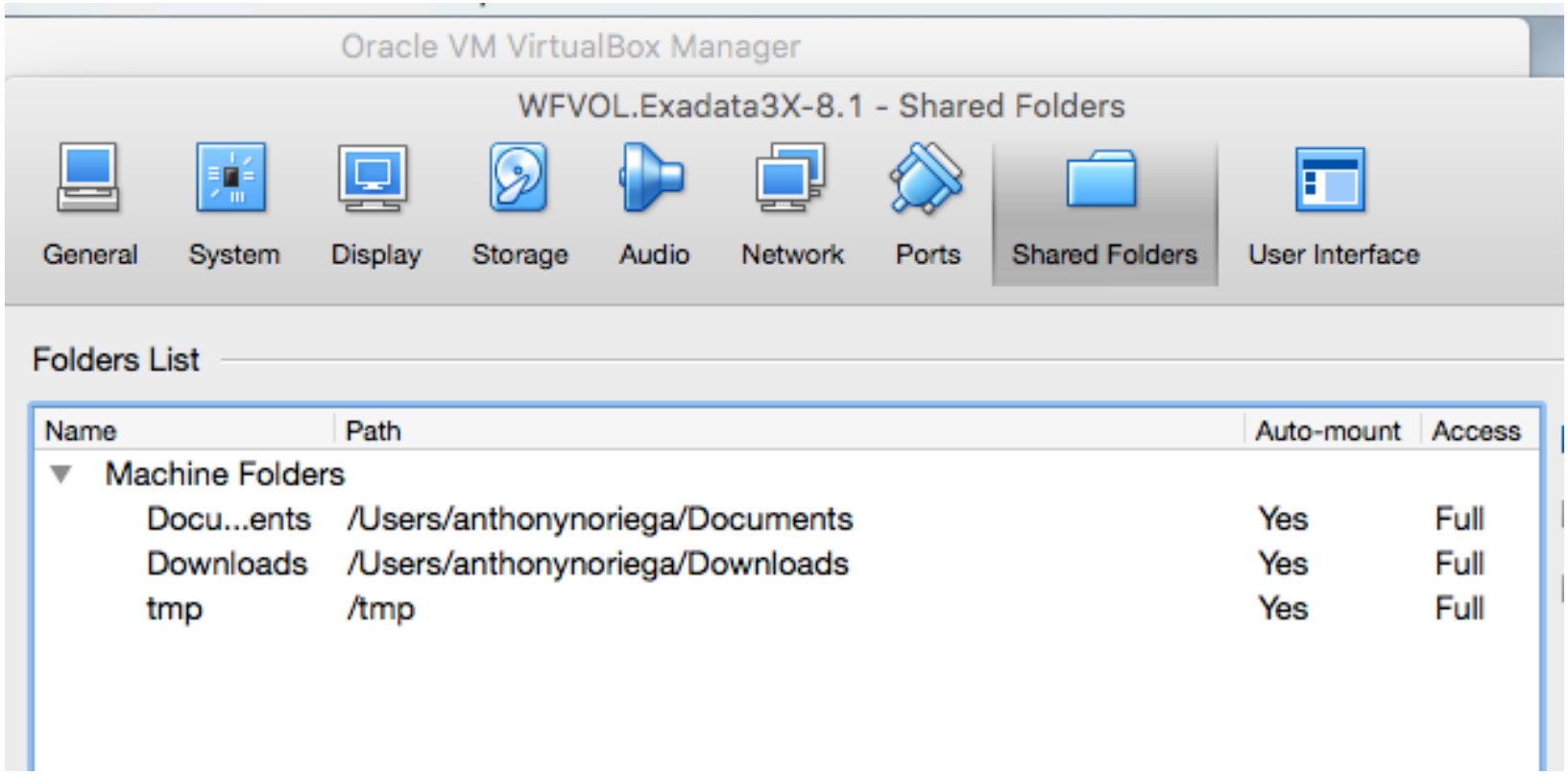
Oracle Virtual Box Configuration



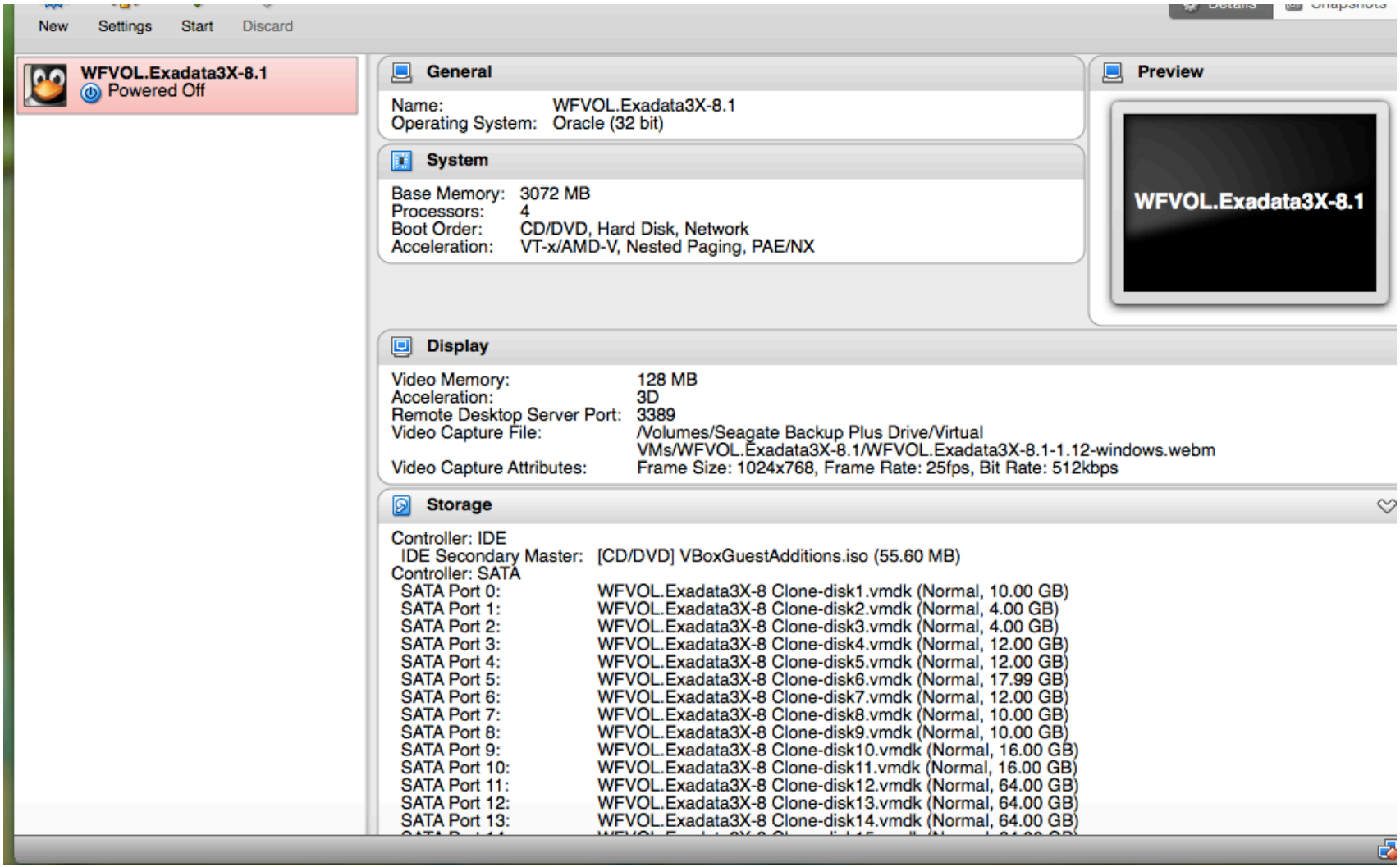
Oracle Virtual Box Configuration



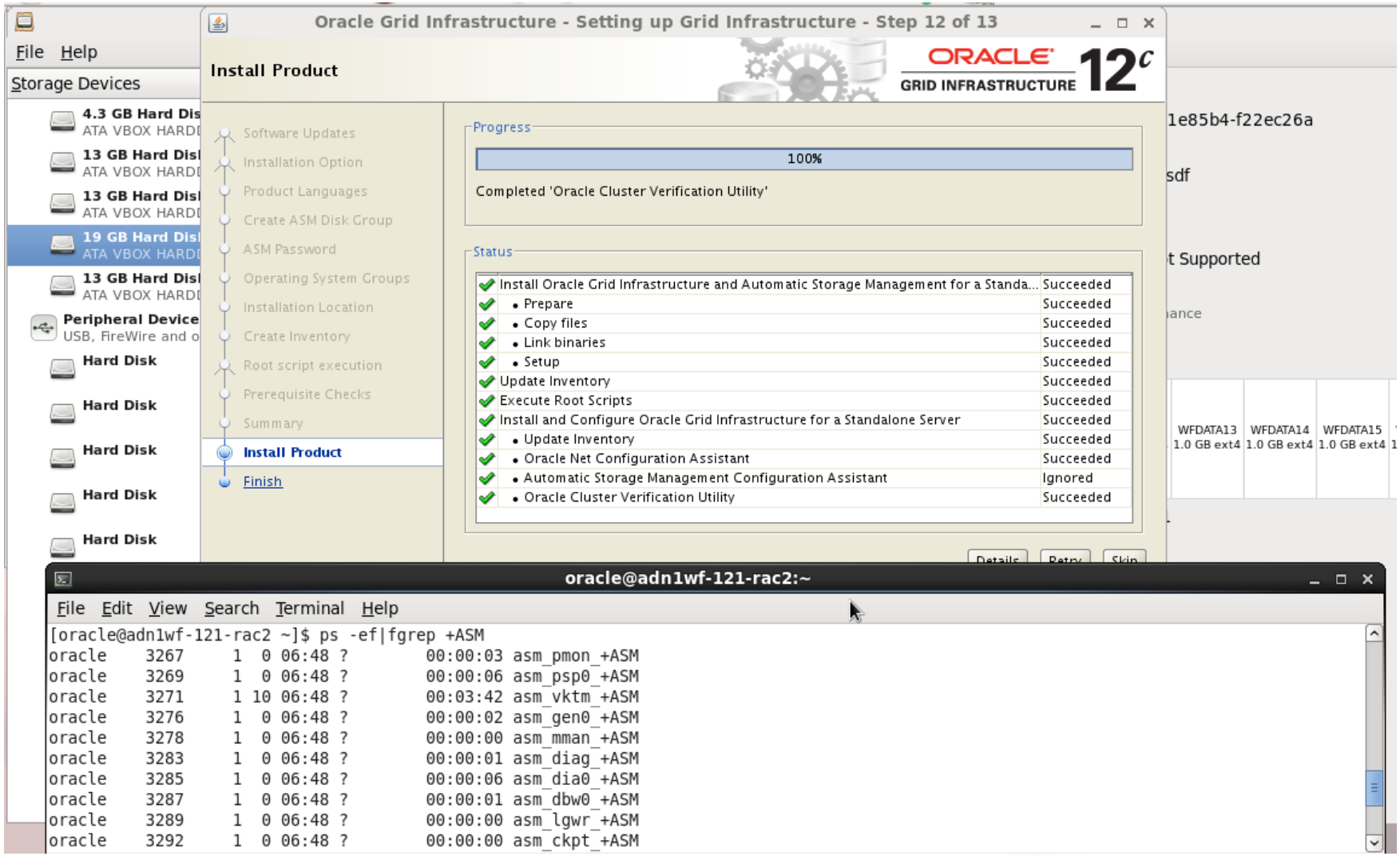
Oracle Virtual Box Configuration



Oracle Virtual Box Configuration



Working with the Oracle12c Clusterware



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Oracle Clusterware VM [Re]Start

```
microcode: CPU2 sig=0x306a9, pf=0x2, revision=0x19
microcode: CPU3 sig=0x306a9, pf=0x2, revision=0x19
microcode: Microcode Update Driver: v2.00 <tigran@aivazian.fsnet.co.uk>, Peter O
ruba
sr 1:0:0:0: Attached scsi generic sg0 type 5
sd 2:0:0:0: Attached scsi generic sg1 type 0
sd 3:0:0:0: Attached scsi generic sg2 type 0
sd 4:0:0:0: Attached scsi generic sg3 type 0
sd 5:0:0:0: Attached scsi generic sg4 type 0
sd 6:0:0:0: Attached scsi generic sg5 type 0
sd 7:0:0:0: Attached scsi generic sg6 type 0
sd 8:0:0:0: Attached scsi generic sg7 type 0
sd 9:0:0:0: Attached scsi generic sg8 type 0
sd 10:0:0:0: Attached scsi generic sg9 type 0
sd 11:0:0:0: Attached scsi generic sg10 type 0
sd 12:0:0:0: Attached scsi generic sg11 type 0
sd 13:0:0:0: Attached scsi generic sg12 type 0
sd 14:0:0:0: Attached scsi generic sg13 type 0
sd 15:0:0:0: Attached scsi generic sg14 type 0
sd 16:0:0:0: Attached scsi generic sg15 type 0
sd 17:0:0:0: Attached scsi generic sg16 type 0
sd 18:0:0:0: Attached scsi generic sg17 type 0
sd 19:0:0:0: Attached scsi generic sg18 type 0
device fsid 89810a0a-7ed4-4756-a1df-c159ddd14dcd devid 1 transid 28680 /dev/dm-1
_
```

Oracle Clusterware VM [Re]Start

```
sd 18:0:0:0: Attached scsi generic sg17 type 0
sd 19:0:0:0: Attached scsi generic sg18 type 0
device fsid 89810a0a-7ed4-4756-a1df-c159ddd14dcd devid 1 transid 28680 /dev/dm-1
                                                           [  OK  ]
Setting hostname adn1wf-121-rac2.localdomain:              [  OK  ]
Setting up Logical Volume Management:   1 logical volume(s) in volume group "wfv
olb1" now active
  2 logical volume(s) in volume group "vg_oraclelinux6" now active
                                                           [  OK  ]
Checking filesystems
acfsmounts: clean, 14/122160 files, 16589/488277 blocks
/dev/sda1: clean, 82/128016 files, 127336/512000 blocks
adnOrclX3-8.v1: recovering journal
adnOrclX3-8.v1: clean, 177233/786432 files, 1903821/3145728 blocks (check in 5 m
ounts)
                                                           [  OK  ]
Remounting root filesystem in read-write mode:             [  OK  ]
Mounting local filesystems:  EXT4-fs (sda1): mounted filesystem with ordered dat
a mode. Opts: (null)
EXT4-fs (sdd): mounted filesystem with ordered data mode. Opts: (null)
EXT4-fs (dm-0): warning: maximal mount count reached, running e2fsck is recommen
ded
EXT4-fs (dm-0): mounted filesystem with ordered data mode. Opts: (null)
EXT4-fs (sdr1): mounted filesystem with ordered data mode. Opts: (null)
_
```

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Oracle Clusterware VM [Re]Start

```
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
  2 logical volume(s) in volume group "vg_oraclelinux6" monitored
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
                                                           [  OK  ]
Starting monitoring for VG wfvolb1:   WARNING: lvmetad is running but disabled.
Restart lvmetad before enabling it!
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
  1 logical volume(s) in volume group "wfvolb1" monitored
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
                                                           [  OK  ]
Starting cgconfig service:                                 [  OK  ]
ip6tables: Applying firewall rules: NET: Registered protocol family 10
ip6_tables: (C) 2000-2006 Netfilter Core Team
nf_conntrack version 0.5.0 (16384 buckets, 65536 max)
                                                           [  OK  ]
Running  start: No pending transaction to rollback

Bringing up loopback interface:                            [  OK  ]
Bringing up interface Auto_eth2:
Determining IP information for eth8...ADDRCONF(NETDEV_UP): eth8: link is not rea
dy
e1000: eth8: e1000_watchdog_task: NIC Link is Up 1000 Mbps Full Duplex, Flow Con
trol: None
ADDRCONF(NETDEV_CHANGE): eth8: link becomes ready
_
```

Oracle Clusterware VM [Re]Start

```
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
  2 logical volume(s) in volume group "vg_oraclelinux6" monitored
  WARNING: lvmetad is running but disabled. Restart lvmetad before enabling it!
                                                           [  OK  ]
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                                                           [  OK  ]
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                                                           [  OK  ]
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trol: None
ADDRCONF(NETDEV_CHANGE): eth8: link becomes ready
_
```

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Oracle Clusterware VM [Re]Start

```
/etc/ktune.d/tunedadm.conf:                                [  OK  ]
Applying sysctl settings from /etc/sysctl.conf
Starting Winbind services:                                 [  OK  ]
Loading autofs4:                                           [  OK  ]
Starting automount:                                        [  OK  ]
Initializing the Oracle ASMLib driver:                     [  OK  ]
Scanning the system for Oracle ASMLib disks:  sdp: sdp1 sdp2 sdp3 sdp4
 sdm: sdm1 sdm2 sdm3 sdm4 sdm5
 sdj: sdj1 sdj2 sdj3 sdj4 sdj5 sdj6 sdj7 sdj8 sdj9 sdj10 sdj11 sdj12 sdj13 sdj14
 sdj15 sdj16
 sdn: sdn1 sdn2 sdn3 sdn4 sdn5
 sdl: sdl1 sdl2 sdl3 sdl4 sdl5
 sdi: sdi1 sdi2 sdi3 sdi4 sdi5 sdi6 sdi7 sdi8 sdi9 sdi10 sdi11 sdi12 sdi13 sdi14
 sdi15 sdi16 sdi17 sdi18 sdi19 sdi20
 sdg: sdg1 sdg2 sdg3
 sdh: sdh1 sdh2 sdh3 sdh4 sdh5 sdh6 sdh7 sdh8 sdh9 sdh10 sdh11 sdh12 sdh13 sdh14
 sdh15 sdh16 sdh17 sdh18 sdh19 sdh20 sdh21
 sde: sde1 sde2 sde3 sde4
 sdk: sdk1 sdk2 sdk3 sdk4 sdk5 sdk6 sdk7 sdk8 sdk9 sdk10 sdk11 sdk12 sdk13 sdk14
 sdk15 sdk16
 sdo: sdo1 sdo2 sdo3 sdo4 sdo5
 sdf: sdf1 sdf2 sdf3 sdf4 sdf5 sdf6 sdf7 sdf8 sdf9 sdf10 sdf11 sdf12 sdf13 sdf14
 sdf15 sdf16 sdf17 sdf18 sdf19 sdf20
 sdq: sdq1 sdq2 sdq3 sdq4
_
```

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Oracle Clusterware VM [Re]Start

```
 sdq: sdq1 sdq2 sdq3 sdq4
                                                           [  OK  ]
Installing knfsd (copyright (C) 1996 okir@monad.swb.de).
Starting NFS services:                                     [  OK  ]
Starting NFS quotas:                                       [  OK  ]
Starting NFS mountd:                                       [  OK  ]
Stopping RPC idmapd:                                       [  OK  ]
Starting RPC idmapd:                                       [  OK  ]
Starting NFS daemon: NFSD: Using /var/lib/nfs/v4recovery as the NFSv4 state reco
very directory
NFSD: starting 90-second grace period
                                                           [  OK  ]
Starting the VirtualBox Guest Additions                    [  OK  ]
Starting VirtualBox Guest Addition service                 [  OK  ]
Starting dnsmasq:                                          [  OK  ]
Server address not specified in /etc/sysconfig/netconsole
Starting snmpd:                                            [  OK  ]
Starting snmptrapd:                                        [  OK  ]
Starting radvd: [Dec 17 13:18:14] radvd: IPv6 forwarding seems to be disabled, e
xiting
                                                           [FAILED]
Starting sshd:                                             [  OK  ]
NTP server not specified in /etc/ntp/step-tickers or /etc/ntp.conf
Starting ntpd:                                             [  OK  ]
Starting postfix: _
```

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Oracle Clusterware VM [Re]Start

```
Starting postfix:                                          [  OK  ]
Starting abrt daemon:                                      [  OK  ]
Starting htcacheclean:                                     [  OK  ]
Starting httpd:                                            [  OK  ]
Starting Qpid AMQP daemon:                                 [  OK  ]
Starting tuned:                                            [  OK  ]
Starting crond:                                            [  OK  ]
Starting atd:                                              [  OK  ]
wdaemon configuration file not present yet
Starting ohasd:
CRS-4123: Oracle High Availability Services has been started.
Starting libvirtd daemon:                                  [  OK  ]
Bridge firewalling registered
tun: Universal TUN/TAP device driver, 1.6
tun: (C) 1999-2004 Max Krasnyansky <maxk@qualcomm.com>
device virbr0-nic entered promiscuous mode
ip_tables: (C) 2000-2006 Netfilter Core Team
Starting oddjobd: sudo exist
                                                           [  OK  ]
Starting certmonger: ADDRCONF(NETDEV_UP): virbr0: link is not ready
                                                           [  OK  ]
device virbr0-nic left promiscuous mode
virbr0: port 1(virbr0-nic) entering disabled state
Starting numad:                                            [  OK  ]
_
```

#NYOUG

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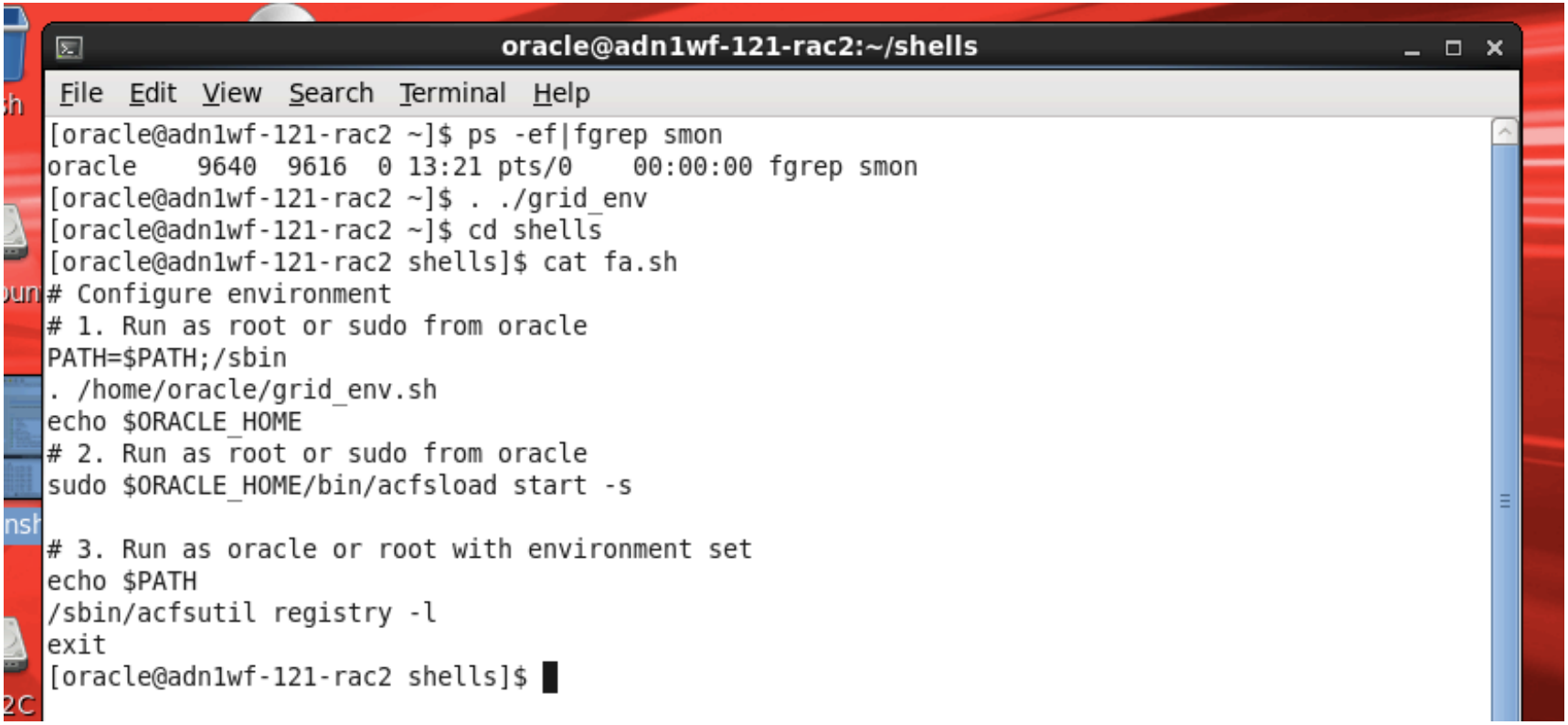
Oracle Clusterware VM [Re]Start



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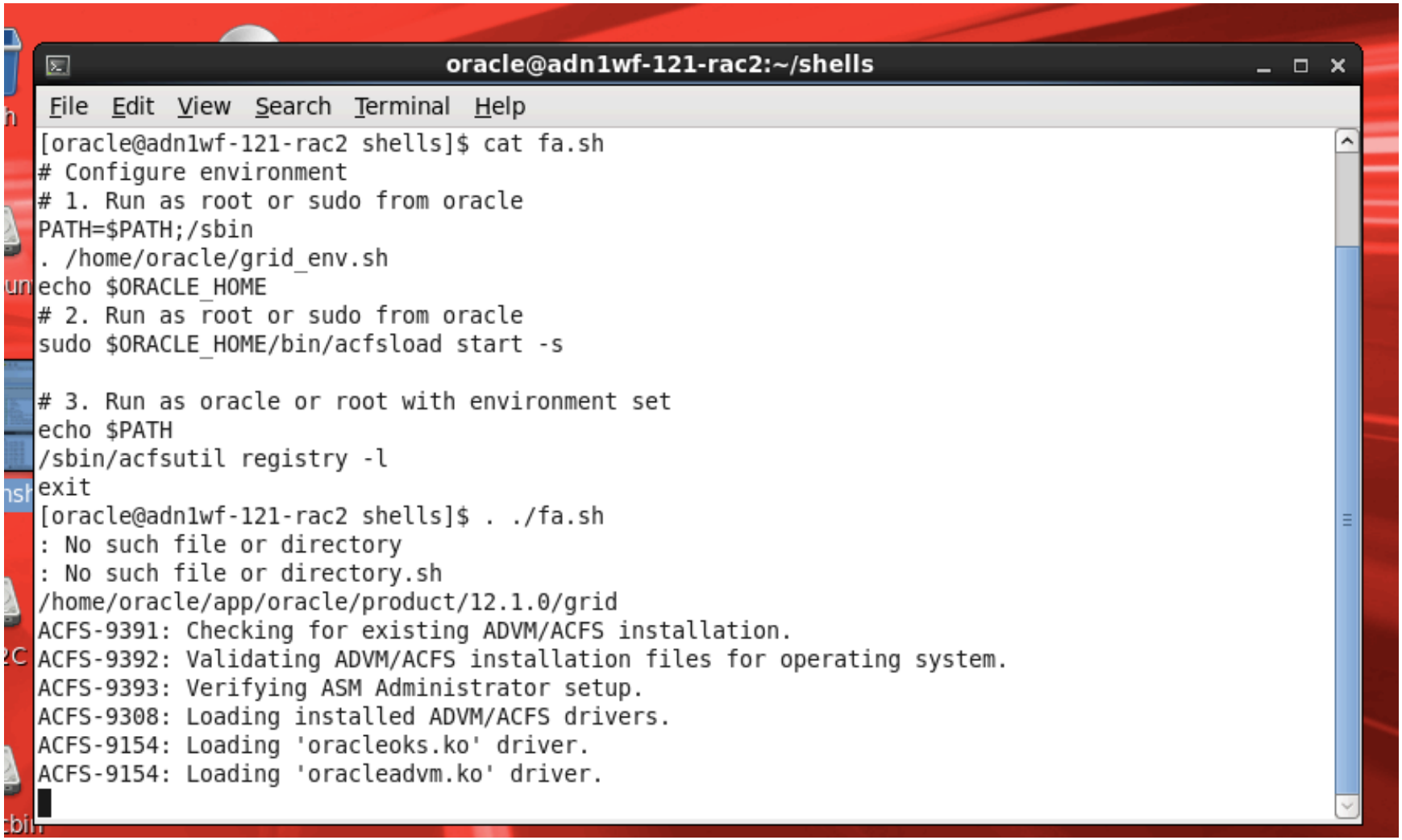
Oracle Clusterware VM [Re]Start



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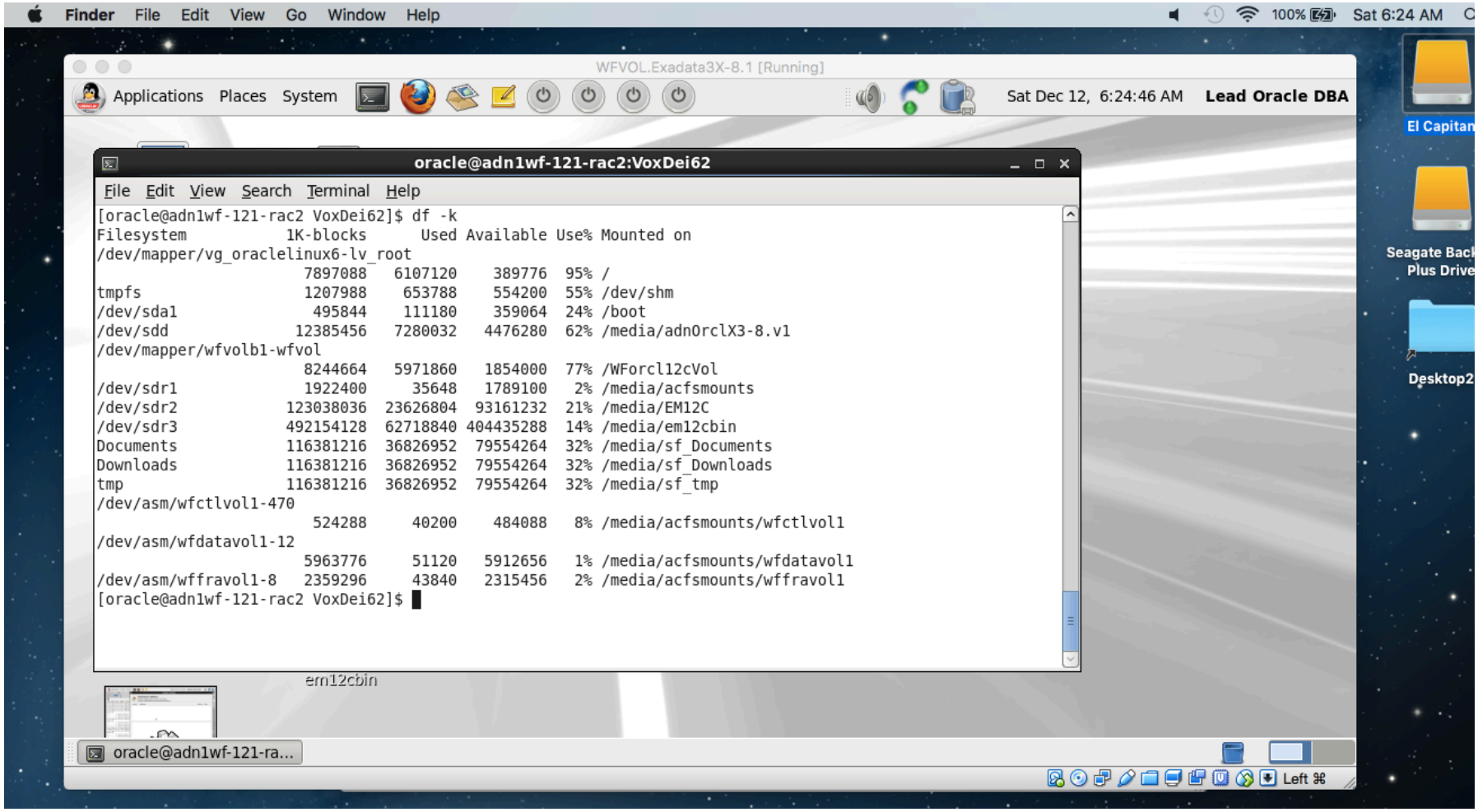
Running the Oracle12c Clusterware



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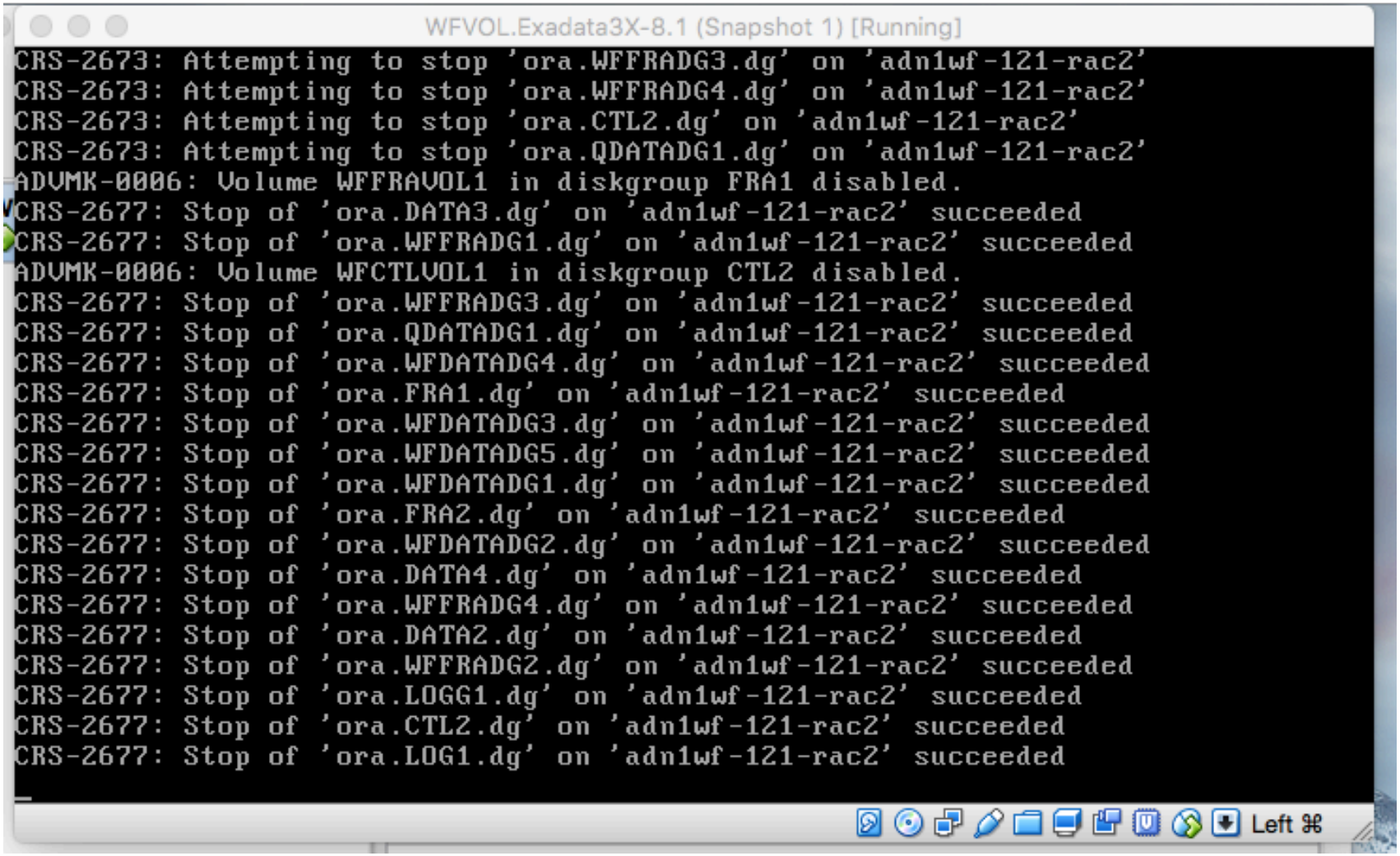
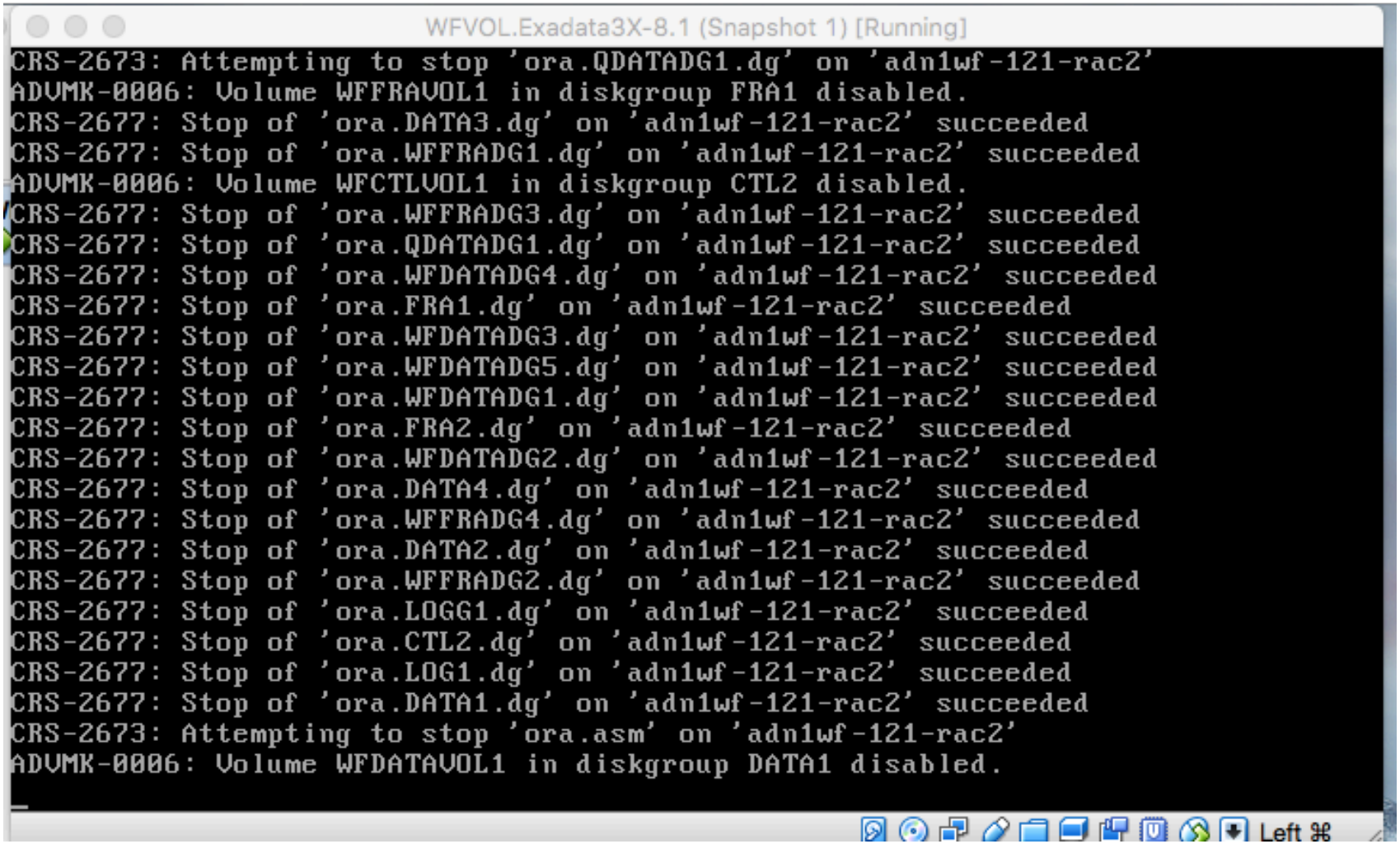
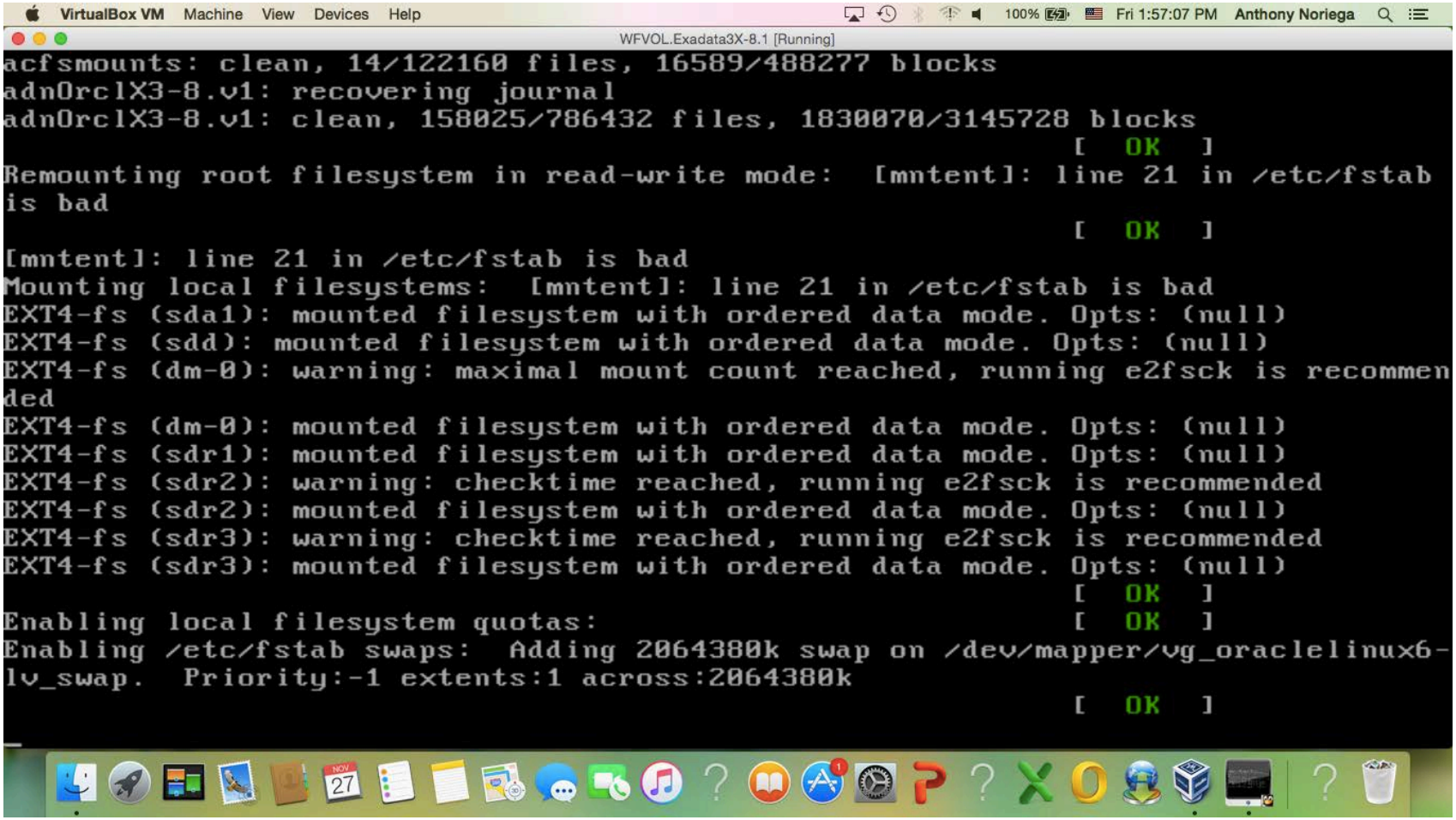
Oracle VM Clusterware Shutdown



Oracle VM Clusterware Shutdown



Running the Oracle12c Clusterware



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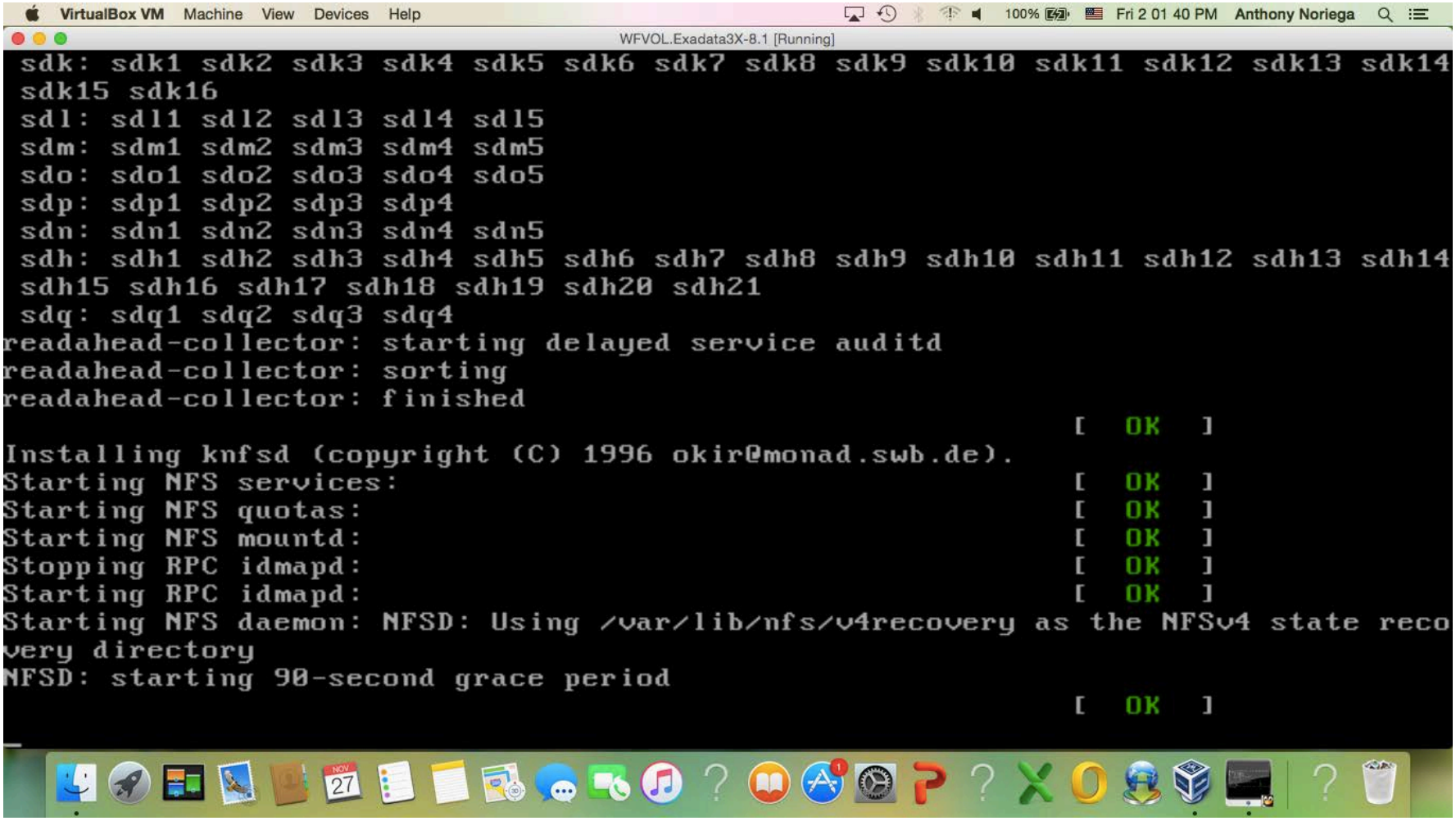
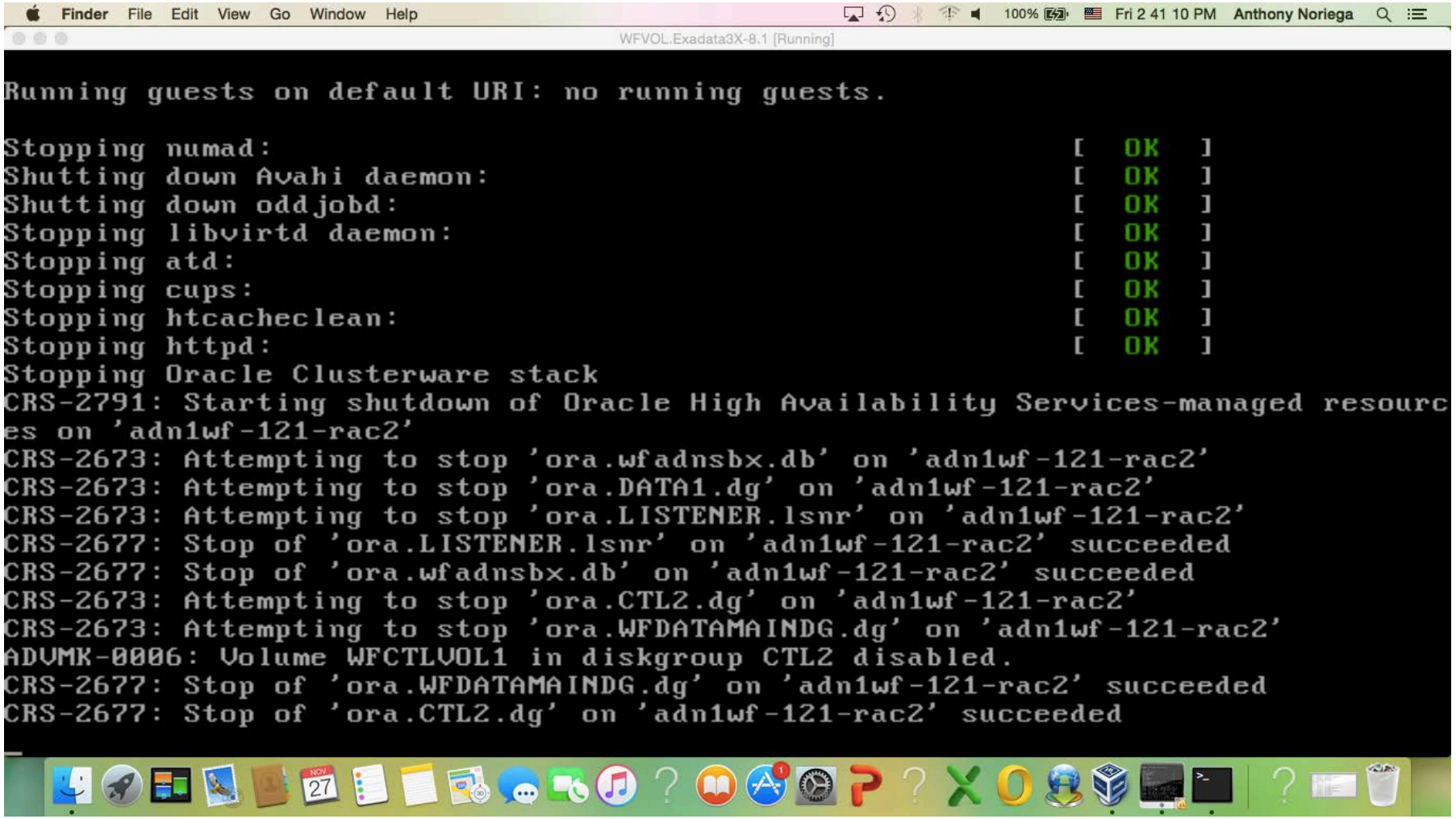
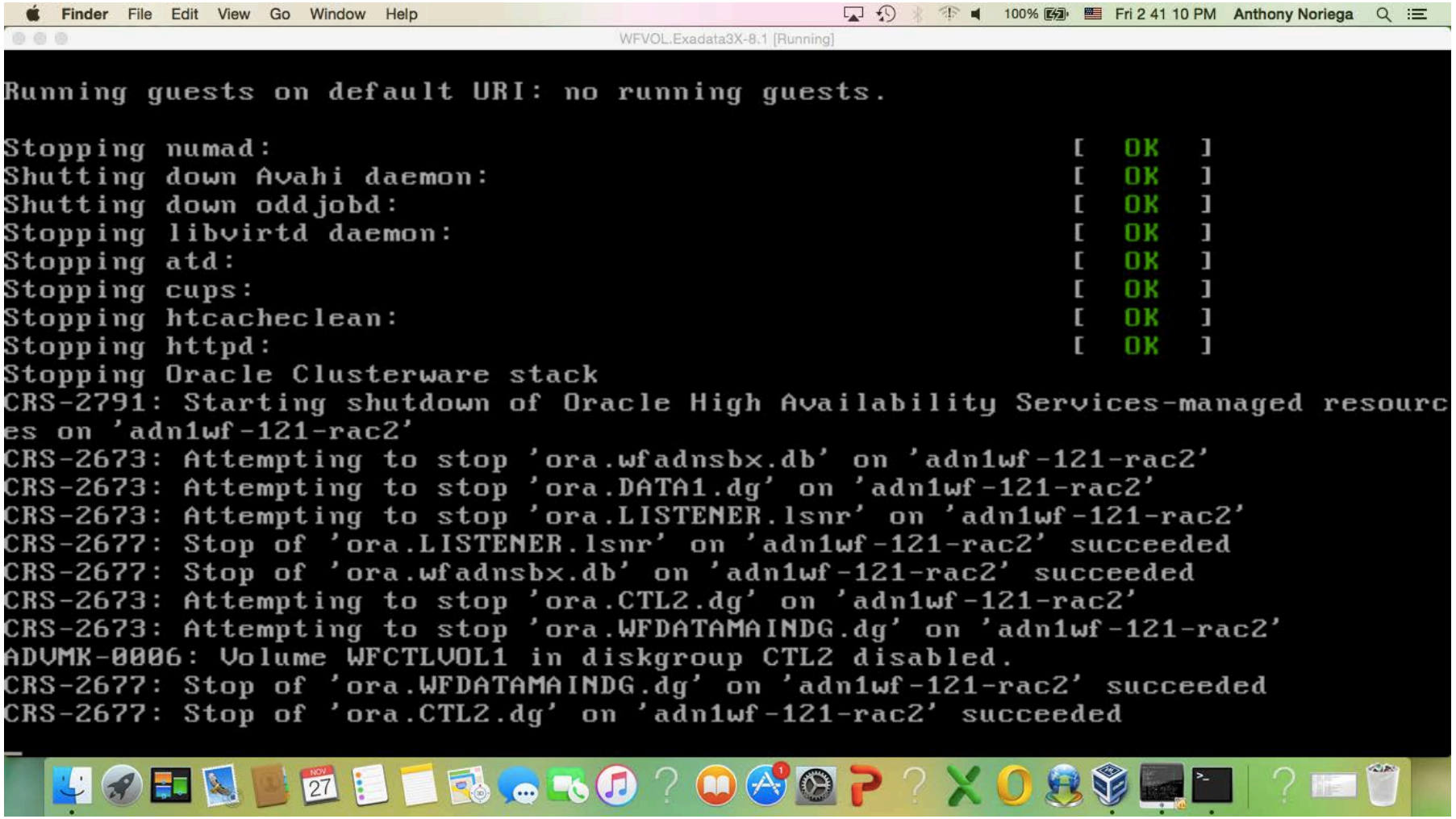
Running the Oracle12c Clusterware



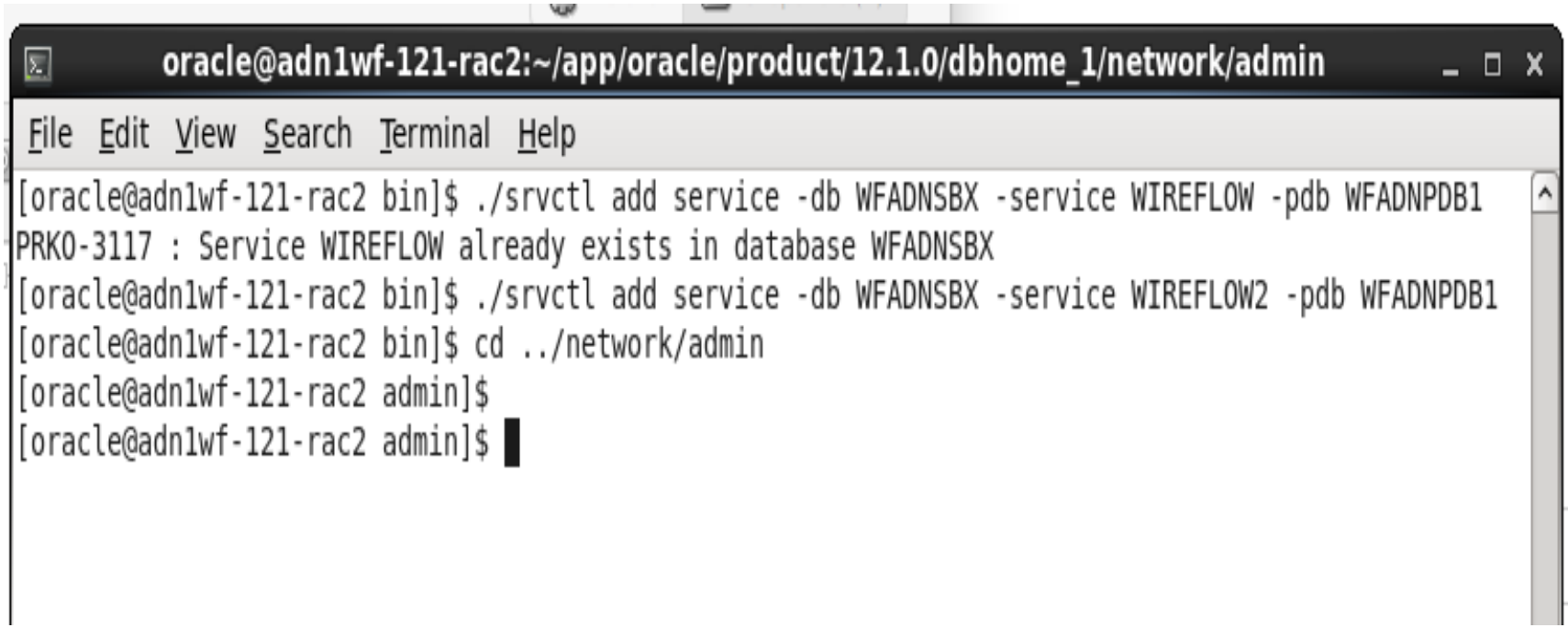
Running the Oracle12c Clusterware



Running the Oracle12c Clusterware



Running Oracle Cluster Databases



Running Oracle Cluster Databases

```
SQL> connect sys@wireflow as sysdba
Enter password:
Connected.
SQL> set pages 50000
SQL> set lines 144
SQL> select * from v$instance;

INSTANCE_NUMBER INSTANCE_NAME    HOST_NAME                                                        VERSION           START
UP_T STATUS        PAR
--------------- ---------------- ---------------------------------------------------------------- ----------------- -----
---- ------------ ---
   THREAD# ARCHIVE LOG_SWITCH_WAIT LOGINS     SHU DATABASE_STATUS   INSTANCE_ROLE      ACTIVE_ST BLO     CON_ID INSTANCE_
MO EDITION
---------- ------- --------------- ---------- --- ----------------- ------------------ --------- --- ---------- ---------
-- -------
FAMILY
--------------------------------------------------------------------------------
             1 WFADNSBX         adn1wf-121-rac2.localdomain                                 12.1.0.1.0        17-DE
C-15 OPEN          NO
         1 STARTED                  ALLOWED    NO  ACTIVE            PRIMARY_INSTANCE   NORMAL    NO           0 REGULAR
   EE



SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         3 WFADNPDB1                      READ WRITE NO
SQL> alter session set container=CDB$ROOT;

Session altered.
```

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Running Oracle Cluster Databases

```
Copyright (c) 1982, 2013, Oracle.  All rights reserved.

SQL> connect sys@wireflow as sysdba
Enter password:
Connected.
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INSTANCE_NUMBER INSTANCE_NAME    HOST_NAME                                                        VERSION           START
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--------------- ---------------- ---------------------------------------------------------------- ----------------- -----
---- ------------ ---
   THREAD# ARCHIVE LOG_SWITCH_WAIT LOGINS     SHU DATABASE_STATUS   INSTANCE_ROLE      ACTIVE_ST BLO     CON_ID INSTANCE_
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---------- ------- --------------- ---------- --- ---------------- ------------------ --------- --- ---------- ---------
-- -------
FAMILY
--------------------------------------------------------------------------------
             1 WFADNSBX         adn1wf-121-rac2.localdomain                              12.1.0.1.0        17-DE
C-15 OPEN          NO
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   EE



SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         3 WFADNPDB1                      READ WRITE NO
```

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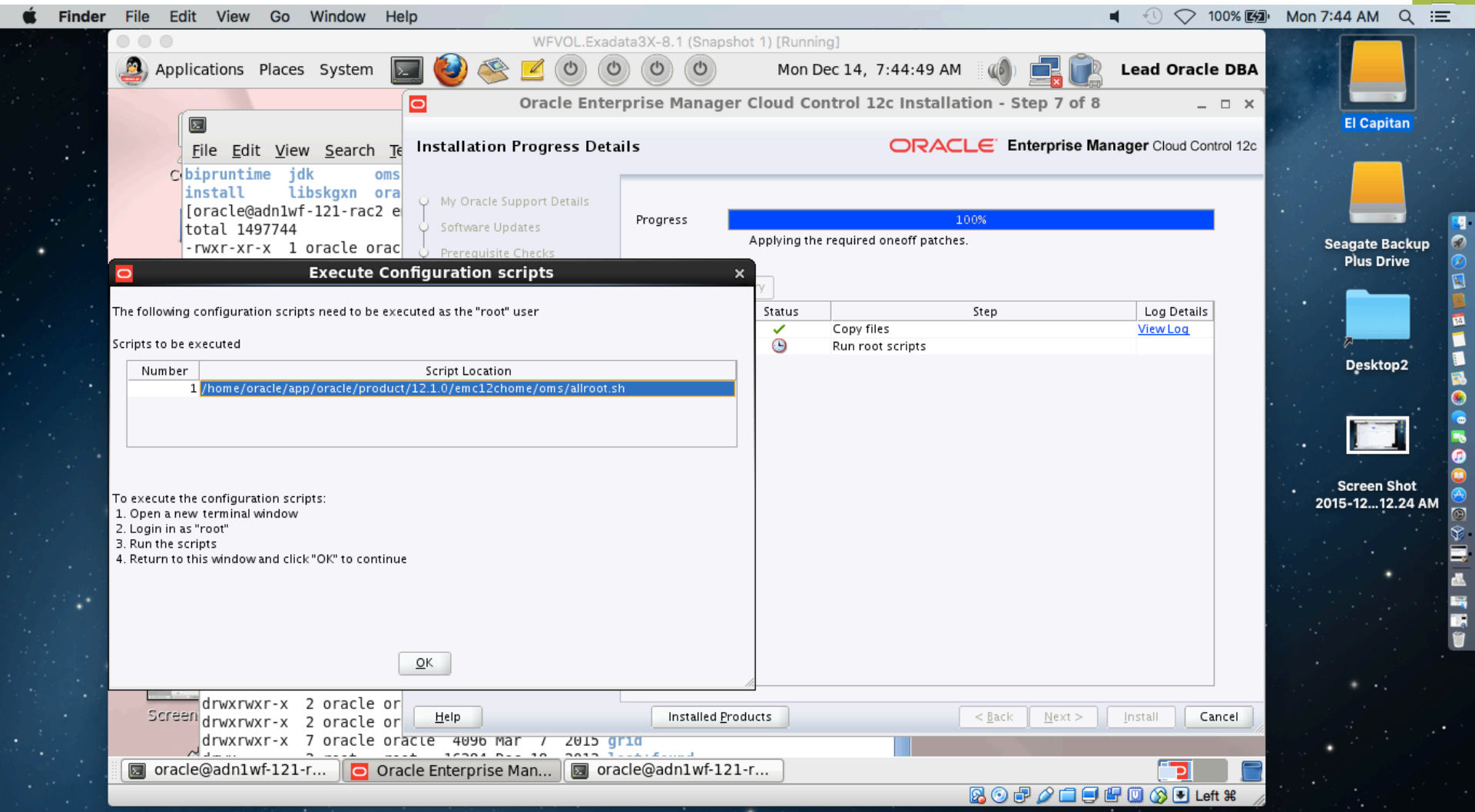
Running Oracle Cluster Databases

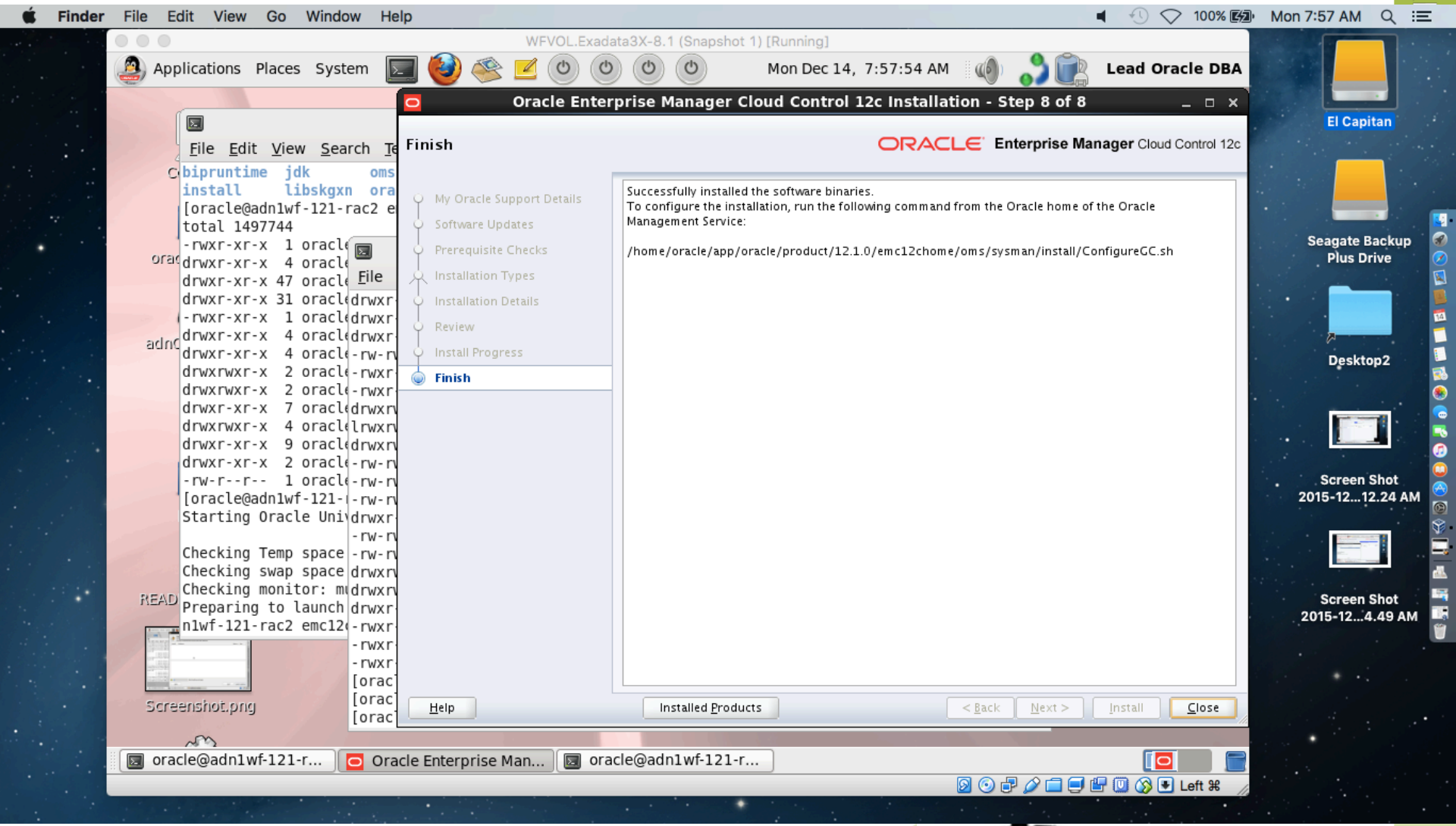
```
WIREFLOW1= (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = adn1wf-121-rac1.localdomain)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = WIREFLOW)
    )
  )

#WFADNPDB1 =
WIREFLOW=
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = adn1wf-121-rac1.localdomain)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = WFADNPDB1)
    )
  )
```

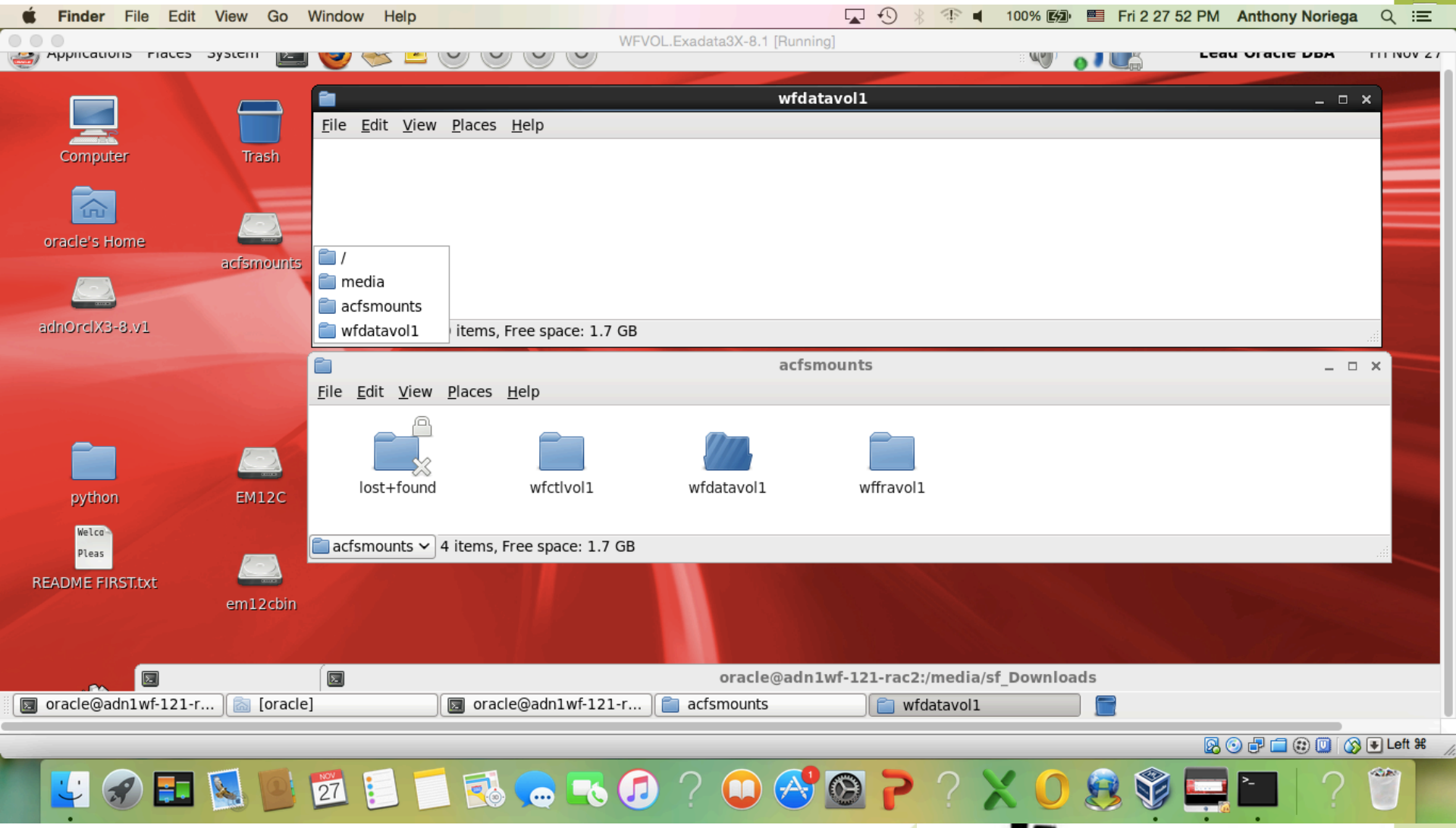
Other Oracle12c Clusterware Views



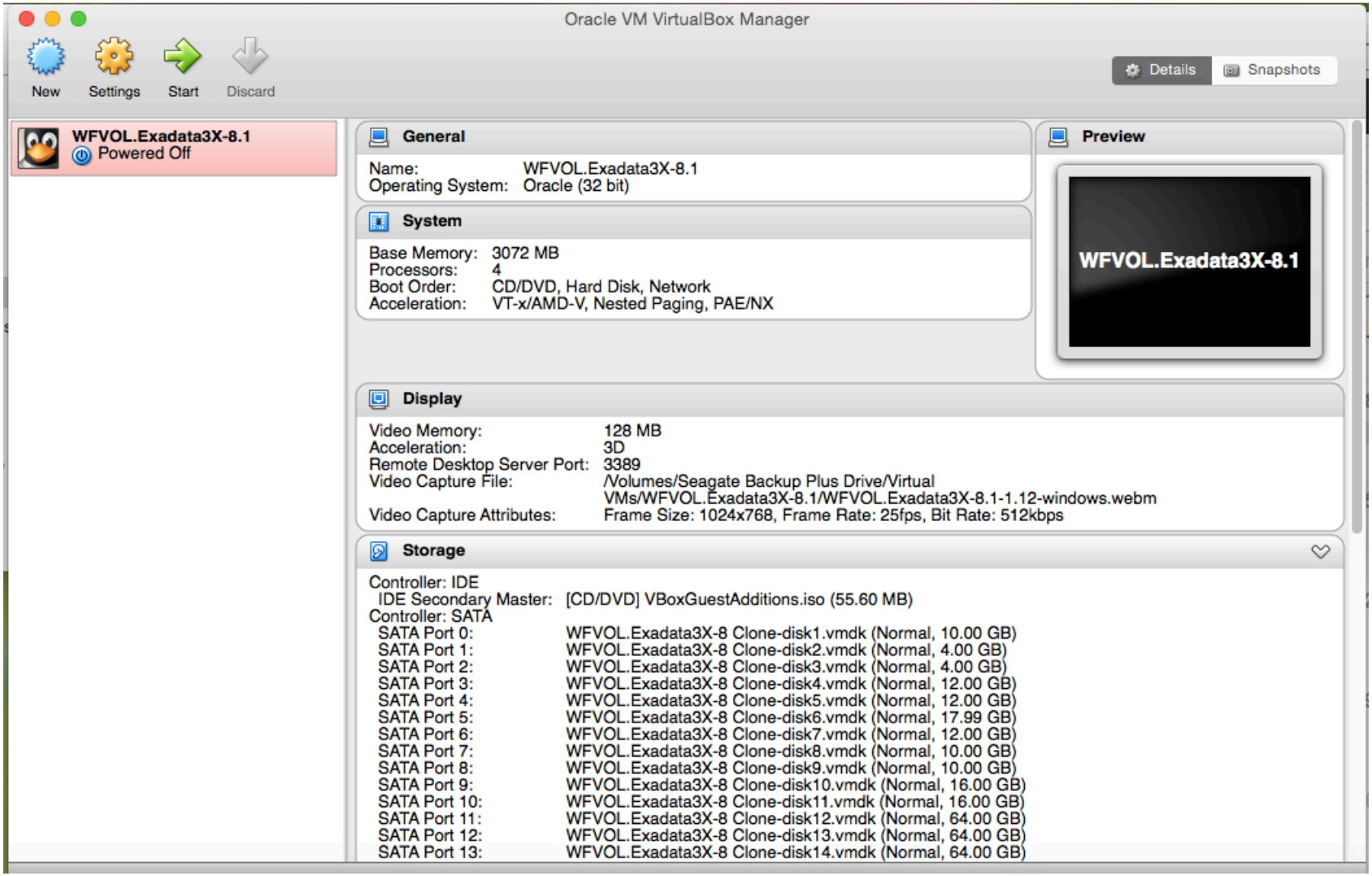
Other Oracle12c Clusterware Views



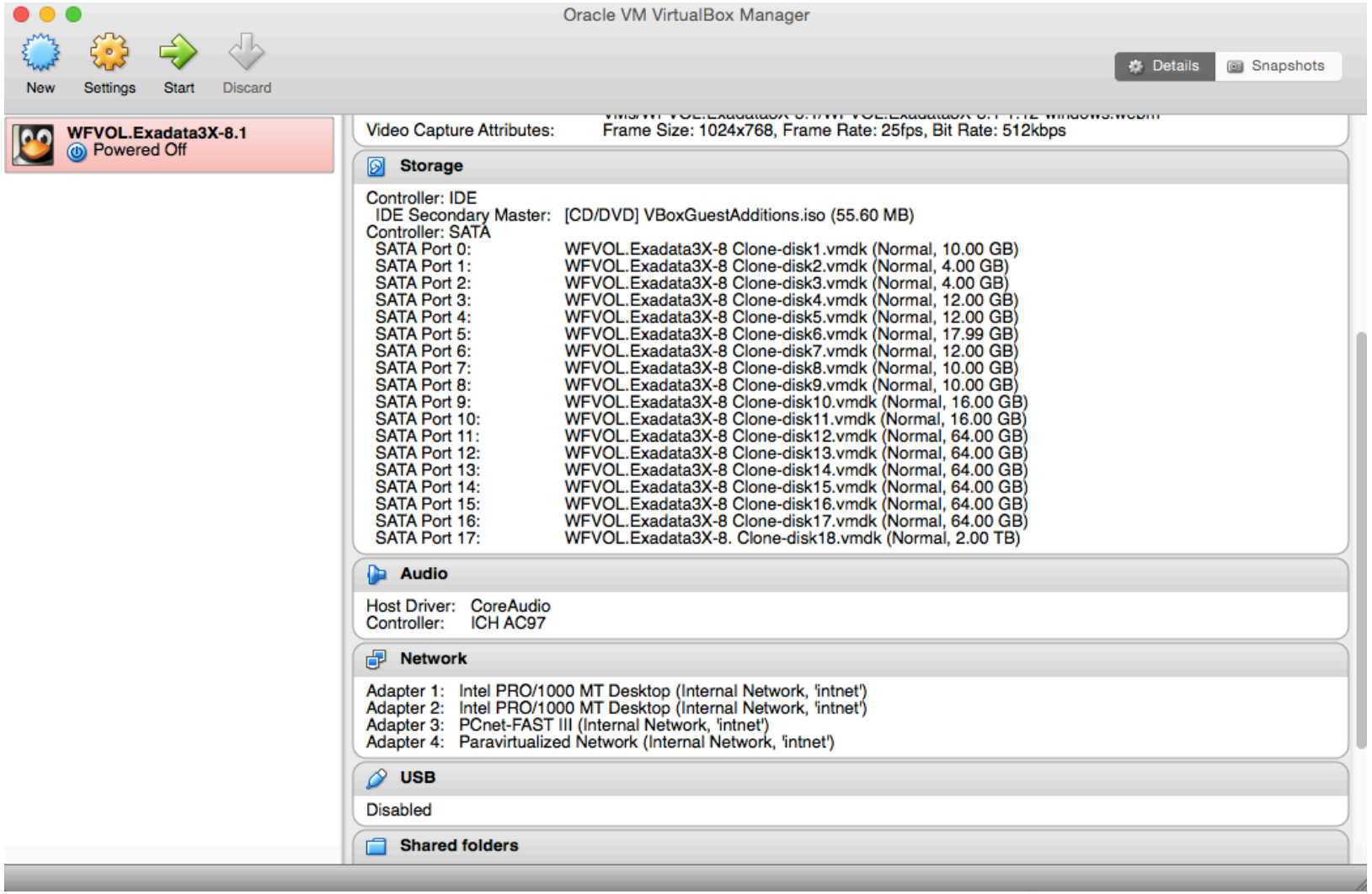
Other Oracle12c Clusterware Views



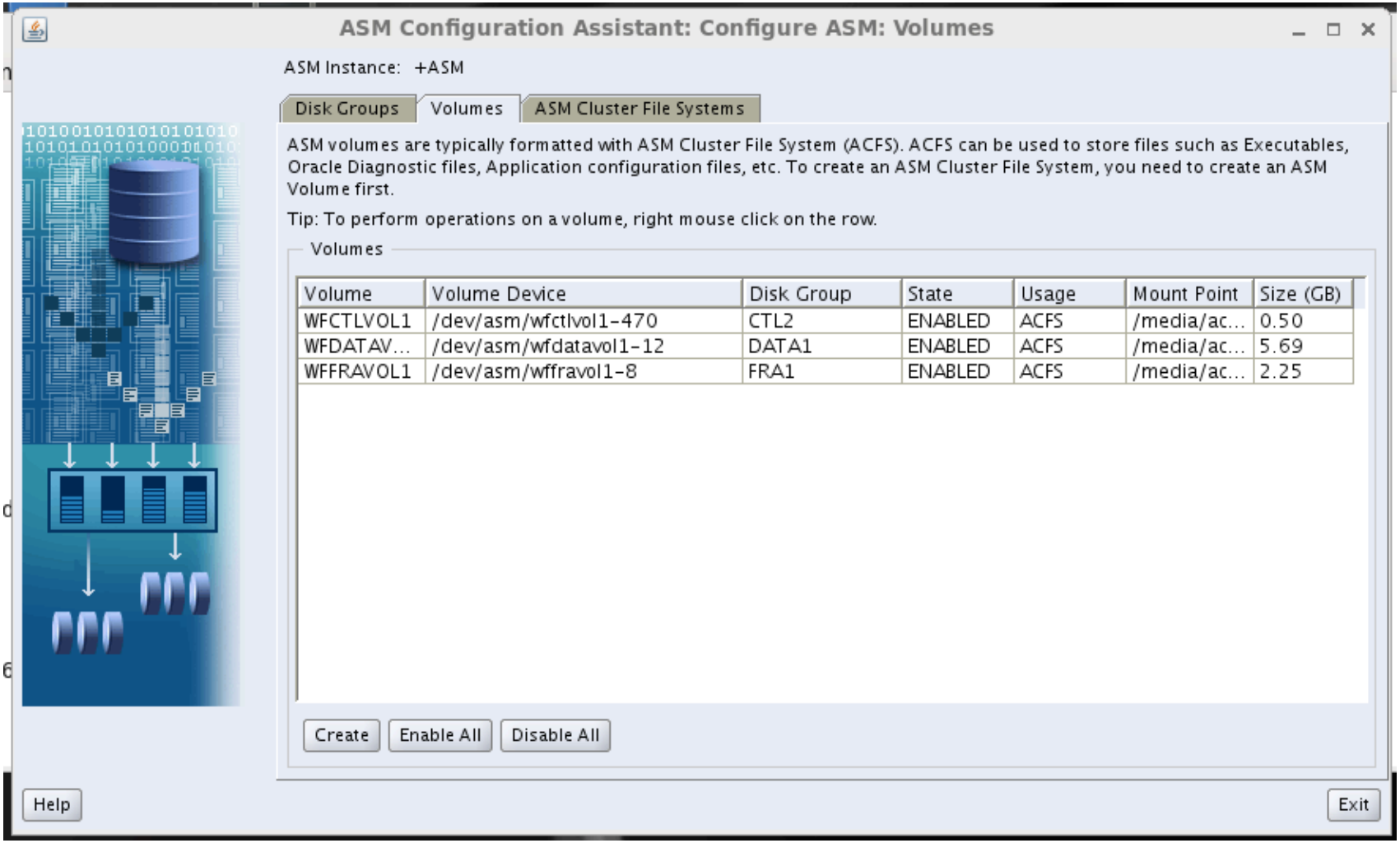
Other Oracle12c Clusterware Views



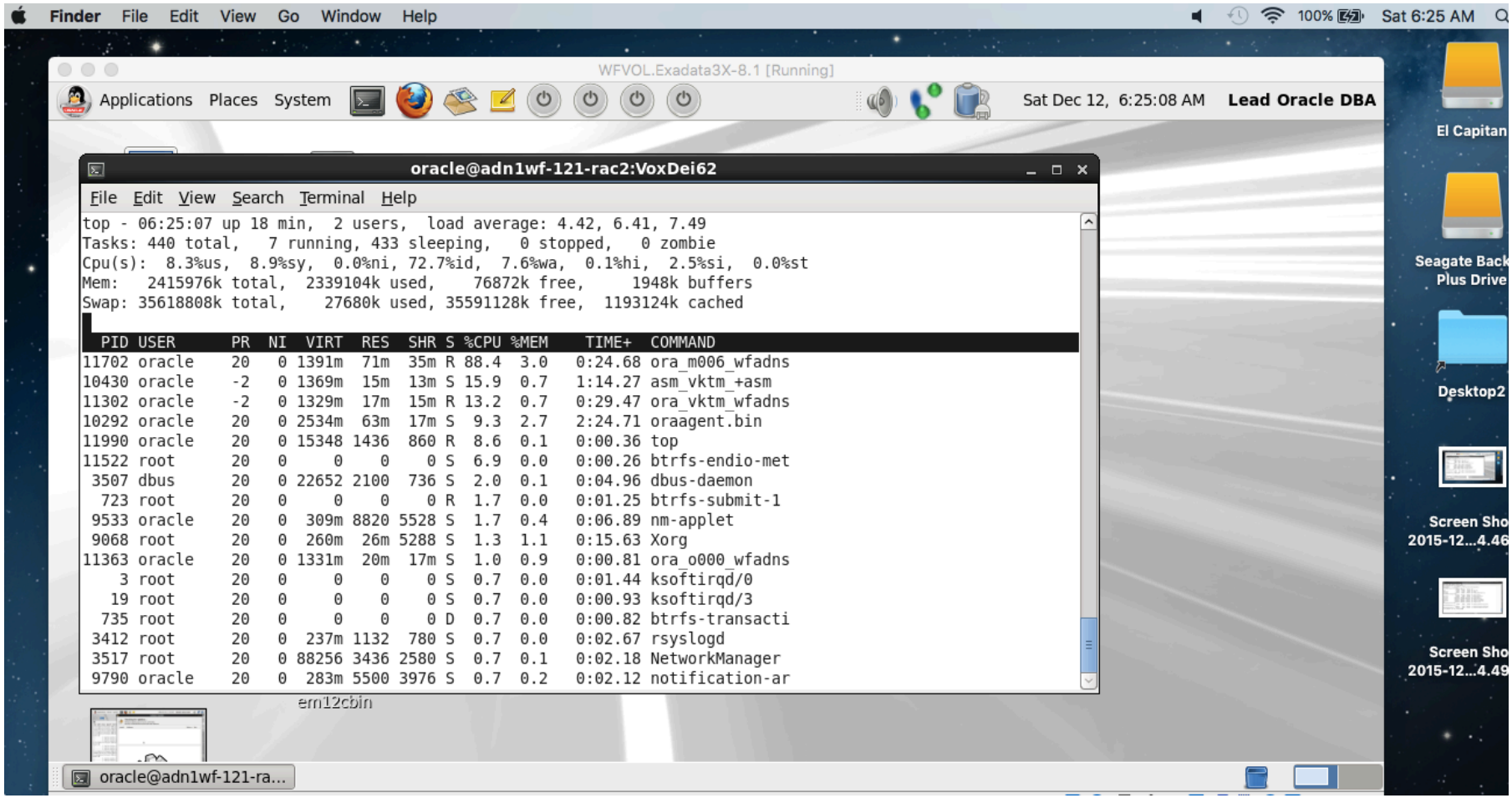
Other Oracle12c Clusterware Views



Other Oracle12c Clusterware Views



Other Oracle12c Clusterware Views



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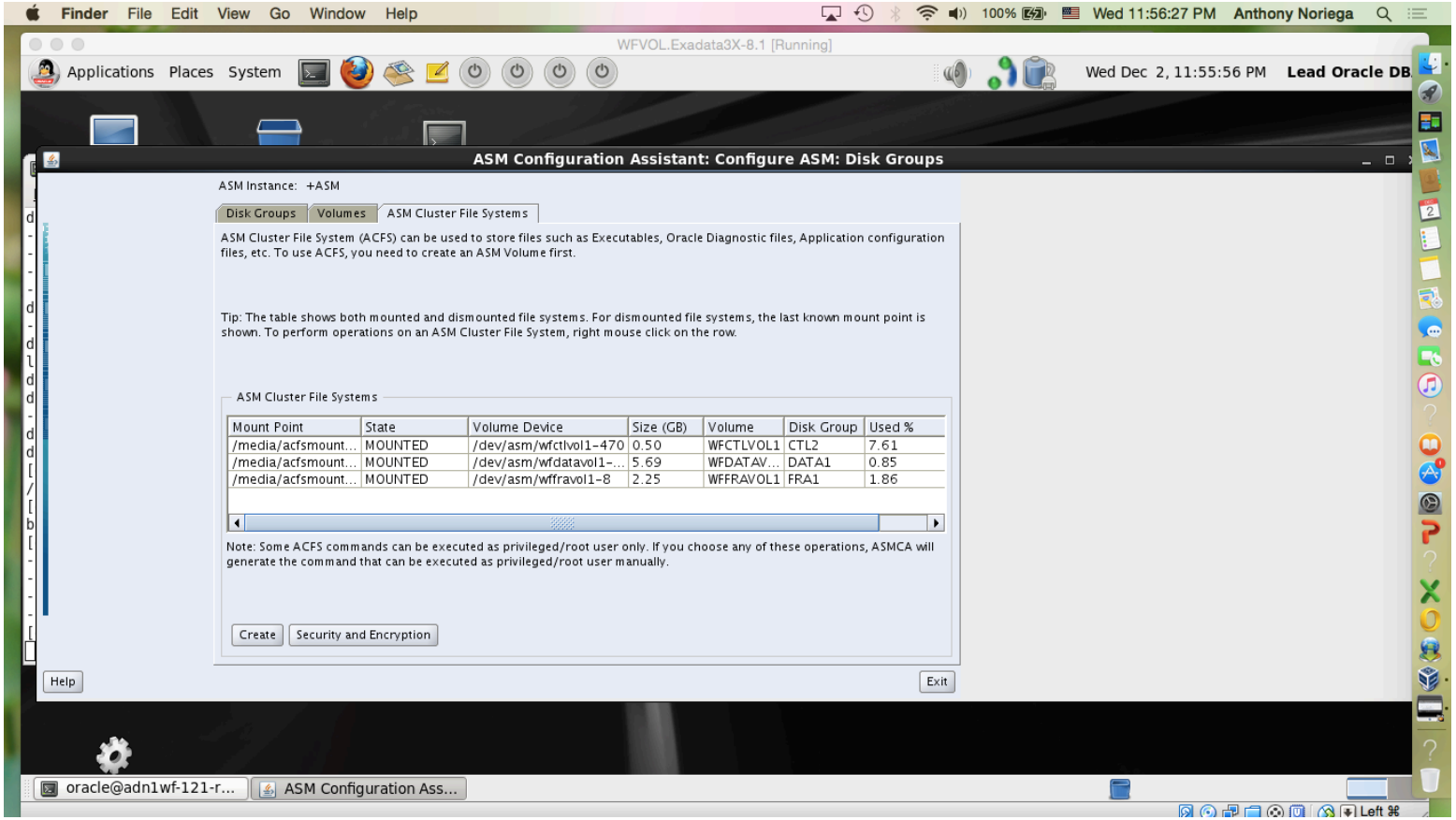
Other Oracle12c Clusterware Views



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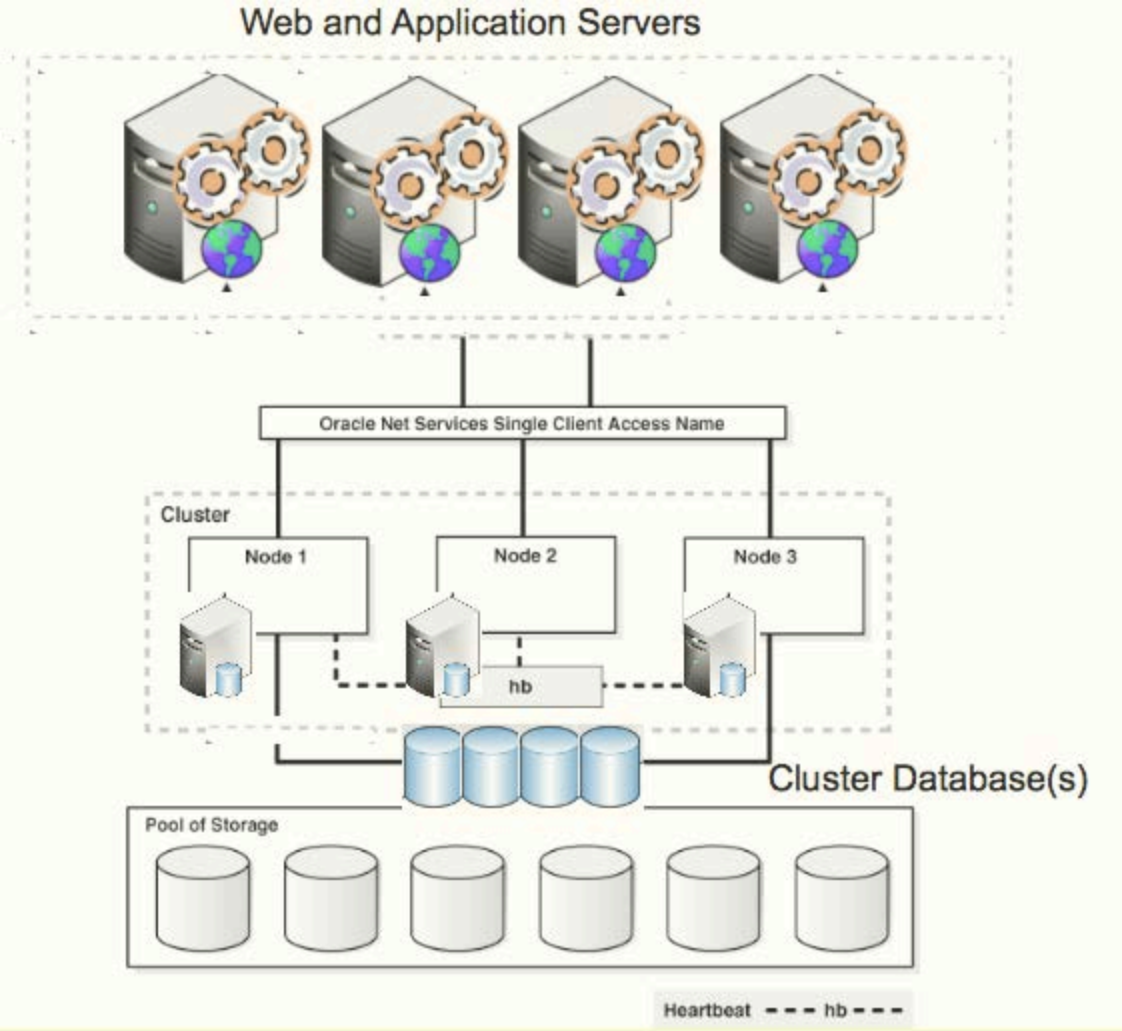
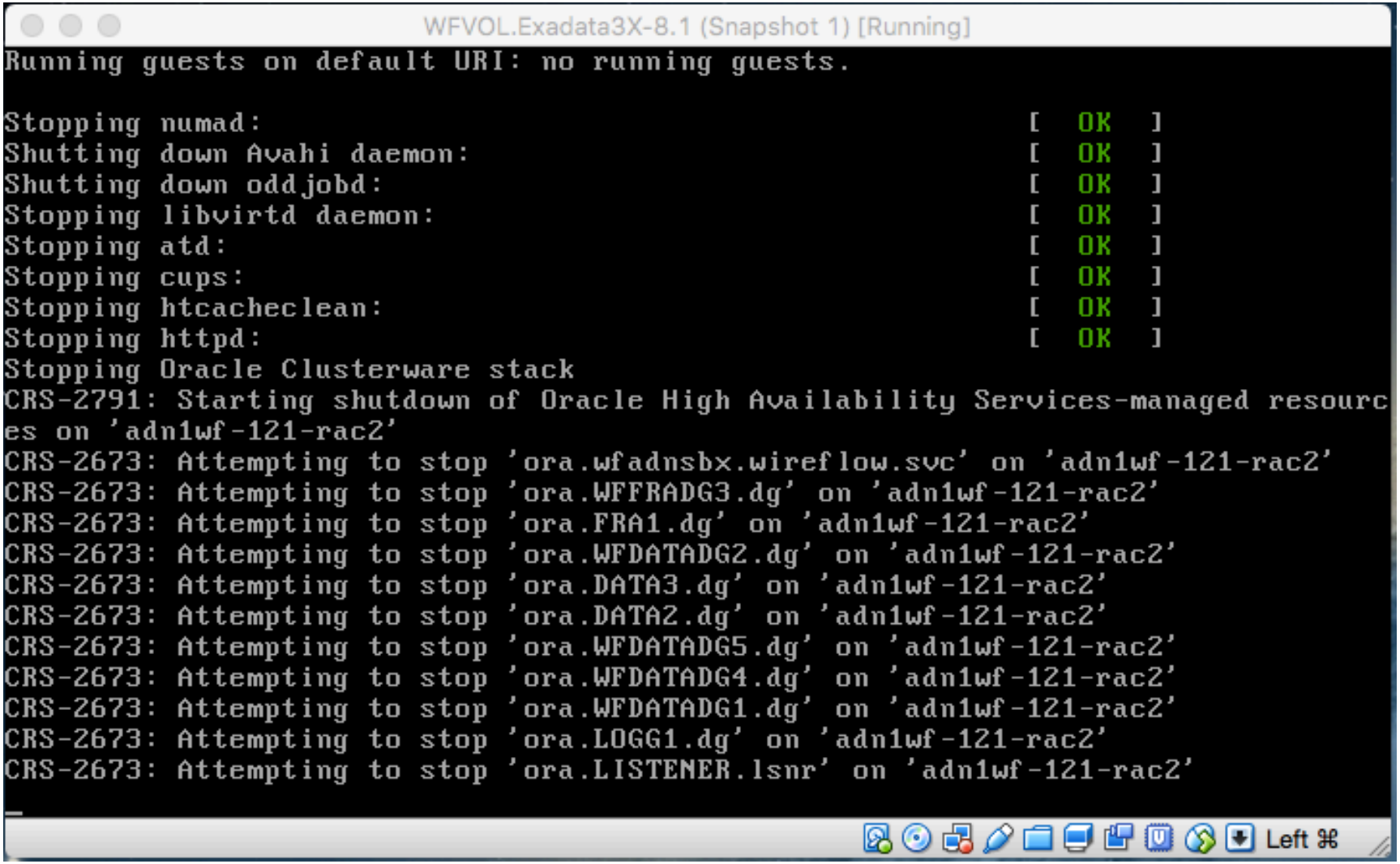
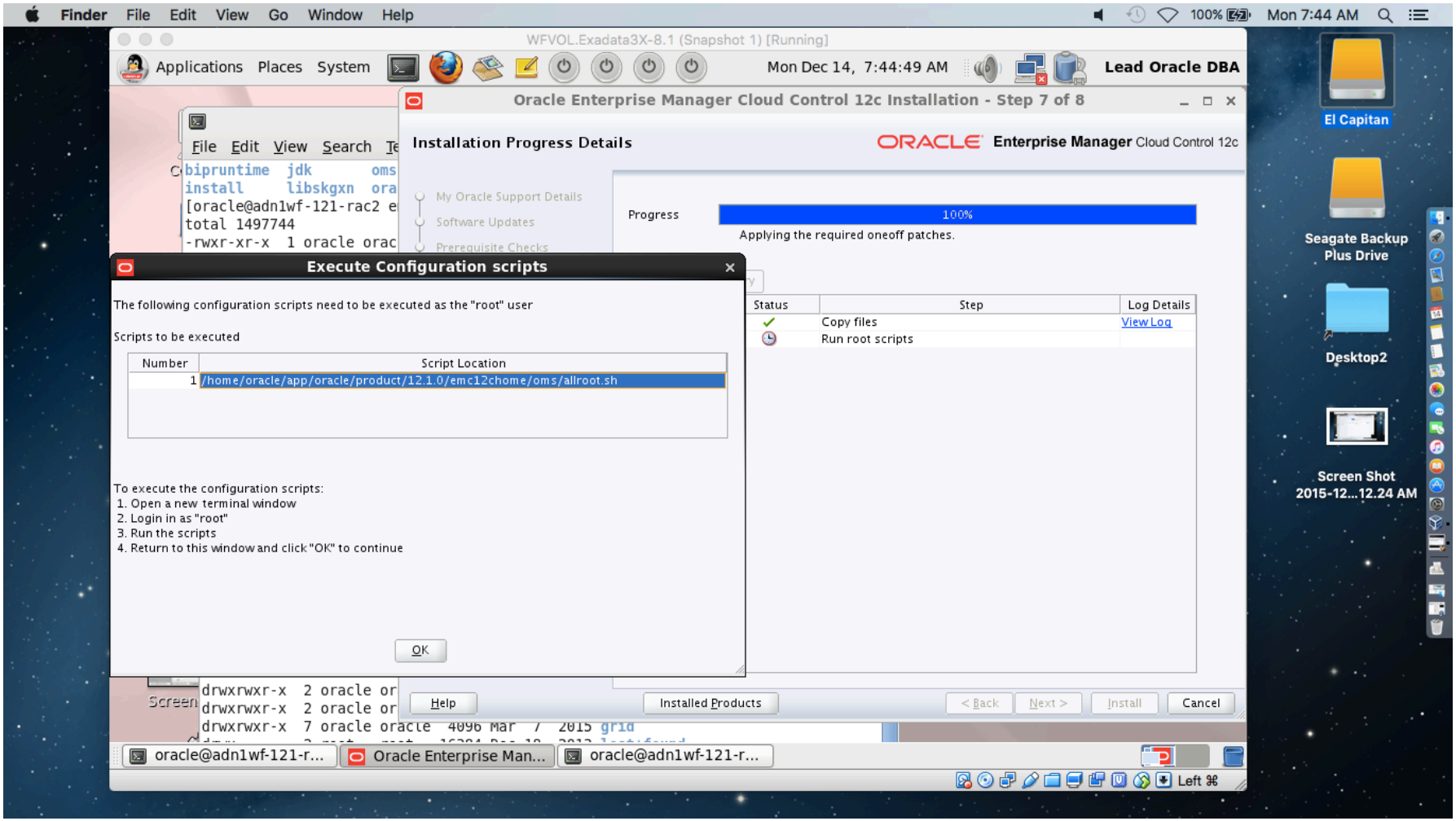
Other Oracle12c Clusterware Views



Other Oracle12c Clusterware Views



Other Oracle12c Clusterware Views



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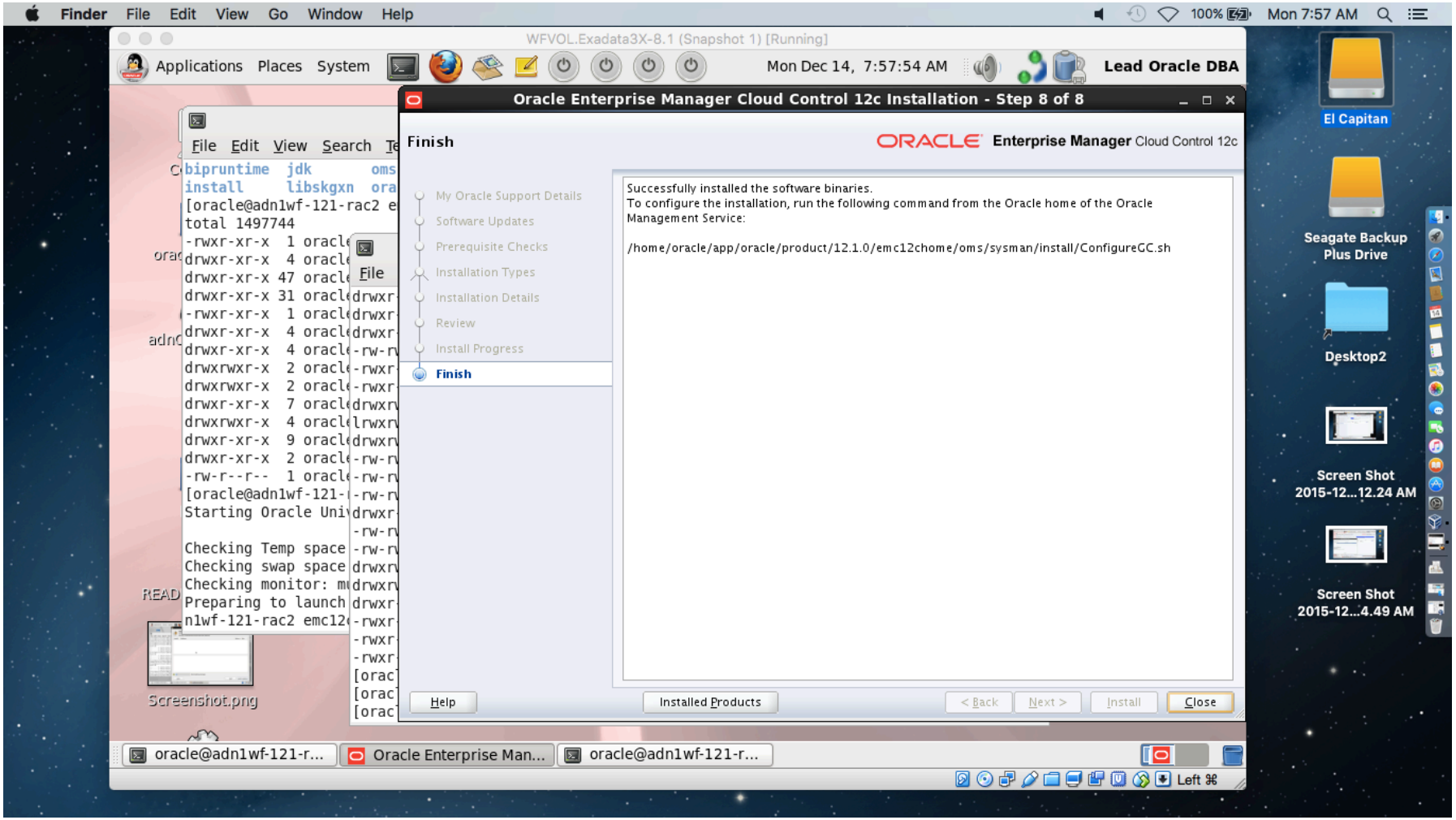
Other Oracle12c Clusterware Views



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QUESTIONS AND ANSWERS

Concluding remarks

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The Grid is the cloud. The cloud is the grid...

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Concluding Remarks

- Oracle Virtual Clusterware is an ideal environment for RAT, where it proves to be greatly cost-effective.
- Oracle Grid Infrastructure works as efficiently as an IT platform when virtualized.
- Envisioning the Cloud Box is attaining a higher level of virtual cluster supercomputing.
- An Enterprise Virtual Configuration of the Oracle Clusterware is highly cost-effective by the dollar on any scale.
- Time Implementation and Rapid Provisioning in the Grid Infrastructure are also important factors towards successful deployments.